ST. XAVIER'S COLLEGE (AUTONOMOUS), AHMEDABAD
ZOOLOGY SYLLABUS

Semester I
Course Code: ZO 1501
BASICS OF ZOOLOGY - I
(HUMAN PHYSIOLOGY, ANIMAL DIVERSITY (nonchordates), CYTOLOGY, GENETICS, ANIMAL BIOTECHNOLOGY)
No. of Credits: 04
Learning Hours: 60 hrs

Unit 1: Human Physiology – The Urinary System:
Introduction, Anatomy**:** V. S. of a kidney, The Nephron**,** Ultrastructure of a nephron, Juxtaglomerular apparatus, Renal Physiology**:** Physiology of urine formation, Glomerular filtration/Ultrafiltration, Tubular reabsorption, Tubular secretion, Counter-current Multiplier Mechanism, Physical characteristics of normal urine, Volume, appearance, turbidity, odour, pH, specific gravity.

Chemical composition of normal urine: water, electrolytes, urea, uric acid, creatinine. physicsal characteristics of abnormal urine: appearance, odour, specific gravity, pH, blood and tissue cells, casts
Abnormal constituents of urine. Protein, carbohydrates, Fat, Ketonebodies, RBC and WBC, Bilirubin, Urobilinogen, Acetone, Pus, Urinary calculi, Microbes

Unit 2 Animal Diversity (Nonchordates) – Type study & General topics:
General structure & morphology with functional anatomy of the following animal: Protozoa Type –Amoeba proteus**:** Systematic position, Habits & Habitat Structure, Locomotion, Nutrition, Reproduction. General topics**:** Protozoa: Nucleus, Modes of asexual reproduction (Binary fission, Multiple fission, Plasmotomy, Budding/Germination), Porifera**:**Economic importance, Modes of asexual reproduction in sponges (Budding, Fission, Reduction bodies, Gemmules)

Unit 3 Cytology:
Microscopes**:** Structure & working of the following student's light microscopes: Simple light microscope, Monocular Compound light microscope, Diversity in Eukaryotic cell - shape & size, Ultrastructure of a typical animal cell, Nucleus**,** Introduction, Occurrence and position, Ultrastructure and general functions, Endoplasmic Reticulum (ER)**,** Introduction and Occurrence, Morphology (Cisternae, Vesicles, Tubules), Types of ER (rough and smooth), General functions.

Unit IV Genetics And Animal Biotechnology:
Genetics**:** Brief introduction to Gene, Mendelism& Laws of Heredity, Incomplete Dominance (e.g. Andalusian fowl, Mirabilis jalapa), Co-dominance (e.g. Roan cattle), Multiple alleles (e.g. ABO blood groups in humans, Coat colour in rabbit), Polygenic inheritance (e.g. skin colour in humans), Lethal genes (e.g. Yellow colour coat in mice, Thalassemia)

Animal Biotechnology**:,** Introduction & definition, Some essential equipments for setting up a tissue culture laboratory:**,** Glasswares/Plasticwares– Test tubes, Flasks, Bottles, Pipettes, Petri dishes, etc., Autoclaves, pH meter, Incubators, LAH, Water bath.

Reference books:

1. Principles of Anatomy & Physiology, Tortora and Gabrowski, Harper Collins College Pub.
2. Animal Physiology and Related Biochemistry, H. R. Singh, Shobhan Lal Naginchand & Co. Edu. Pub., Jalandhar.
3. Textbook of Animal Physiology, A. K. Berry, Emkay Pub., New Delhi.
4. Textbook of Invertebrates, R. L. Kotpal, Rastogi Publications, Meerut.
5. Manual of Zoology, Vol. 1 & 2, E. K. Ayyer.
6. Invertebrate Zoology, Jordan and Verma, S. Chand & Company, Delhi.
7. Cytology, P. S. Verma, S. Chand &Co. Ltd., New Delhi.
8. Cell Biology, C. B. Powar, Himalaya Pub. House.
9. Cell and Mol. Biol., E.D.P. DeRobertis and E.M.F. DeRobertis, Holt-Saunders, Japan.
10. Genetics, P. K. Gupta, Rastogi Publications, Meerut.
11. Genetics, V. B. Rastogi, KedarnathRamnath, Meerut.
12. Genetics Vol. 1, C. B. Powar, Himalaya Pub. House.
13. Elements of Biotechnology, P. K. Gupta, Rastogi Publications, Meerut.
14. Culture of Animal Cells-A Manual of Basic Techniques, R. Ian Freshney, 5th Ed., A. John Wiley & Sons Inc. Pub.

Semester I
Course Code: ZO 1502L
Basics of Zoology Practicals - I
No. of Credits: 03
Learning Hours: 60 hrs

Human Urine Analysis: Physical analysis: Colour appearance, odour, deposits if any, Chemical analysis**:** Detection of abnormal constituents in urine: Sugar, Proteins, Bile salts. Determination of: pH, specific gravity, Ketones (Rothera's test), Urea (using soyabean powder) and Creatinine (Jaffe's test). microscopic analysis: Detection of presence of: Pus cells, RBC, Bacteria.
Human Urinary System: Study by permanant slides/charts of: V.S. of kidney., Renal corpuscle., T.S. through Juxtaglomerular apparatus, Counter current multiplier mechanism.
Amoeba: Study by permanant slides/charts of: W.M. of Amoeba, Binary fission,
Nonchordates: Study by charts of: Protozoa:Modes of asexual reproduction (as per theory syllabus), Porifera**:**Modes of asexual reproduction,
Cytology: Study of by charts/models of: Simple light microscope and Monocular Compound light microscope. Diversity in eukaryotic cell-shape & size, Ultrastructure of: Typical animal cell, Nucleus, Endoplasmic Reticulum
Genetics: Study by charts of: Monohybrid cross, Dihybrid cross, Incomplete Dominance (e.g. Andalusian fowl, Mirabilis jalapa), Co-dominance (e.g. Roan cattle), Multiple alleles (e.g. ABO blood groups in humans, Coat colour in rabbit), Polygenic inheritance (e.g. skin colour in humans), Lethal genes (e.g. Yellow colour coat in mice, Thalassemia), Study of genetic problems
Animal Biotechnology: Autoclave, Calibration of pH meter (only demonstration), Determination of pH of various types of samples using pH paper strips, Incubators, Laminar airflow hood, Water bath

Semester II
PAPER – ZO 2501 (Theory)
BASICS OF ZOOLOGY - II
(HUMAN PHYSIOLOGY, ANIMAL DIVERSITY (nonchordates), ORGANIC EVOLUTION, CYTOLOGY, GENETICS, ANIMAL BIOTECHNOLOGY)

No. of Credits: 04
Learning Hours: 60 hrs

Unit I Human Blood Physiology:
Composition of blood**: Blood Plasma,** Water, Dissolved solids:Blood proteins, Supplies for the cells, Cellular products, Cellular waste-products, Dissolved gases.**Blood Cells:** RB Structure, Total count, Functions, Haemoglobin, Effect of isotonic, hypotonic and hypertonic solutions, Development & Life history, Factors affecting Erythropoesis, Anaemia: General symptoms, Types:Nutritional, Pernicious, Haemorrhagic, Haemolytic, Aplastic and Sickle-cell, WBC - Structure, Total count, Functions, Classification (brief note for each WBC), Development & Life history A very brief concept of Leukemia Platelets: Structure, Total count, Functions, Development & Life history, Blood coagulation**:** Brief introduction and significance Factors involved in blood clotting, Intrinsic & Extrinsic pathways of blood coagulation Basic concept of Intravascular blood clotting, Blood grouping/typing**:** Classification of blood groups: ABO grouping system, Rh system

Unit II
Animal Diversity (Nonchordates) **–** Type study: General structure & morphology with functional anatomy of the following animal: Coelenterata**:**Type – Hydra: Classification, Habit & Habitat, Morphology, Histology, Locomotion, Nutrition and Reproductive organs & Reproduction.
Organic Evolution**:** Introduction, Origin of Life, Chemical evolution & Spontaneous origin of life, Oparin's theory of Coacervate droplets Miller's experiment, Protenoid microspheres, Theories of Organic Evolution, Lamarckism, Darwinism

Unit III Cytology:
Structure & working of the TEM & SEM.
Centrifugation**: I**ntroduction, Low speed centrifugation, Ultracentrifugation, Eukaryotic Ribosomes, Introduction and Occurrence Types of Ribosomes (70S, 80S), Structure, Ultrastructure and general functions, Mitochondria**,** Introduction and Occurrence, Morphology - Shape, Size, Number, Ultrastructure and general functions, Mitochondrial DNA, Mitochondrial Ribosome, Golgi complex**:** Introduction and Occurrence, Morphology/Ultrastructure and general functions.

Unit IV Genetics and Animal Biotechnology:
Genetics**:**Complementary genes (e.g. Pea plant – Purple & White flowers), Epistasis – Dominant (e.g. Dog), Recessive (e.g. Mice), Sex-linked inheritance, X-linked (dominant) e.g. enamel of tooth), X-linked (recessive) (e.g. colour blindness in man, eye-colour in Drosophila), Y-linked (Holandric genes), Sex-influenced inheritance, - Baldness in man

Animal Biotechnology**:** Fields/Applications of Animal Biotechnology.Some important requirements for cell & tissue culture (maxi. 5-7 sentences each):pH, CO_2 and Bicarbonate, Buffer, O_2, Temperature, Balanced Salt Solution (BSS), Antibiotics, Serum, Gas phase, Media (Natural/Defined, Liquid/Solid)

Reference book:

1. Principles of Anatomy & Physiology, Tortora and Gabrowski, Harper Collins College Pub.
2. Animal Physiology and Related Biochemistry, H. R. Singh, Shobhan Lal Naginchand & Co. Edu.Pub., Jalandhar.
3. Textbook of Animal Physiology, A. K. Berry, Emkay Pub., New Delhi.
4. Textbook of Invertebrates, R. L. Kotpal, Rastogi Publications, Meerut.
5. Invertebrate Zoology, Jordan and Verma, S. Chand & Company, Delhi.

6. Organic Evolution. B. Rastogi, KedarnathRamnath Publications, Meerut.
7. Cell Biology, Genetics, Molecular Biology, Evolution and Ecology, P. S. Verma& V. K.Agarwal, S. Chand & Company, Delhi.
8. Cytology, P. S. Verma, S. Chand &Co. Ltd., New Delhi.
9. Cell Biology, C. B. Powar, Himalaya Books Pub.
10. Cell and Mol. Biol., E.D.P. DeRobertis and E.M.F. DeRobertis, Holt-Saunders, Japan.
11. Genetics, P. K. Gupta, Rastogi Publications, Meerut.
12. Genetics, V. B. Rastogi, KedarnathRamnath, Meerut.
13. Elements of Biotechnology, P. K. Gupta, Rastogi Publications, Meerut.
14. Culture of Animal Cells-A Manual of Basic Techniques, R. Ian Freshney, 5th Ed., A. John Wiley & Sons Inc. Pub.

