ST. XAVIER'S COLLEGE (AUTONOMOUS)

AHMEDABAD

CHOICE BASED CREDIT SYSTEM

ZOOLOGY SYLLABUS

(Semester I and II)

B.Sc. ZOOLOGY

PROGRAMME SPECIFIC OUTCOMES

PSO1	Build a reliable foundation of all allied subjects of Zoology, besides pure Zoology itself.
PSO2	Link Zoology to various fields in real life, viz., Parasitology, Entomology, Fisheries, etc.
PSO3	Student will be able to recognize and appreciate the plethora of fields into which he/she can progress onto, after graduation, viz., Biochemistry, Biotechnology, Bioinformatics, Toxicology, Food & Nutrition, Agriculture, Ethology, Parasitology, Environmental Science, Wildlife, Fisheries, Entomology, etc.
PSO4	With the fundamental knowledge of applied Zoology subjects like Poultry Science, Sericulture, Apiculture, Fishery Science, Wildlife, etc., a zoology student can develop a STARTUP of their own.
PSO5	Create employability, skill development and entrepreneurship.

ST. XAVIER'S COLLEGE (AUTONOMOUS)

AHMEDABAD

Choice based credit system

ZOOLOGY SYLLABUS

(Semesters I and II)

(EFFECTIVE FROM JUNE 2018)

ST. XAVIER'S COLLEGE (AUTONOMOUS), AHMEDABAD
Semester-1 B.Sc.
ZOOLOGY SYLLABUS
(effective from June 2018)

The syllabus is to be completed by assigning FOUR hours each,
for Theory Paper as-well-as Practical Paper, per week.

Pattern of Examination:
Theory (Ext. 70 marks & Int. 30 marks)
Practicals (Ext. 70 marks & Int. 30 marks)

Examination	Duration	External Marks	Internal Marks	Total Marks
Theory-Paper ZO 1501 **(** Basics of Zoology - I **)**	3 hours	70	30	100
Theory (Total)		70	30	100
Practical-Paper ZO 1502L **(** Basics of Zoology Practicals - I **)** **(** Based on Theory Paper – ZO 1501 **)**	5 hours	70	30	100
Practicals (Total)		70	30	100

INSTRUCTIONS

1. The theory question paper comprises of FIVE QUESTIONS. All questions carry equal marks, i.e. 14 marks (hence, 14 x 5 = 70) in the final examinations.
2. In order to be qualified to appear in the Final Practical Examination, the student must submit his/her duly certified journal during the examination.

ST. XAVIER'S COLLEGE (AUTONOMOUS), AHMEDABAD
B.Sc. Zoology, Semester-1
Choice Based Credit System (CBCS)
PAPER – ZO 1501 (Theory)

BASICS OF ZOOLOGY - I
(HUMAN PHYSIOLOGY, ANIMAL DIVERSITY (nonchordates), CYTOLOGY, GENETICS, ANIMAL BIOTECHNOLOGY)

No. of Credits: 04

Learning Hours: 60 hrs

COURSE OUTCOME (CO)

On Completion of this course, the Student will be able to-

CO1 understand human urinary system

CO2 understand single celled animals and their habits with special emphasis on *Amoeba*

CO3 grasp the basics of CYTOLOGY, starting with the most basic instruments like Light Microscopes, the fundamental structure of a typical Animal cell, diversity in animal cells and a couple of important organelles

CO4 study structure of gene and related terminology

CO5 understand basic principles of genetics and its deviations

Unit I ***HUMAN PHYSIOLOGY – THE URINARY SYSTEM*** **:**

A) Introduction

B) *Anatomy* **:**
1. V. S. of a kidney

C) *The Nephron* **:**
1. Ultrastructure of a nephron.
2. Juxtaglomerular apparatus.