Semester II
Course Code: ZO 2502L
No. of Credits: 03
Learning Hours: 60 hrs

1. Human Blood Physiology:

a) Method of separation of plasma from blood.
b) Method of separation of serum from blood.
c) Preparation of a blood smear to identify various WBCs, using only Leishman stain.
d) Determination of ABO blood groups.
e) Demonstrate the effect of isotonic, hypotonic and hypertonic salines on RBCs.

2. Hydra:

Study by permanent slides:

a) W.M. of Hydra
b) W.M. of Hydra with gonads
c) T.S. of Hydra
d) L.S. of Hydra
e) T.S. passing through testis
f) T.S. passing through ovary
g) Nematocyst.

3. Organic Evolution:

Study by charts**:**

a) Miller's experiment
b) Coacervates
c) Proteinoid microspheres
d) Lamarckism
e) Darwinism

4. Cytology:

Study by charts**:**

a) TEM and SEM.
b) Low speed centrifuge.
c) Ultrastructures of Eukaryotic Ribosome, Mitochondrion, Golgi complex.

5. Genetics:

A. Study by charts**:**

a) Complementary genes (e.g. Pea plant – Purple & White flowers)
b) Epistasis – Dominant (e.g. Dog)
Recessive (e.g. Mice)
c) Sex-linked inheritance:

X-linked (dominant) e.g. enamel of tooth)
X-linked (recessive) (e.g. colour blindness in man, eye-colour in Drosophila)
Y-linked (Holandric genes)

d) Sex-influenced inheritance:
Baldness in man

B. Study of genetic problems (as per APPENDIX)

Semester III
CORE Paper: ANIMAL DIVERSITY (nonchordates) and GENETICS & ANIMAL BIOTECH
Course Code: ZO 3501
No. of Credits: 04
Learning Hours: 60 hrs

Unit I *ANIMAL DIVERSITY* (Nonchordates)*:*

A. Salient features and Classification of Invertebrates, starting from Kingdom upto

Classes, giving reasons & suitable examples (***as per practical syllabus***):

Phylum:

1. Protozoa
2. Porifera
3. Coelenterata
4. Platyhelminthes
5. Nemathelminthes

(Classification, as per adapted in the book – TEXTBOOK OF INVERTEBRATES by R.L.Kotpal, Rastogi Publication, Meerut).

Unit II *ANIMAL DIVERSITY* (Nonchordates)*:*

A. Salient features and Classification of Invertebrates, starting from Kingdom upto

Classes, giving reasons & suitable examples (***as per practical syllabus***):

Phylum:

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

(Classification, as per adapted in the book – TEXTBOOK OF INVERTEBRATES by R.L.Kotpal, Rastogi Publication, Meerut).

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

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

Annelida: Type – **Earthworm** (*Pheritima posthuma*) - Classification, Habits & Habitat, Ext. characters, Body wall, Digestive system, Circulatory system, Excretory system, Nervous system, and Reproductive systems & reproduction

B. General topics:

1. Coelenterata: Kinds of coral reefs (Fringing, Barrier, Atoll)
2. Types of Symmetry.
3. Types and significance of Coelom.
4. Types and significance of Metamerism.

Reference Books for* Units I, II & III*:

1. **Textbook of Invertebrates**, R. L. Kotpal, Rastogi Publishers, Meerut.
2. **A Manual of Zoology**, E. K. Ayyer, Vol. I & II.
3. **Invertebrate Zoology**, Jordan and Verma, S. Chand & Company Ltd., Delhi.
4. **Invertebrate: Structure and Function**, E. J. W. Barrington.

Unit IV *GENETICS* & *ANIMAL BIOTECHNOLOGY*:

(A) Genetics:

1. Nonepistatic interaction/Collaboration of genes (e.g. Comb in hen)
2. Duplicate genes (15:1 ratio, e.g. Fruit shape in Shepherd's purse)
3. Cytoplasmic inheritance in *Paramoecium* & *Limnea*.
4. Chromosomal aberrations:

a) Numerical/Ploidy (Down's Syndrome, Turner's Syndrome and Klinefelter's Syndrome)
b) Structural (Deletion, Duplication, Inversion and Translocation)

5. Human Genome Project

(B) Animal Biotechnology:

1. Equipments for animal cell culture laboratory, in brief:

a) Magnetic stirrer
b) Variable volume micropipettes
c) Inverted microscope.

2. Cryopreservation
3. Advantages & Disadvantages of Tissue Culture.

Reference Books for* Unit IV*:

1. **Textbook of Genetics**, Veerbala Rastogi, Kedar Nath Ram Nath, Meerut.
2. **Genetics**, P.S.Verma & V.K.Agarwal, S. Chand & Company Ltd., Delhi.
3. **Fundamentals of Biotechnology**, P.K.Gupta, S. Chand & Company Ltd., Delhi.
4. **Culture of Animal Cells-A Manual of Basic Techniques**, R. Ian Freshney, 5th Ed., A. John Wiley & Sons Inc. Pub.

Semester III
CORE Paper: ANIMAL DIVERSITY (chordates), CYTOLOGY and HUMAN HISTOLOGY
Course Code: ZO 3502
No. of Credits: 04

Learning Hours: 60 hrs

Unit I *ANIMAL DIVERSITY* (Chordates) – *Systematics*:

Salient features & Classification, starting from Kingdom upto Orders, with reasons & suitable examples (***as per practical syllabus***) of Protochordata, Cyclostomata, Pisces, Amphibia, Reptilia, Aves and Mammalia.

(Classification as per adapted in the book – TEXTBOOK OF VERTEBRATES by R. L. Kotpal, Rastogi Publication, Meerut).

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

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

Chondrichthyes: Type – **Shark – (***Scoliodon sorrakowah***):** Ext. characters, Digestive system, Heart, Arterial system, Urinogenital systems, Placoid scales.

B. General topics:

1. Comparison of chordates with non-chordates.
2. Identification of venomous and non-venomous snakes of India **(*only external characters*):**
   - Venomous: Russel's viper, Krait, Cobra, King cobra, Marine snake.
   - Non-venomous: Boa, Pythons, Rat snake.

Reference Books for* Units I & II*:

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 III *CYTOLOGY:*

1. Cytoplasm:

a) Physical nature of matrix

b) Chemical organization of matrix
   - Chemical elements
   - Atom
   - Compounds & Molecules
   - Electrolytes & Non-electrolytes
   - Acids, Bases and Salts

2. Lysosomes:
   - Occurrence
   - Chemical composition
   - Kinds of Lysosomes
   - General functions

3. Cytoskeleton:
   - Microtubules
   - Microfilaments

4. Morphological characteristics of cancer cells.
5. Physiological characteristics of cancer cells.
6. Fluorescence microscope.

***Reference Books for* Unit III:**

1. **Cytology**, P. K. Gupta, S. Chand & Company Ltd., Delhi.
2. **Cell Biology**, C. B. Power, Himalaya Publishing House.
3. **Cellular and Molecular Biology**, De Robertis and De Robertis, Saunders Pub.

Unit IV *HUMAN HISTOLOGY:*

Histology of the following organs:

(A) Lung:

1. Location and external characters **(*to be asked in Q.5 as objective questions only*)**
2. T.S. of lung/Lung histology:

a) Bronchial intercom
b) Bronchi
c) Bronchiole
d) Respiratory bronchiole
e) Alveolar duct
f) Alveoli

3. Kinds of cells **(*to be asked in Q.5 as objective questions only*)**

a) Pneumocytes
b) Clara cells
c) Dust cells

(B) Bone:

1. General organization from external to internal surface.
2. Types of bones:

a) Compact bone
b) Cancellous bone

3. T.S. of compact bone/Histo-architecture of compact bone:

a) Periosteum
b) Bone cells (in brief)
c) Haversian system
d) Kinds of lamellae
e) Endosteum
f) Bone marrow

4. Bone matrix/Chemical composition of bone
5. Bone cells:

a) Osteoblasts
b) Osteocytes
c) Osteoclasts
d) Osteoprogenitor cells

(C) Cartilage:

1. Introduction to general functions **(*not to be asked in the exams*)**
2. Location of Hyaline cartilage, Elastic cartilage and Fibrocartilage
3. Cartilage matrix Molecular organization)

a) T.S. of Hyaline cartilage

b) T.S. of Elastic cartilage
c) T.S. of Fibrocartilage

***Reference Books for* Unit IV:**

1. **Principles of Anatomy and Physiology,** G. J. Tortora & S. R. Grabowski, HarperCollins College Publications.
2. **diFiore's Atlas of Histology with Functional Correlation**, Victor P.Eroschenko 10th Ed., Lipikott Williams & Wilkins Pub.
3. **Basic Histology**, Luiz Carlos junqueria, Jose Carenerio, Robert O. Kelley, 9th Ed., Lang Med Book/McGraw-Hill Pub.
4. **Basic Medical Histology; The Biology of Cells, Tissues and Organs**, Richard G Kessel: Oxford Univ. Press
5. **Textbook of Animal Histology**, A. K. Berry, Emkay Pub.

Semester III
Practicals
Course Code: ZO 3503L
No. of Credits: 03
Learning Hours: 60 hrs

1. ***ANIMAL DIVERSITY* (Nonchordates) – *Systematics:***
Identification & classification (*Kingdom to Class*) *giving reasons:*

1. Protozoa: Amoeba, Paramoecium, Polystomella, Euglena, Vorticella.
2. Porifera: Leucosolenia, Hyalonema, Euspongia.
3. Coelenterata: Hydra, Sea anemone, Physalia, Aurelia, Coral.
4. Platyhelminthes: Planaria, Liverfluke, Tapeworm.
5. Nemathelminthes: Enterobius, Ascaris, Rhabditid.
6. Annelida: Nereis, Leech, Aphrodite, Amphitrite, Tubifex.
7. Arthropoda: Apus, Balanus, Prawn, Crab, Centipede, Butterfly, Scorpion.
8. Mollusca: Chiton, Dentalium, Pila, Unio, Octopus.
9. Echinodermata: Brittle star, Sea urchin, Sea cucumber, Feather star, Starfish.
10. Hemichordata: Balanoglossus, Saccoglossus, Rhabdopleura, Cephalodiscus

(Alongwith classification, a short description and habitat should also be written for each animal)

2. ***ANIMAL DIVERSITY* (Nonchordates):**
Study of Earthworm by charts/specimens:

A) For Dissections & Temporary mountings:
1. Study of external characters.
2. Study of Digestive system and Nervous system.
3. Temporary mountings of setae, septal nephridia and blood glands.

B) *Permanant slides of Earthworm:*
T.S. passing through pharynx, T.S. passing through gizzard, T.S. passing through typhlosole.

3. ***ANIMAL DIVERSITY* (Nonchordates):**
Study by charts/models/slides:

1. Coelenterata: Kinds of coral reefs (Fringing, Barrier, Atoll)
2. Types of symmetry (Radial, Biradial, Bilateral, Asymmetrical)
3. Coelom formation

4. ***CYTOLOGY:***

Study charts/models:

1. Types of Lysosomes in a cell.
2. Cytoskeleton - T.S. of a microtubule

5. *Study of genetics through charts:*

1. Nonepistatic interaction/Collaboration of genes (e.g. Comb of hen)
2. Duplicate genes (15:1 ratio, e.g. Fruit shape in Shepherd's purse)
3. Cytoplasmic inheritance in *Paramoecium* and *Limnea*.
4. Chromosomal aberration:

– Numerical (Down's Syndrome, Turner's Syndrome, Klinefelter's Syndrome)
– Structural (Deletion, Duplication, Inversion, Translocation)

6. ***ANIMAL BIOTECHNOLOGY*:**

Study of animal biotechnology by charts/specimens:

1. Magnetic stirrer
2. Variable volume micropipettes
3. Cryostorage containers
4. Inverted microscope.

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1. ***ANIMAL DIVERSITY*** **(Chordates) –** ***Systematics*:**

Identification & classification (*Kingdom to Order*) *giving reasons:*

1. Protochordata: Amphioxus, Salpa, Doliolum, Ascidian.
2. Cyclostomata: Lamprey, Hagfish.
3. Pisces: Sting rayfish, Electric rayfish, Sea horse, Flying fish, Suckerfish, Eel, Sole fish, Ophiocephalus.
4. Amphibia: Ichthyophis, Salamader, Hyla, Siren, Toad.
5. Reptilia: Giant turtle, Horned toad, Chameleon, Snake.
6. Aves: Pelican, Goose, Kite, Peacock, Cuckoo, Kingfisher, Woodpecker, Parakeet, Owl, Crow.
7. Mammalia: Hedgehog, Flying fox, Human, Dog, Blue bull, Elephant, Dugong, Squirell, Indian hare, Pangolin.

(Alongwith classification, a short description and habitat should also be written for each animal)

2. ***ANIMAL DIVERSITY*** **(Chordates)*:***

Study of Shark by charts/specimens:

1. Study of external characters.
2. Study of Digestive system, Arterial system, Urinogenital systems and Brain.

3. Temporary mountings of Placoid scales, Striated muscle fibres, Medullated nerve fibres.

3. *IDENTIFICATION OF SNAKES:*

Study by snakes by specimens/charts **(*only external characters*):**

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

4. *BIRDS:*

1. Study of beaks in birds
2. Study of feet in birds

5. *HUMAN HISTOLOGY*:

Identification & histological study of the following organs by permanant slides of:
T.S. of Lung, Bone and Cartilage (Hyaline, Elastin, Fibrous)

Semester 4
Course Code: ZO 4501
ANIMAL BIOCHEMISTRY, BIOPHYSICS and ANIMAL PHYSIOLOGY
No. of Credits: 04
Learning Hours: 60 hrs

Unit I *PROTEINS*:

1. Introduction and Definitions.
2. Amino acids:
- General Structure
- Classification (based upon the composition of the side chain/R group)

3. Peptides:
- N- and C- terminals
- Naming of peptide chain

4. Protein structure (*No particular example should be asked as a short note or full question*):

Chemical Bonds: a) Primary - Peptide bond
b) Secondary - Disulfide, Hydrogen, Hydrophobic and Ionic.

5. Protein Configuration (*No particular example to be asked as a short note or full question*):
a) Primary structure (Amino acid sequence)
b) Secondary structure (α-helix & β-pleated sheet)
c) Tertiary structure (Folding of the peptide chain)
d) Quaternary structure (Protein-protein interactions)

6. Classification of proteins (*No particular example to be asked as a short note or full question*):
a) Based upon shape - Globular and Fibrillar
b) Based upon composition & solubility - Simple, Conjugated and Derived.

7. Properties:

Physical - Colour & Taste, Shape & Size, Molecular weight, Colloidal nature, Denaturation, Amphoteric nature and Solubility.

Chemical -

a) Hydrolysis
b) Reactions involving -COOH group:

- Reaction with alkalis (Salt formation)
- Reaction with alcohols (Esterification)

c) Reactions involving -NH_2 group:

- Reaction with mineral acids (Salt formation)
- Reaction with formaldehyde

3. Biological significance of proteins

Reference Books for **Unit I:**

1. **Elementary Biochemistry,** J. L. Jain, S. Chand & Company Ltd., Delhi.
2. **Biochemistry,** I. Stryer, Freeman.
3. **Harper's Biochemistry,** Lange, McGraw-Hill.
4. **Principles of Biochemistry,** Lehninger, CBS Publications.

Unit II *SOME PHYSICO-CHEMICAL LAWS APPLIED TO PHYSIOLOGY* (Biophysics):

1. Units of concentration of solutions(Percentage, Normal solution, Molar solution, Molal solution)
2. Ions, Electrolytes and Non-electrolytes
3. Filtration
4. Ultrafiltration
5. Diffusion
6. Osmosis
7. Dialysis
8. Surface tension
9. Adsorption
10. Hydrotrophy

Unit III *PHYSIOLOGY OF DIGESTION and ABSORPTION:*

A. Histophysiology of the following mammalian organs (with reference to humans):

Tongue, Stomach, Small Intestine, Liver and Pancreas.

B. Digestion and Absorption of following dietary components in mammals only:

a) Carbohydrates
b) Proteins
c) Lipids
d) Nucleic acids

Unit IV *PHYSIOLOGY OF CONDUCTION OF NERVE IMPULSE:*

1. Sensory Receptors:

– Epithelio-sensory receptor cells
– Neuro-sensory receptor cells)

2. Classification of Sensory Receptors :

– Thermo-receptors

- Mechano-receptors
- Chemo-receptors
- Photoreceptors

3. Neurotransmitters **(*neither shot notes nor structures should not be asked in the exam*):** Acetylcholine, Nor-epinephrine, Dopamine
4. Conduction/Propagation/Transmission of Nerve Impulse:

A) Conduction in a nerve-fibre

- along a non-myelinated neuron

- along a myelinated neuron

B) Transmission through a synapse

Reference Books for* Units II, III & IV*:

1. **Principles of Anatomy and Physiology,** G. J. Tortora & S. R. Grabowski, HarperCollins College Publications.
2. **Animal Physiology and Related Biochemistry,** H. R. Singh, Shobhan Lal Nagin Chand & Co., Educational Publishers, Jalandhar.
3. **A Textbook of Animal Physiology**, A. K. Berry, Emkay Publications, Delhi.
4. **Human Physiology**, C. C. Chatterjee, New Central Book Agency, Calcutta.

Semester 4
Course Code: ZO 4502
APPLIED ZOOLOGY
No. of Credits: 04
Learning Hours: 60 hrs

Unit I *APPLIED ENTOMOLOGY:*

1. Brief introduction and importance of studying Applied Entomology **(*not be asked in the exam*)**
2. Study of the following larval pests:

I. Groundnut: White grub, Groundnut stem borer, Red hairy caterpillar.

II. Cotton: Spotted bollworm, Pink bollworm, Cotton leaf roller.

III. Wheat: Cut worm, Wheat fly.

3. Insect-pest: - Cultural control methods

Control - Physical controls

- Mechanical controls

- Chemical control methods **(*individual chemicals like DDT, BHC, etc. should not be taught*)**

- Biological control methods **(*individual natural enemies should not be taught*)**

***Reference books for* Unit I:**

1. **Economic Zoology**, G. S. Shukla and V. B. Upadhyay, Rastogi Pub., Meerut.
2. **Economic and Applied Entomology**, Kumar and Nigam, Emkay Pub., Delhi.

Unit II *FISHERY SCIENCE:*

1. Brief introduction and importance of studying Fishery Science **(*not to be asked in exam*)**
2. Fisheries development in Gujarat
3. Study of fishing gears**:**

a) Nets**:** Stringed Cast net, Gill net, Drag net, Trawl net.
b) Boats**:** Dugout canoe, Macchwa, Flat-bottomed boat, Trawler.

4. Identification & Classification of the following fishes from Kingdom to Family**:**
   Catla, Rohu, Mrigal, Hilsa, Dara, Ghol, Bombay duck and Pomfret.

5. Home Aquarium: Primary knowledge, Construction, General maintenance and Popular aquarium fishes.

6. Fish Culture in Fresh Water:

a) Selection of fishes
b) Procedure of Induced Breeding
c) External factors affecting induced breeding

Reference books for* Unit II*:

1. **Fish & Fisheries of India,** V. B. Jhingran, Hindustan Pub., Meerut.
2. **Fishery Science and Indian Fisheries,** Srivastav, Kitab Mahal Pub., Delhi.
3. **Fishes,** Chandy.

Unit III *WILDLIFE of* India:

1. Introduction to the terms: National Parks, Sanctuaries.
2. Elementary knowledge of:

a) Marine National Park of Gujarat.
b) Velavadar National Park.
c) Gir National Park and Sanctuary.
d) Wildass Sanctuary of Gujarat.
e) Nalsarovar Bird Sanctuary.
f) Jim Corbett National Park
g) Kaziranga National Park
h) Bandipur National Park
i) Bharatpur Bird Sanctuary
j) Kanha National Park

3. Wildlife Protection Act
4. Importance & Methods of Conservation of Wildlife
5. IUCN & Red Data Book

***Reference books for* Unit III:**

1. **Indian Wildlife**, **Srilanka**, **Nepal**, APA Publications.
2. **Wildlife of India**, Mark E. Trisch, Harper Collins Pub.

3. **Threatened Animals of India**, B. K. Tikader, ZSI, Calcutta.