D) *Renal Physiology* **:**
1. Physiology of urine formation **:**
   a) Glomerular filtration/Ultrafiltration
   b) Tubular reabsorption
   c) Tubular secretion
2. Counter-current Multiplier Mechanism.
3. Physical characteristics of normal urine:
   a) Volume
   b) Appearance
   c) Turbidity
   d) Odour
   e) pH
   f) Specific gravity
4. Chemical composition of normal urine (***maxi. 5-6 sentences each***) :
   a) Water
   b) Electrolytes
   c) Urea
   d) Uric acid
   e) Creatinine
5. Physical characteristics of abnormal urine (***maxi. 5-6 sentences each***) :
   a) Appearance
   b) Odour
   c) Specific gravity
   d) pH
   e) Blood and tissue cells
   f) Casts

6. Abnormal constituents of urine (***maxi. 5-6 sentences each***) :
   a) Protein
   b) Carbohydrates
   c) Fat
   d) Ketone bodies
   e) RBC and WBC
   f) Bilirubin
   g) Urobilinogen
   h) Acetone
   i) Pus
   j) Urinary calculi
   k) Microbes

Reference books for Unit I :

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.

<u>Unit II</u> ***ANIMAL DIVERSITY*** **(Nonchordates) –** ***Type study*** **&** ***General topics*** **:**

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

Protozoa **:** Type – ***Amoeba proteus*** **:** Systematic position, Habits & Habitat, Structure, Locomotion, Nutrition, Reproduction.

B) 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)

Reference books for Unit II :

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

<u>Unit III</u> ***CYTOLOGY*** **:**

A) <u>*Microscopes*</u> **:**

Structure & working of the following student's light microscopes **:**

- Simple light microscope.
- Monocular Compound light microscope.

B) (*i*) Diversity in Eukaryotic cell - shape & size.

(*ii*) Ultrastructure of a typical animal cell.

C) <u>*Nucleus*</u> **:**

- Introduction, Occurrence and position
- Ultrastructure and general functions.

D) <u>*Endoplasmic Reticulum*</u> (ER) **:**

- Introduction and Occurrence.
- Morphology (Cisternae, Vesicles, Tubules).
- Types of ER (rough and smooth).
- General functions.

Reference books for Unit III :

1. Cytology, P. S. Verma, S. Chand & Co. Ltd., New Delhi.
2. Cell Biology, C. B. Powar, Himalaya Pub. House.
3. Cell and Mol. Biol., E.D.P. DeRobertis and E.M.F. DeRobertis, Holt-Saunders, Japan.

<u>Unit IV</u> ***GENETICS* and *ANIMAL BIOTECHNOLOGY* :**

A) *<u>Genetics</u>* **:**

1. Brief introduction to Gene. (***can be asked only as objective questions in Q. 5 only***)
2. Mendelism & Laws of Heredity.
3. Incomplete Dominance (e.g. Andalusian fowl, *Mirabilis jalapa*)
4. Co-dominance (e.g. Roan cattle)
5. Multiple alleles (e.g. ABO blood groups in humans, Coat colour in rabbit)
6. Polygenic inheritance (e.g. skin colour in humans)
7. Lethal genes (e.g. Yellow colour coat in mice, Thalassemia)

Reference books for Genetics :

1. Genetics, P. K. Gupta, Rastogi Publications, Meerut.
2. Genetics, V. B. Rastogi, Kedarnath Ramnath, Meerut.
3. Genetics Vol. 1, C. B. Powar, Himalaya Pub. House.

B) *<u>Animal Biotechnology</u>* **:**

1. Introduction & definition.
2. Some essential equipments for setting up a tissue culture laboratory **:**
   a) Glasswares/Plasticwares – Test tubes, Flasks, Bottles, Pipettes, Petri dishes, etc..
   b) Autoclaves
   c) pH meter.
   d) Incubator
   e) Laminar airflow hood
   f) Waterbath

Reference books for Animal Biotechnology :

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

ST. XAVIER'S COLLEGE (AUTONOMOUS), AHMEDABAD
B.Sc. Zoology, Semester-1
Choice Based Credit System (CBCS)
PAPER – ZO 1502L (Practical)
Effective from June-2018

No. of Credits: 02

COURSE OUTCOME (CO)

On Completion of this course, the Student will be able to-

CO1 learn urine analysis by performing biochemical tests

CO2 learn amoeba's anatomy and its habits so as to get general idea of protozoans

CO3 Whatever the students have learnt about CYTOLOGY in theory, they will understand the same practically

CO4 understand pattern of inheritance different from Mendelism

CO5 apply knowledge of genetics in problem solving

CO6 study animal tissue culture laboratory instruments

.