Unit IV *HUMAN PARASITOLOGY*:

1. Definitions: Parasite, Host and Parasitology.
   Types of Parasites **(*only definition and one example for each*):**
   Facultative parasites, Obligate parasites, Endoparasites and Ectoparasites

   Types of Hosts **(*only definition and one example for each*)**:
   Principal, Intermediate and Reservoir

4. Life Cycle and Pathogenicity of the following human parasites:

- *Entamoeba histolytica*
- *Plasmodium vivax*
- *Enterobius vermicularis*
- *Ascaris lumbricoides*
- *Taenia solium*.

***Reference Books for* Unit IV:**

1. **Protozoa**, R. L. Kotpal, Rastogi Publications, Meerut.
2. **Helminthes**, R. L. Kotpal, Rastogi Publications, Meerut.
3. **An Introduction to Parasitology**, P. N. Sharma, L. S. Ratnu, S. Chand & Co. Ltd., New Delhi.
4. **A Textbook of Zoology**, R. D. Vidyarthi, S. Chand & Company Ltd., New Delhi,

Semester 4
Course Code: ZO 4503L
Based on Theory Paper ZO-4501& 4502
No. of Credits: 03
Learning Hours: 60 hrs

1. Confirmation of presence of Proteins.
2. Demonstration of process of osmosis.
3. Formation of crystals of Urea, Urea nitrate and Urea oxalate.
4. Adsorption of oxalic acid on charcoal.
5. Determination of relative surface tension of a liquid by Drop Method.
6. Digestion of starch using salivary amylase.
7. Study of digestion of proteins by chart.
8. Study of digestion of lipids by chart.
9. Study of digestion of nucleic acids by chart.
10. Study of absorption of Monosaccharides and Amino acids by charts.
11. Study of the structures of types of neurons:
Unipolar, Bipolar, Non-myelinated & Myelinated Multipolar

12. Study of conduction of nerve impulse by charts:
- Propagation in non-myelinated nerve-fibre.

– Propagation in myelinated nerve-fibre.
– Transmission through synapse.

13. Histological study of the following mammalian organs by permanant slides:
Tongue, Stomach, Small intestine, Liver, Pancreas.

1. *APPLIED ENTOMOLOGY*:

Study of the following larval pests by charts/specimens:

I. Groundnut: White grub, Groundnut stem borer, Red hairy caterpillar.
II. Cotton: Spotted bollworm, Pink bollworm, Cotton leaf roller.
III. Wheat: Cut worm, Wheat fly.

2. *FISHERY SCIENCE*:

1. Study of fishing gears:
- Nets**:** Stringed Cast net, Gill net, Dole net, Drag net, Trawl net.
- Boats: Dugout canoe, Macchwa, 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. Hatching hapa
4. Home aquarium
5. Popular aquarium fishes:
Gold fish, Gourami, Angel fish, Sword-tail fish, Platy, Fighter fish

3. *WILDLIFE of* India:

1. Study by photographs of some endangered fauna of India, alongwith scientific names:
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.
2. Study by specimens/photographs of Wildlife management tools:
Binoculars, Cameras, Radio-transmitters/receivers, Tranquilizer gun/darts.
3. NP & S (*as per theory syllabus*) spotting in map of India.

4. *HUMAN PARASITOLOGY*:

Study by charts/specimens/slides:

1. *E. histolytica* (Trophozoite & Cystic stage)
2. Asexual phase of life cycle of *Plasmodium vivax*
3. Sexual phase of life cycle of *Plasmodium vivax*
4. *E. vermicularis*
5. *Taenia solium*
6. Scolex of *Taenia solium*
7. Cysticercus larva of *T. solium*.

Semester V
Course Code: ZO 5501
(ANIMAL DIVERSITY (nonchordates))
No. of Credits: 04
Learning Hours: 60 hrs

Unit I ***ANIMAL DIVERSITY*** **(Nonchordates) –** ***Type Study*** **:**

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

Porifera **:** Type – *Leucosolenia* - Classification, Habits & Habitat, Ext. characters, Histology of Body wall, L.S. of Leucosolenia, Reproduction & Development.

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

Platyhelminthes **:** Type – **Sheep Liver Fuke** (*Fasciola hepatica*) – Classification, Habits & Habitat, Ext. characters, Histology of Body Wall, Digestive system, Excretory system, Respiration, Nervous system, Reproductive systems & Reproduction.

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

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

Arthropoda : Type – **Scorpion** – Classification, Habits & Habitat, Ext. characters, Digestive system, Book-lungs, Circulatory system, Excretory organs, Nervous system, Sense organs and Reproductive systems.

B. General topics **:**

1. *Porifera* **:** Skeleton and Canal systems
2. *Coelenterata* **:** Polymorphism
3. *Platyhelminthes* : Parasitic adaptations
4. *Annelida* **:** Nephridia & Coelomoducts.

Unit III ***ANIMAL DIVERSITY*** **(Nonchordates) –** ***Type Study*** **&** ***General topics*** **:**

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

Mollusca **:** Type – **Cuttlefish** (*Sepia officinalis*) - Classification, Habits & Habitat, External Characters, Digestive System, Respiratory system, Circulation system, Excretory system, Nervous system, Sense organs and Reproductive systems.

B. General topics **:**

1. *Arthropoda* **:** Crustacean larvae (Nauplius, Zoea, Megalopa) and Excretory organs.
2. *Mollusca* **:** Foot and Torsion & Detorsion.

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

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

Echinodermata **:** Type- **Starfish** (*Asterias*) - Classification, Habit & Habitat, External Characters, Body wall, Digestive system, Water vascular system, Reproductive system.

B. General topics **:**

1. *Echinodermata* **:** Larval forms (Bipinnaria, Brachiolaria, Echinopluteus, Ophiopluteus, Auricularia, Doliolaria)
2. *Minor phyla* **:** General characters of Phoronida, Brachiopoda and Echiuroidea.

***Reference Books for* Units I, II, III & IV :**

1. **Textbook of Invertebrates**, R. L. Kotpal, Rastogi Publications, Meerut.
2. **Manual of Zoology**, E. K. Ayyer, Vol. I & II.
3. **Invertebrate Zoology**, Jordan and Verma, S. Chand & Company, Delhi.

Semester V
Course Code: ZO 5502
(ANIMAL DIVERSITY (Chordates))
No. of Credits: 04
Learning Hours: 60 hrs

Unit I ***ANIMAL DIVERSITY*** **(Chordates) –** ***Type Study* & *General Topics* :**

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

Osteichthyes **:** Type **- Labeo** (*Labeo rohita*) - Classification, Habits & Habitat, External characters, Digestive System, Respiratory system, Heart, Arterial & Venous systems, Brain and Urinogenital systems.

B. General topics **:**

1. *Pisces* **:** Differences between Chondrichthyes & Osteichthyes, Swim bladders, Accessory respiratory organs, Parental care, Migration, Types of Scales and Types of fins.
2. *Dipnoi* **:** Habits, habitat and peculiarities of Protopterus, Lepidosiren and Neoceratodus.

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

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

Reptilia **:** Type - **Garden lizard** (*Calotes versicolor*) - Classification, Habits & Habitat, External characters, Digestive System, Respiratory system, Heart, Arterial & Venous systems, Brain and Urinogenital systems.

B. General topics **:**

1. *Amphibia* **:** Neoteny and Parental care.
2. *Reptilia* **:** Dinosaurs (Brontosaurus, Triceratops, Tyranosaurus, Dimetrodon, Stegosaurus, Pteranodon, Ichthyosaurus, Iguanodon), Theories of extinction of dinosaurs, Temporal openings

Unit III ***ANIMAL DIVERSITY*** **(Chordates) –** ***Type study* & *General Topics* :**

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

Aves **:** Type **- Pigeon** (*Columba livia*) - Classification, Habits & Habitat, External characters, Digestive system, Respiratory system, Circulatory systems, Brain, Excretory System, Reproductive systems and Types of feathers.

B. General topics **:**

1. *Aves* **:** Birds are glorified reptiles, Migration.

2. *Mammalia* **:** - Adaptations of aquatic mammals,
   - Dentition (Types, Dental formulae of Rat, Cat, Dog, Rabbit, Human, Cow, Horse, Elephant).

Unit IV ***ANIMAL DIVERSITY*** **(Chordates) –** ***General topics*** **:**

Comparative anatomy of **:**

a) Alimentary canals
b) Aortic arches
c) Venous systems
d) Brain

Reference Books for **Units I, II, III & IV :**

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

Semester V
Course Code: ZO 5503
(ANIMAL BIOCHEMISTRY and METABOLISM)
No. of Credits: 04
Learning Hours: 60 hrs

Unit I ***CARBOHYDRATES*** **:**

1. Asymmetry, Isomers, Optical isomerism and Mutarotation.
2. Introduction, definition and classification of Carbohydrates.
3. Monosaccharides (*No particular example should be asked as a short note or full question*) :

- Definition, General formula.
- Classification upto Hexoses (with structures of suitable examples)
- Ring/Cyclic structures (Fischer & Haworth)
- Chemical properties **:**

a) Reaction involving glycosidic –OH group.
b) Reaction involving alcoholic –OH group (Etherification).
c) Reactions involving both, glycosidic as-well-as alcoholic –OH groups (Esterification).
d) Reactions involving both, –OH as-well-as –CHO/-C=O groups **:**

- Oxidation **:** Sugar acids, Oxidation with metal hydroxides.
- Reduction **:** Reaction with sodium amalgam, Reaction with dilute alkalis.
- Osazone formation **:** Reaction with phenyl hydrazine.

4. Disaccharides :

- Definition.
- Flow-chart of classification, based upon the type of glycosidic linkages.
- Occurrence, formation, structure and general properties of Maltose, Lactose, Cellobiose and Sucrose.

5. Polysaccharides :

- Definition.
- Flow-chart of classification, based upon structures and functions.
- Occurrence, formation, structure and general properties of **:**

a) Homopolysaccharides – Starch, Glycogen, Cellulose and Chitin.

b) Heteropolysaccharides – Mucopolysaccharides **:** Hyaluronic acid, Chondroitin sulphate.

6. Biological significance of Carbohydrates.

Unit II *LIPIDS* :

A. Lipids :

1. Introduction and definition.
2. **Components :**
   a) Alcohols
   b) Fatty acids
3. **Types of Fatty Acids :**
   a) *Saturated acids* **:** Butyric, Palmitic, Stearic and Arachidic.
   b) *Unsaturated acids* **:** Monoethenoid, Diethenoid, Triethenoid and Tetraethenoid.
4. **Classification of Lipids :**

a) *Simple* **:** i. Triglycerides (Fats)
ii. Waxes (*Formulae not required*)

b) *Compound* **:** Phospholipids **:** Phosphoglycerides **:**

i. Lecithins
ii. Cephalins
iii. Plasmalogens

c) *Derived Lipids* **:** Steroids (*Basic steroid nucleus and Cholesterol only*).

5. **Properties :**

Physical - Colour, Odour, Taste, Solubility, Melting point, Specific gravity, Insulation and Emulsification.

Chemical -

i) Reactions involving –COOH group (Hydrolysis, Saponification and Hydrolytic rancidity)

ii) Reactions involving double bonds (Hydrogenation, Halogenation and Oxidative rancidity)

6. Biological significance of Lipids.

Unit III *ENZYMES* :

1. Nomenclature & Classification.
2. Chemical nature of enzymes.
3. Mechanisms of enzyme action.
4. Factors affecting enzyme activity/enzyme catalyzed reaction **:**

a) Temperature
b) pH
c) Inhibitors
d) Enzyme concentration
e) Substrate concentration

3. Some clinically important enzymes **(*to be asked only as objective questions in Q.5 only*)**
   Serum acid phosphatase, Serum alkaline phosphatase, SGOT, SGPT, LDH, Serum creatine phosphokinase, Serum amylase, Serum lipase and Serum isocitrate dehydrogenase

Unit IV ***METABOLISM*** **:**

A. *Metabolism of Carbohydrates* **:**

1. Glycogenesis (structures not required)
2. Glycogenolysis (structures not required)
3. Glycolysis (EM Pathway) (structures required)
4. Krebs Cycle (structures required)
5. ETS (structures not required)
6. Glucogenesis (structures required)
7. Gluconeogenesis (structures not required)
8. HMP Shunt Pathway (structures required)

B. *Metabolism of Proteins* **:**

1. Deamination
2. Transamination
3. Decarboxylation
4. Urea synthesis (structures required)

C. *Metabolism of Lipids* **:**

1. Glycerol metabolism (structures not required)
2. Fatty acid metabolism **:**

- β-oxidation of saturated fatty acids (structures required).

Reference Books for **Units I, II, III & IV :**

Elementary Biochemistry, J. L. Jain, S. Chand & Company, Delhi.
Biochemistry, I. Stryer, Freeman.
Harper's Biochemistry, Lange, McGraw-Hill.
Principles of Biochemistry, Lehninger, CBS Publications.

Semester V
Course Code: ZO 5504
(CYTOLOGY, DEVELOPMENTAL BIOLOGY)
No. of Credits: 04
Learning Hours: 60 hrs

Unit I ***CYTOLOGY*** **(Tools and Techniques) :**

1. Electron Microscopes (TEM, SEM)
2. Confocal microscope
3. Phase contrast microscope
4. Paper chromatography (Ascending, Descending and Circular)
5. TLC
6. Column Chromatography
7. PAGE - Slab gel electrophoresis

Unit II ***CYTOLOGY*** **:**

1. Karyotyping & Karyotype
2. Ultrastructure and functions of Plasma membrane **:**

a) Brief concept of chemical composition.
b) Ultrastructure – 'Fluid Mosaic model' only.

c) Specialized structures of plasma membrane **:**
- Specialization due to outpushings/evaginations.
- Specialization due to inpushings/invaginations.
- Specializations due to contact **:**
  Desmosomes, Hemi-desmosomes, Septate desmosomes, Tight junctions,

  Gap junctions, Terminal bars and Interdigitation.

d) Functions of plasma membrane **:**
Permeability, Osmosis, Diffusion, Facilitated transport, Active transport, Endocytosis, Exocytosis.

3. Classification of chromosomes based upon **:**
   - the location of their centromeres
   - their functions (i.e. somatic & sex chromosomes)
4. Ultrastructures of **:**
   A) Metaphase Chromosome
   B) Giant chromosomes - Polytene chromosome and Lampbrush chromosome.
5. Typical Cell Cycle
6. Meiosis
7. Ultrastructure & general functions of Centrioles/Basal bodies.
8. Ultrastructure & general functions of Cilia/Flagella.
9. Cell differentiation.

Reference Books for **Units I and II :**

1. **Cytology**, P. S. Verma & V. K. Agarwal, S. Chand & Company, Delhi.
2. **Cell Biology**, C. B. Power, Himalaya Publishing House.
3. **Essential Cell Biology**, Bruce Alberts, et. al., Garland Pub. Inc., New York.
4. **Cellular and Molecular Biology**, De Robertis and De Robertis, Saunders Pub.

<u>Unit III</u> ***DEVELOPMENTAL BIOLOGY*** **:**

1. Gametogenesis
2. Types of eggs depending upon the quantity of yolk. (Microlecithal/Oligolecithal, Mesolecithal and Polylecithal/Macrolecithal/Megalecithal)
3. Types of eggs depending upon the distribution of yolk. (Homolecithal/Isolecithal, Centrolecithal and Telolecithal)
4. Laws of cleavage
5. Patterns of cleavage - radial, biradial, spiral(dextral, sinistral), bilateral, incomplete/meroblastic and complete/holoblastic.
6. Regeneration
7. Embryonic induction
8. Growth - Measurement of growth
   - Types of cell growth
   - Factors controlling growth
9. Types of Placentation in mammals (histological).

<u>Unit IV</u> ***DEVELOPMENTAL BIOLOGY*** **:**

Chick Embryology (upto 72 hours) **:**

- Structure of a hen's unfertilized egg.
- Fertilization, Fate map, Cleavage, Blastulation, Gastrulation.
- Description of 21hr. 33hr. 48hr. and 72hr. old chick embryos.
- Development of brain upto 72 hrs.

- Development of heart upto 72 hrs.
- Flexion & Torsion.
- Extra-embryonic membranes.

Reference books for **Unit III & IV :**

Chordate Embryology, P. S. Verma & V. K. Agarwal, S. Chand Pub., New Delhi.
Elements of Chordate Embryology, R. Prakash & P. C. Jain, S. Nagin Pub., ND.
Embryology, R. MAthur & M. Mehta, Anmol Pub., New Delhi.
A Textbook of Animal Embryology, A. K. Berry, Emkay Pub., Delhi.
Embryology, N. Arumugam, Saras Publications, Kanyakumari.
Introduction of Embryology, Balinsky, CBS College Publishers.
Vertebrate Zoology, R. L .Kotpal, Rastogi Publication, Meerut.
Developmental Biology, V. B. Rastogi, Rastogi Publications, Meerut.

Semester V
Course Code: ZO 5401
SUBJECT ELECTIVE COURSE (SEC): (BIOSTATISTICS, HUMAN REPRODUCTIVE HEALTH, ZOOLOGICAL PARKS, NUTRITION)
No. of Credits: 04
Learning Hours: 60 hrs

Unit-I *BIOSTATISTICS* :

1. Mean
2. Mode
3. Median
4. SD, SE
5. Student's t-test
6. Chi-square test
7. ANOVA

Reference books for **Unit I :**

1. **Genetics and Biostatistics**, R.P. Meyyan, Saras Pub., Nagercoil, Kanyakumari dist.

Unit-II *HUMAN REPRODUCTIVE HEALTH* :

1. Anatomy of ♂ & ♀ reproductive systems
2. Causes of Infertility (in ♂ & ♀)
3. Methods of Contraception (in ♂ & ♀)
4. STDs (Gonnorhea, Syphillis, Genital herpes, Trichomoniasis, Non-gonococcal Urethritis (UGA).
5. Personal hygiene

Unit-III *ZOOLOGICAL PARKS* :

1. History of Zoological parks in India **(*not to be asked in the exams*)**
2. Aim of zoological parks
3. *ex situ* & *in situ* conservation
4. Classification of zoological parks, with suitable examples

5. Career opportunities in zoological parks
6. Wildlife Protection Act, 1972 and National Zoo Policies 1998

Unit-IV ***NUTRITION*** **:**

1. Macronutrients and their main sources :

   Carbohydrates, Proteins and Lipids

2. Micronutrients and their main sources **:**

   Vitamins and Minerals

Semester V
Course Code: ZO 5505L
Practical: Based Theory papers ZO 5501-5504
No. of Credits: 04
Learning Hours: 60 hrs

1. ***ANIMAL DIVERSITY*** **(Nonchordates) :**

Study of Leucosolenia by charts/models/specimens/ppt **:**

1. W.M. of *Leucosolenia*
2. L.S. of *Leucosolenis*

2. ***ANIMAL DIVERSITY*** **(Nonchordates) :**

Study of Sheep Liver Fluke by charts/models/specimens/ppt **:**

1. WM of liver fluke
2. T. S. through bodywall of liver fluke
3. Reproductive systems of liver fluke
4. Life cycle of liver fluke (larvae)

3. ***ANIMAL DIVERSITY*** **(Nonchordates) :**

Study of Scorpion by charts/models/specimens/ppt **:**

1. External characters of scorpion
2. Digestive system of scorpion
3. Nervous system of scorpion
4. Male reproductive system
5. Female reproductive system
6. Booklungs and Pectine

4. ***ANIMAL DIVERSITY*** **(Nonchordates) :**

Study of Cuttlefish by charts/models/specimens/ppt **:**

1. Study of external characters.
2. Study of Digestive system
3. Study of Nervous system

4. Jaws, Spermatophore, Cuttle bone

5. *ANIMAL DIVERSITY* (Nonchordates) :

Study of Starfish by charts/models/specimens/ppt **:**

1. Study of external characters.
2. Study of Water-vascular system.
3. Tube feet.

6. *ANIMAL DIVERSITY* (Nonchordates) :

Study by charts/models/specimens/ppt to study peculiarities of **:**

Canal systems in Porifera, Spicules, Porpita, Physalia, Obelia (W.M. & Medusa), Crustacean larvae(Nauplius, Zoea, Megalopa), Echinoderm larvae(Bipinnaria, Brachiolaria, Echinopluteus, Ophiopluteus, Auricularia, Doliolaria), Bonelia, Lingula, Phoronis.

1. *ANIMAL DIVERSITY* (Chordates) :

Study of Labeo by charts/models/specimens/ppt **:**

External characters, Digestive system, Urinogenital system, Respiratory system, Brain.

2. *ANIMAL DIVERSITY* (Chordates) :

Study of Calotes by charts/models/specimens/ppt **:**

External characters, Digestive system, Arterial system, Venous sysem, Urinogenital system, Brain.

3. *ANIMAL DIVERSITY* (Chordates) :

Study of Pigeon by charts/models/specimens/ppt of **:**

External characters, Digestive system, Heart, Arterial & Venous systems, Brain, Excretory System, Reproductive system, Types of feathers and Air-sacs.

4. *ANIMAL DIVERSITY* (Chordates) :

Study by charts/models/specimens/ppt to study peculiarities of **:**

Swim bladder, Accessory respiratory organs in fishes, Petromyzon, Myxine, Protopterus, Eel, Neoteny(Siren, Necturus, Axolotl larva), Parental care(Male Hippocampus, Male Kurtus, Male Arius, Female Tilapia, Alytes, Pipa, Rhacophorus, Hyla, Rhinoderma).

5. *ANIMAL DIVERSITY* (Chordates) :

Study by charts/models/specimens/ppt to study peculiarities of **:**

- Aquatic mammals (Dolphin, Whale, Walrus, Seal),
- Dentition in mammals (dental formulae of Human, Cow, Horse, Elephant, Rat, Dog, Cat), - - Dinosaurs (Brontosaurus, Triceratops, Tyranosaurus, Dimetrodon, Stegosaurus, Pteranodon, Ichthyosaurus, Iguanodon).
- Temporal openings in reptiles.

6. ***ANIMAL DIVERSITY*** **(Chordates) :**

Study of comparative anatomy by charts/specimens/ppt **:**

- Alimentary canals, Aortic arches, Venous systems, Brain.

1. ***CARBOHYDRATES*** **:**

Detection of carbohydrates **:**

- Monosaccharides – Glucose and Fructose
- Disaccharides - Lactose, Maltose and Sucrose

2. ***PROTEINS*** **:**

Detection of Proteins – Albumin and Casein

3. ***LIPIDS*** **:**

Study by charts/ppt of **:**

- Basic steroid nucleus and Cholesterol.

4. ***COLORIMETRIC ESTIMATION OF*** **:**

- Proteins (Preparation of Std. Curve by Biuret method).
- Glucose (Nelson-Somogyi method)
- Cholesterol in Serum/Plasma (Ferric chloride method).
- Creatinine in urine.

4. ***PREPARATION OF ATOMIC MODELS OF CARBOHYDRATES*** **:**

- Acyclic as-well-as all cyclic structures of Ribose, Arabinose, Ribulose, Glucose, Mannose, Galactose, Fructose and Tagatose.
- Maltose, Lactose and Sucrose.

5. ***PREPARATION OF ATOMIC MODELS OF PROTEINS*** **:**

- All amino acids except heterocyclic amino acids.
- Glysyl-Alanine, Glysyl-Valine and Ala-Ser.

6. ***PREPARATION OF ATOMIC MODELS OF LIPIDS*** **:**

- Glycerol, Butyric acid, Crotonic acid, Tributyrin, Lecithins, Cephalins

3. ***ENZYMES*** **:**

Study by charts/ppt of **:**

Factors affecting enzyme activity **:**

1. Temperature
2. pH
3. Graph showing effect of [S] on the velocity of an enzyme catalyzed reaction.

4. ***METABOLISM*** **:**

Study by charts/ppt of **:**

1. Glycogenesis (structures not required).
2. Glycogenolysis (structures not required).
3. Glucogenesis (structures required).

4. Gluconeogenesis (structures not required).
5. Glycolysis (EM Pathway) (structures required)
6. Krebs Cycle (structures required).
7. ETS (structures not required).
8. HMP Shunt Pathway (structures required).
9. Urea synthesis (structures required).
10. β-oxidation of saturated fatty acids (structures required).

1. *CYTOLOGY* :

Study by charts/models/ppt with brief description & applications of **:**

1. Electron Microscopes (TEM, SEM)
2. Confocal microscope
3. Phase contrast microscope
4. ***Demonstration only*** of Slab Gel Electrophoresis

2. *CYTOLOGY* :

Study by charts/models/ppt of **:**

1. Fluid Mosaic model of Plasma membrane.
2. Specialized structures of plasma membrane **:**

a) Specialization due to outpushings/evaginations
b) Specialization due to inpushings/invaginations
c) Specializations due to contact **:**
Desmosomes, Tight junctions and Gap junctions

3. Transmission & Scanning electron micrographs of a metaphase chromosome
4. Nucleosome
5. Ultrastructure of primary constriction
6. Typical Cell cycle
7. Mieosis
8. Ultrastructure of Polytene chromosome and Lampbrush chromosome
5. Hammerling's experiment on *Acetabularia*
6. Bantook's experiment on zygote of *Mayetiola destructor*
7. Spemann's experiment on eggs of newt
8. Somatic hybridization

4. *CYTOLOGY* :

Techniques **:**

1. Preparation of temporary slides of **:**

a) Mitosis in Onion root tip
b) Barr-body in cheek cells

2. Human Karyotyping (preparation of chart only)
3. Ascending Paper Chromatography.

5. *DEVELOPMENTAL BIOLOGY* :

Study by charts/ppt of **:**

1. Spermatogenesis, Oogenesis
2. Types of eggs depending upon the amount of yolk (as per theory syllabus)

3. Types of eggs depending upon the distribution of yolk (as per theory syllabus)
4. Patterns of cleavage (as per theory syllabus)
5. Regeneration **:**

- Regeneration in *Planaria*
- Regeneration in *Salamander*
- Histological process involved in regeneration

6. Embryonic induction **:**

- Spemann and Manglod's experiment of embryonic induction in *Triturus*
- Curtis' experiment of embryonic induction in *Xenopus*

7. Types of cell growth.
8. Types of placenta in mammals (histological).

6. *CHICK EMBRYOLOGY* :

1. *Study by charts/ppt of* **:**
   – Blastula and Gastrula stage of chick embryo
2. *Study & preparation of permanant slides of* W.M. of 21, 33, 48 & 72 hrs. old chick embryos

Semester VI
Course Code: ZO 6501
(ECOLOGY, POLLUTION, ANIMAL DIVERSITY (chordates), MOL. BIOL. & GENETICS)
No. of Credits: 04
Learning Hours: 60 hrs

Unit I *ECOLOGY* :
A) *Adaptations* **:**

Arboreal, Cursorial, Volant, Desert and Deep-sea.

B) *Marine Ecosystem* **:**

1. Physico-chemical aspects of Marine Environment **:** Light, Temperature, Pressure, Salinity, Currents and Tides.
2. Zonations in Marine Environment/Sea.
3. Biodiversity in Rocky shore and Sandy shore.

C) *Fresh water ecosystem* **:**

a) Characteristics **:** Salinity, pH, Water current, Transparency, O_2, CO_2, Pressure, Density, Light, Temperature and Thermal stratification (Summer & Winter stratifications).

b) Lentic system - Ponds **:** Characteristics, Types, Zonations, Flora and Fauna.
Lakes **:** Characteristics, Types.

c) Lotic system - Rivers **:** Characteristics (Current, Land-water interchange, O_2)
Zonations (Flowing-water, Rapid/Riffle, Pool zones)
Types of river-beds (Eroding, Depositing, Sandy).

D) *Terrestrial ecosystems* (Biomes) **:** Tundra, Savanna, Grassland, Taiga, Desert and Tropical Rain Forest and Temperate Forest.

E) *Ecological Succession* **:**

- Kinds of Succession
- Process of succession
- Patterns of succession (Hydrosere, Xerosere)
- Monoclimax & Polyclimax theories of Ecological Succession.

***Reference Books for* Unit I :**

1. **Fundamentals of Ecology**, P. S. Odum, Saunders.
2. **Concepts of Ecology**, N. Arumugam, Saras Publication, Nagercoil.
3. **Ecology and Environment**, P. D. Sharma, Rastogi Publications, Meerut.
4. **Ecology**, Ricklefs. W. H. Freeman.
5. **Concepts of Ecology**, 4th Edition, E. J. Kormondy, Prentice-Hall of India.

<u>Unit II</u> *POLLUTION* :

A) Various pollutants & their effects on animal life (***maximum 6-8 sentences for each pollutant***) **:**

1. Air pollutants :

a) Gaseous - CO, SO_2, NO_2.
b) Particulate - Dust, Lead, Aerosol.

2. Water pollutants :

Biological organisms (bacteria & protozoa), acids, alkalies, dyes, hydrogen sulphide, pesticides, fertilizers, toxic metals (Fluoride, Hg, Arsenic), faeces, domestic wastes, and suspended matters.

3. Soil/Land Pollutants :

a) Industrial solid wastes - Toxic metals like Cu, Pb, Ni.
b) Urban wastes - Garbage, paper, glasses, metal cans, plastics, faeces.
c) Agricultural sources - Wastes from cattle sheds & poultry farms, fertilizers, pesticides and fumigants.

4. Radioactive Pollution
5. Noise Pollution

B) Biological Treatment of Effluents **:**

1. Trickling filters system
2. Stabilization Ponds.
3. Aerated lagoons.

***Reference Book for* Unit II :**

1. **Environmental Pollution (Popular Science)** , N. Manivasakan, National Book Trust, New Delhi.
2. **Ecology and Environment**, P. D. Sharma, Rastogi Publications, Meerut.

<u>UNIT III</u> *ANIMAL DIVERSITY* (Chordates) – *Type Study* & *General topics* :

A) General structure and morphology with functional anatomy of the following animal **:**

Mammalia **:** Type **- Rat** (*Rattus rattus*) - External characters, Digestive system, Respiratory system, Heart, Arterial & Venous systems, Brain, Excretory System and Reproductive systems.

B) General topics **:**

1) Types of beaks and feet in birds
2) Basics of birding
3) V.S. of mammalian skin

Derivatives of mammalian skin (Claw, Nail, Hoof, Horn and Hair)

***Reference Books for* Unit III :**

1. **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.

<u>UNIT IV</u> *MOLECULAR BIOLOGY* & *GENETICS* :

A) *Molecular Biology* **:**

1) DNA Replication in Prokaryotes and Eukaryotes
2) DNA Synthesis **:** Basic idea of DNA polymerases, primer DNA, template (*in vitro*) DNA, Proof-reading by polymerases, Continuous & Discontinuous synthesis, DNA ligase, DNA helicases,
   DNA- binding proteins and DNA topoisomerases.
3) Types of DNA **:** A-DNA, B-DNA, Z-DNA
4) Types of RNA **:** m, t, r and sn
5) Protein synthesis (in details)
6) Southern Blotting Technique
7) Northern Blotting Technique
8) Western Blotting Technique
9) Polymerase Chain Reaction (PCR)
10) Sanger's method of DNA Sequencing
11) DNA Fingerprinting

B) *Genetics* **:**

1) Linkage of genes **:** Definition, Types (with examples), Factors affecting linkage.
2) Crossing over **:** Definition, Mechanism, Types (with examples), Factors affecting crossing over, Crossing over in *Drosophila*
3) Chromosome maps

Reference Books for **Unit IV :**

1. **Molecular Cell Biology**, Lodish et. al., Scientific American Books.
2. **Cell Biology**, C. B. Powar, Himalaya Publishing House.
3. **Cytology and Genetics**, P. K. Gupta, S. Chand & Company, Delhi.
4. **Elements of Biotechnology**, P. K. Gupta, S. Chand & Company, Delhi.

Semester VI
Course Code: ZO 6502
(HUMAN PHYSIOLOGY)
No. of Credits: 04
Learning Hours: 60 hrs

Unit I ***HUMAN PHYSIOLOGY – LYMPHATIC SYSTEM*** **:**

1. Brief introduction.
2. Lymphatic vessels.
3. Structure of lymph node.
4. Lymph circulation **:**

- Route, Thoracic duct, Right Lymphatic duct, Maintenance.

5. Lymphatic organs **:**

- Tonsils, Spleen, Thymus gland.

6. Non-Specific Resistance to Disease **:**

- Skin & Mucous Membranes **:**
- Mechanical factors
- Chemical factors
- Antimicrobial substances **:**
- Interferon
- Complement
- Properdin

- Phagocytosis
- Kinds of phagocytes
- Mechanism
- Inflammation
- Fever

7. Functions of the Lymphatic system.

<u>Unit II</u> ***HUMAN PHYSIOLOGY – IMMUNITY*** **:**

1. Brief introduction.
2. Immunity (Specific Resistance to Disease)

- Antigens/Immunogens :
- Definition
- Characteristics
- Major Histocompatible Complex Antigens
- Antibodies/Immunoglobulins **:**
- Definition
- Structure
- Cellular & Humoral Immunity :
- Formation of T cells & B cells
- T cells & Cellular Immunity
- B cells & Humoral Immunity

3. Disorders, Homeostatic Imbalances :

- Hypersensitivity (Allergy)
- Tissue rejection
- Autoimmune diseases
- AIDS
- SCID

4. Types of Immunity :

- Naturally acquired active & passive immunities
- Artificially acquired active & passive immunities

5. Functions of Immunity.

<u>Unit III</u> ***HUMAN PHYSIOLOGY – RESPIRATION*** **and** ***CARDIOLOGY*** **:**

A. ***<u>Respiration</u>*** **<u>:</u>**

1. Exchange of respiratory gases
2. Transport of respiratory gases **:**

a) Oxygen
b) Carbon dioxide

3. Carbon monoxide poisoning
4. Control of respiration **:**

a) Nervous control - Respiratory centre **:** Medullary rythmicity area, pneumotaxic area and apneustic area.
- Regulation of respirator centre activity **:** Cortical influences and Inflation reflex.

b) Chemical stimuli - Hypercapnia
c) Other factors - body temperature, sudden pain, etc.

B. *Cardiology* **:**

1. Origin and Conduction of heart beats
2. Normal cardiac cycle
3. Concept of ECG
4. Factors affecting rate of heart beats **:**

- Autonomic control
- Carotid sinus reflex
- Aortic reflex
- Right heart reflex
- Chemicals
- Temperature
- Emotions
- Sex & Age

Unit IV ***HUMAN PHYSIOLOGY – REPRODUCTION*** **and** ***MUSCLE CONTRACTION*** **:**

A. *Reproduction* **:**

1. Role of male sex hormones in men.
2. Role of female sex hormones in women.
3. Constituents of normal semen.
4. T.S. of uterus
5. Menstrual cycle.
6. Menopause.

B. *Muscle contraction* **:**

1. T.S. of a skeletal muscle
2. Histology of a striated muscle fibre
3. Motor unit, NMJ
4. Mechanism of muscle contraction and relaxation

Reference Books for **Units I, II, III & IV :**

Principles of Anatomy and Physiology, Tortora and Anagnostakos, HarperCollins College Publishers, 4th Edition.

Animal Physiology and Related Biochemistry, H. R. Singh, Shobhan Lal Naginchand & Co. Edu. Pub., Jalandhar.

3. **Textbook of Animal Physiology**, A. K. Berry, Emkay Pub., New Delhi.

Semester VI
Course Code: ZO 6503
(TOXICOLOGY, ANIMAL BIOTECHNOLOGY, ANIMAL BEHAVIOR, MAMMALIAN HISTOLOGY)
No. of Credits: 04
Learning Hours: 60 hrs

Unit I ***TOXICOLOGY*** **:**

1. Brief Introduction. **(*can be asked only as objective questions in Q. 5 only*)**
2. Definitions of Toxicology, Toxicity, Toxicants and Xenobiotics. **(*only for Q. 5*)**

3. Classification of Toxicants **:** Corrosives, Irritants, Neurotics and Cardiac poisons.
4. Types of toxicity **:** Acute, Subacute, Chronic.
5. Toxicity rating chart **(** ***for information only, not to be asked in the exam*****)**.
6. Economic Toxicology **:**

a) Food Toxicology (Major Food Contaminants)
b) Drug Toxicology

7. Areas of Toxicology **(*individual areas should not be asked in the exam*) :**
   Mechanistic, Regulatory, Forensic, Clinical, Environmental, Industrial and Ethnic/Geographical.
   8. Factors affecting Toxicity **:** Size of animal, Age, Sex, Species, Strain, Feed & Feeding, Changes in internal environment, Habitually used drugs, Route & Rate of administration, Environment, Plasma-Protein binding.
   Entry of toxicants into the animal's body **:** Gastro-intestinal route, Skin, Lungs, Parenteral administration.

Reference Books for **Toxicology :**

Fundamentals of Toxicology, Pandey, Shukla and Trivedi, New Central Book Agency (P) Ltd., Kolkata.

Modern Toxicology. Volumes 1-3, P. K.Gupta and D. K. Salunkhe, Metropolitan Book Co. Pvt. Ltd., New Delhi.

<u>Unit II</u> ***ANIMAL BIOTECHNOLOGY*** **:**

1. Advantages and disadvantages of Tissue Culture
2. Substrates on which cells grow and Gas phase for Tissue Culture - in brief.
3. Disaggregation of tissue.
4. Tissue Culture techniques.
5. Organ Culture techniques.
6. Whole Embryo Culture technique.
7. IVF and ET in humans & livestock.
8. Hybridoma technology.

Reference book for **Animal Biotechnology :**

1. **Elements of Biotechnology**, P. K. Gupta, Rastogi Publication, Meerut.
   Culture of Animal Cells-A Manual of Basic Technique, R. Ian Freshney, 5th Ed., A John Wiley & Sons Inc. Pub.

<u>Unit III</u> ***ANIMAL BEHAVIOUR*** **(Ethology) :**

1. Introduction to Ethology **(*not to be asked in the exam*)**
2. Learning **:**

- Definition.
- Types of Learning **:** (a) Imprinting
  (b) Habituation
  (c) Classical conditioning (e.g. Pavlov's expt.)
  (d) Insight learning
  (e) Instinctive learning
  (f) Operant learning (e.g. Skinner's expt.)
  (g) Instrumental conditioning **:**
  - Discrete trials procedures
  - Active avoidance learning

- Escape learning
- Passive avoidance learning

3. Reproductive behavior patterns **:**

- Courtship **:** Introduction, Need of courtship.
  - Courtship signals – e.g. Balloon Fly (*Hilara sartor*)
  - Persuasion & Appeasement – e.g. ♂ Stickleback's zigzag dance, Herring gull.
  - False information – e.g. Scorpion fly (*Hylobittacus apicalis*)
- Concept of Polygamy and Polyandry.

4. Communication in/between bats and moths.
5. Social organization in baboons.

Reference Books for **Animal Behaviour :**

1. **Animal Behaviour**, Mohan P. Arora, Himalaya Publishing House.
2. **Essentials of Behaviour**, P. J. B. Slater, Cambridge Univ. Press.
3. **An Introduction to Animal Behaviour**, Manning, Addition Wesley.

Unit IV *MAMMALIAN HISTOLOGY* :

Histophysiology of the following endocrine glands **:**

1. Hypothalamus (*Histology not needed*)
2. Pituitary
3. Testis
4. Ovary
5. Thyroid
6. Parathyroid
7. Adrenal.

Reference Books for **Histology :**

1. **Principles of Anatomy and Physiology**, Tortora and Grabowski, HarperCollins College Publications.
2. **A Textbook of Animal Histology**, A. K. Berry, Emkay Publications, Delhi.
3. **Bailey's Textbook of Histology**, The Williams & Wilkins Company, Baltimore.

Semester VI
Course Code: ZO 6504
(APPLIED ZOOLOGY)
No. of Credits: 04
Learning Hours: 60 hrs

Unit-I *APICULTURE* :

1. Introduction. **(*Not to be asked in the exams*)**
2. Classification of *Apis*
3. Different species of honey bees
4. Castes in honey bees
5. Structures and functions of each caste of honey bees
6. A typical natural bee hive/honey comb
7. Communication in honey bees
8. Life cycle of honey bee
9. Apiculture - choice of flora
   - choice of bees

10. Apiculture methods **:** Old and Modern methods
11. Honey
12. Beeswax

Unit-II *SERICULTURE* :

1. Introduction **(*Not to be asked in the exams*)**
2. Classification of *Bombyx mori*
3. Introduction to different species of silkworms used for sericulture
4. External features and Life cycle of *Bombyx mori*
5. Sericulture industry **:**
   - Requirements for sericulture
   - Mulberry
   - Rearing of silkworm **:** Grainage management
   - Post-cocoon processing
6. Chemistry and uses of silk

***Reference books for* Units I & II :**

1. **Arthropoda**, R. L. Kotpal, Rastogi Publications, Meerut.

2. **Economic Zoology**, G. S. Shukla and V. B. Upadhyay, Rastogi Publications, Meerut.

3. **Economic and Applied Entomology**, Kumar and Nigam, Emkay Pub., Delhi.

Unit-III *POULTRY SCIENCE* :

1. History **(*Not to be asked in the exams*)**
2. Importance of Poultry Science
3. Different characters to be considered for selection of the perfect poultry birds
4. Poultry breeds (***only external characters, separate breeds should not be asked in exam*) :**
   a) American Breeds (Plymouth rock, New Hampshire)
   b) Mediterranean Breeds (White Leghorn)
   c) English Breeds (Sussex)
   d) Asiatic Breeds (Brahmas)
5. Poultry houses – Necessity, Location, Types of roofs
6. Poultry equipments –Incubators, Waterers, Feeders, Brooders
7. Care of egg-laying hen
8. Gradation & Preservation of eggs
9. Poultry diseases – Symptoms, treatment and prevention of Ranikhet, Pulorium, Ascariasis and Coccidiosis

Unit-IV *FISHERY SCIENCE* :

1. Types of fisheries **:**
   - Capture fisheries
   - Inland fisheries
   - Marine fisheries
2. Fresh-water, brackish water and marine water fisheries of Gujarat

3. Role of fisheries in Indian economy
4. Mariculture with reference to Prawn culture and Pearl culture
5. Fish by-products (*as per practicals syllabus*)
6. Shell fishery (*crustacean and molluscan*)
7. Preservation & Processing of fishes and prawns
8. Fish pathology

***Reference books for* Units III :**

1. **Poultry**, G. C. Banerjee, Oxford & IBH Publishings, New Delhi.

2. **Poultry Science**, N. T. Mehta and M. I. Ghasura, Univ. Granth Nirman Board, Gujarat.

3. **Economic Zoology**, g. S. Shukla and V. B. Upadhyay, Rastogi Publications, Meerut.

***Reference books for* Units IV :**

1. **A Textbook of Fishery Science and Indian Fisheries**, C.B.L. Srivastava, Kitab Mahal, Allahabad.
2. **Fish and Fisheries of India**, V.G. Jhingran, Hindustan Publishing Corp.(India), New Delhi.
3. **Economic Zoology**, g. S. Shukla and V. B. Upadhyay, Rastogi Publications, Meerut.

Semester VI
Course Code: ZO 6401
SUBJECT ELECTIVE COURSE (SEC): (CANCER BIOLOGY, CYTOLOGICAL TECHNIQUES)
No. of Credits: 04
Learning Hours: 60 hrs

***CANCER BIOLOGY* :**

Unit I

1. What is cancer?
2. Types of cancer.
3. Physiological & Morphological characteristics of cancer cells.
4. Possible causes of carcinogenesis **:**

a) Mutation theory.
b) Virus theory.
c) Metabolic theory.
d) Hormonal disturbance theory.
e) Irritation theory.

Unit II

1. Chemical carcinogens.
2. Mechanism by which carcinogens induce cancer.
3. Oncogenic viruses.
4. Retroviruses.

***CYTOLOGICAL TECHNIQUES* (Cytological study of dead cells) :**

Unit III

1. Introduction **(*not to be asked in the exam*)**.
2. Types of slide preparations – W.M., smears, squashes, sections.
3. Fixation & Fixatives **:**

a) Purpose of fixation.
b) Some commonly used chemical fixatives **:**
Acetic acid, Potassium dichromate, Ethanol, Formaldehyde, Osmium tetroxide, Bouin's fixative, Carnoy's fixative.
c) Some specialized chemical fixatives **:**
Dichromate fixatives – Zenker's fluid, Helly's fluid, Heidanhain's fluid.
Chromic acid fixatives – Lo Bianco's fluid.
Mercuric fixatives – Gilson's fluid, Lebrun's fluid.
d) Removal of fixatives – Lugol's solution, Lenoir's fluid, Lithium carbonate.

Unit IV

1. Fixation by Freezing **:**

a) Freeze-Drying method.
b) Freezing-Substitution method.
c) Freeze-Etching method.

2. Dehydration.
3. Embedding.
4. Sectioning by Ordinary microtome, Cryotome, Ultramicrotome.
5. Staining & Stains for light microscopy and electron microscopy.

***Reference books* :**

1. **Cytology**, P. S. Verma & V. K. Agarwal, S. Chand & Company, Delhi.
2. **Cell Biology**, C. B. Power, Himalaya Publishing House.
3. **Handbook of Basic Microtechnique**, Peter Gray, McGraw-Hill Book Company.
4. **Cellular and Molecular Biology**, De Robertis and De Robertis, Saunders Pub.
5. **Essential Cell Biology**, Bruce Alberts, et. al., Garland Pub. Inc., New York.

Semester VI
Course Code: ZO 6505L
(*Based on Theory Paper ZO-6501 to 6504*)
No. of Credits: 04
Learning Hours: 60 hrs

1. ***ECOLOGY* :**

A) *Ecological adaptations of the following animals according to their habitat* **:**

Adaptations		**Animals**
Sedentary & Fixed Animals	**:**	Sponges, Gorgonia
Tubeworms	**:**	Arenicola, Sabella
Planktons	**:**	Daphnia
Nectons	**:**	Fish, Prawn
Benthic	**:**	Solefish, Sting rayfish
Arboreal	**:**	Hyla, Squirrel

Burrowing	**:**	Snake, Hedgehog
Flying	**:**	Bird, Bat

B) *Study by charts of* **:**

1. Biomes (Tundra, Savanna, Grassland, Tropical Rain Forest, Tiaga and Desert)
2. Summer & Winter Thermal stratifications in Fresh water ecosystem.

2. ***POLLUTION*** **:**

Estimation of **(***in water samples***) :**

Titrimetric – Acidity, Alkalinity, Calcium hardness (using Murexide indicator), Total Hardness (using Eriochrome Black T indicator), Ca^{++} and Mg^{++}

2. Colorimetric – Phosphate

3. ***ANIMAL DIVERSITY*** **(Chordates) :**

Study by charts/specimens/models/ppt of **:**

1. Sympathetic nervous system of frog.
2. V.S. of mammalian skin.
   Derivatives of mammalian skin (Claw, Nail, Hoof, Horn and Hair)

4. ***ANIMAL DIVERSITY*** **(Chordates) :** Basics of birding

5. ***ANIMAL DIVERSITY*** **(Chordates) :**

A) *Study of shark by charts/specimens/models/ppt of* **:**

1. The V, VII, IX, X cranial nerves.
2. Membranous labyrinth.

B) *Study of rat by charts/specimens/models/ppt of* **:**

1. External characters.
2. Digestive, Arterial, Venous, Respiratory & Urinogenital systems and Brain.
3. Striated muscle fibres and Medullated nerve fibres.

6. ***MOLECULAR BIOLOGY & GENETICS*** **:**

A) Study by charts of **:**

- DNA replication in Prokaryotes and Eukaryotes
- DNA synthesis (*in vitro*)
- Types of DNA
- Types of RNA
- Protein synthesis
- Southern blotting
- Thermocycler
- DNA fingerprinting

B) Genetic Problems 1 to 5 (see **APPENDIX**)

GENETICS PROBLEMS

1. *HUMAN PHYSIOLOGY* – Immunity :

Study by charts/ppt of **:**

1. Lymphatic circulatory system in humans
2. T.S. through a lymph node
3. T.S. through spleen
4. T.S. through thymus
5. Structure of a typical antibody
6. IgG, IgA, IgM, IgD, IgE

2. *HUMAN PHYSIOLOGY* – Blood :

1. Estimation of Hb in your own blood
2. Preparation of Haemin crystals from your own blood
3. Preparation of your own blood smear to identify different WBCs. (Stain with Geimsa stain only)
4. Total RBC count in your own blood
5. Total WBC count in your own blood
6. Determination of your own bleeding time
7. Determination of your own blood clotting time

3. *HUMAN PHYSIOLOGY* - Respiration :

Study by charts/ppt of **:**

1. Respiratory muscles
2. Alveolar-capillary (respiratory) membrane
3. Exchange of the respiratory gases
4. Oxygen-haemoglobin dissociation curve

2. *HUMAN PHYSIOLOGY* – Cardiology :

Study by charts/ppt of **:**

1. Origin & conduction of heart beats.
2. Normal ECG.

4. *HUMAN PHYSIOLOGY* – Reproduction :

Study by charts/ppt of **:**

1. T.S. of uterus.
2. Menstrual cycle.
3. Molecular structures of Testosterone, Estrogen and Progesterone.

5. *HUMAN PHYSIOLOGY* – Muscle contraction :

Study by charts/ppt of **:**

1. T. S. of muscle.

2. Ultrastructure of sarcomere.
3. Ultrastructure of Neuro-muscular junction.

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1. *HISTOTECHNOLOGY* :

1. Study of microtome
2. Method of staining for preparation of permanant slides

2. *MAMMALIAN HISTOLOGY* :

Identification & histological study of the following organs by permanant slides/charts/ppt of **:**
T.S. of Testis, Ovary, Thyroid, Parathyroid, Adrenal, V.S. of Pituitary

3. *TOXICOLOGY* :
Study by chart/ppts of **:**
LD_{50} test

4. *ANIMAL BIOTECHNOLOGY* :
Study by chart/ppts of **:**
1. Classical organ culture technique
2. Trowel's type II culture chamber
3. Hybridoma technology

5. *ANIMAL BEHAVIOUR* (Ethology) :
Study by charts/ppt of **:**
1. Pavlov's experiment
2. Skinner's experiment
3. Insight learning
4. Communication in/between bats & moths
5. Social organization in Baboons
6. Reproductive behavior patterns **:**
   a. Courtship signals – e.g. Balloon Fly (*Hilara sartor*)
   b. Persuasion & Appeasement – e.g. ♂ Stickleback's zigzag dance, Herring gull.
   c. False information – e.g. Scorpion fly (*Hylobittacus apicalis*)

6. *ANIMAL BEHAVIOUR* (Ethology) :
Study of human habituation by playing cards.

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1. *APICULTURE* :

Study by charts/ppt **:**

1. Castes in honey bee
2. A typical natural bee hive/honey comb
3. A typical artificial/movable bee hive
4. Round dance of honey bees
5. Waggle dance of honey bees

6. Life cycle of honey bees
7. Nutritional & medicinal value of honey

2. *SERICULTURE* :

Study by charts/ppt **:**

1. Life cycle of *Bombyx mori*
2. Chemistry of silk
3. Uses of silk

3. *POULTRY SCIENCE* :

Study by charts/specimens/ppt **:**

1. Different breeds of poultry birds **(*as per theory syllabus*)**
2. Types of incubators **(**Hot-air Flat type, Mammoth**)**
3. Types of feeders **(**Linear with rod, Linear with openings, Linear with wire grill-top, Hanging**)**
4. Types of waterers **(**Earthen bowl, Simple water fountain, Water trough**)**
5. Types of brooders **(**Kerosene, Electric)
6. Types of roofs **(**Shed type, Unequal double slanted, "A" shaped, Semi-Monitor type, Monitor type**)**
7. Visit to a poultry farm for knowledge of selection of site for the poultry farm, different breeds of poultry birds, poultry feeding & watering, Incubation, brooding and houses.

4. *FISHERY SCIENCE* :

1. Fish by-products **(**Conch, Cowry, Pearl oyster, Edible oyster, Isin glass, Fish glue, Fish meal, Fish flour, Fish selage, Fish fertilizer, Fish skin,

   Body oil, Liver oil**)**
2. Visit to any fresh water/ marine fisheries centre for the knowledge of induced breeding, preservation/processing of fishes, by-products and mariculture.