1. ***HUMAN URINE ANALYSIS*** **:**

A) *Physical analysis* **:**
Colour appearance, odour, deposits if any.

B) *Chemical analysis* **:**
a) Detection of abnormal constituents in urine **:**
Sugar, Proteins, Bile salts.
b) Determination of **:**
pH, specific gravity, Ketones (Rothera's test), Urea (using soyabean powder) and Creatinine (Jaffe's test).

C) *Microscopic analysis* **:**
Detection of presence of**:**
Pus cells, RBC, Bacteria.

2. ***HUMAN URINARY SYSTEM*** **:**
Study by permanant slides/charts of **:**
a) V.S. of kidney.
b) Renal corpuscle.
c) T.S. through Juxtaglomerular apparatus.
d) Countercurrent multiplier mechanism.

3. ***AMOEBA*** **:**
Study by permanant slides/charts of **:**
a) W.M. of *Amoeba*
b) Binary fission

4. ***NONCHORDATES*** **:**
Study by charts of **:**
Protozoa **:** Modes of asexual reproduction (as per theory syllabus)
Porifera **:** Modes of asexual reproduction (as per theory syllabus)

5. ***CYTOLOGY*** **:**
Study of by charts/models of **:**
a) Simple light microscope and Monocular Compound light microscope.
b) Diversity in eukaryotic cell-shape & size.
c) Ultrastructure of **:**

- Typical animal cell
- Nucleus
- Endoplasmic Reticulum

6. ***GENETICS*** **:**

A) *Study by charts of* **:**

a) Monohybrid cross
b) Dihybrid cross
c) Incomplete Dominance (e.g. Andalusian fowl, *Mirabilis jalapa*)
d) Co-dominance (e.g. Roan cattle)
e) Multiple alleles (e.g. ABO blood groups in humans, Coat colour in rabbit)
f) Polygenic inheritance (e.g. skin colour in humans)
g) Lethal genes (e.g. Yellow colour coat in mice, Thalassemia)

B) *Study of genetic problems* (as per APPENDIX)

7. ***ANIMAL BIOTECHNOLOGY*** **:**

a) Autoclave.
b) Calibration of pH meter **(*only demonstration*)**
c) Determination of pH of various types of samples using pH paper strips.
d) Incubators
e) Laminar airflow hood
f) Waterbath

==========

APPENDIX for PAPER – ZO 1502L
(GENETIC PROBLEMS)

1. Red fruit colour (R) is dominant over yellow colour (r) and tallness (T) is dominant over shortness (t) in plants. What phenotypic ratio & genotypes would result if one of the plants is red homozygous - tall homozygous and other is red heterozygous - tall heterozygous?

Solution :

Phenotypic ratio = All equal
Genotypes = RRTT, RRTt, RrTT, RrTt.

2. In rabbits, black skin (B) is dominant over brown skin (b) and short hair (S) is dominant over long hair (s). If homozygous black-short haired male is crossed with a homozygous brown-long haired female, what will be the genotypes and phenotypes of F_1 and F_2 offsprings if F_1 is self fertilised?

Solution :

F_1 = BbSs = all black-short haired
F_2 = 9:3:3:1

3. In four o'clock plants, red colour of flowers (R) is incompletely dominant over white (r). The F_1 is having pink flower colour(Rr). What will be the phenotypes of the offsprings in a cross between plants having red flowers and pink flowers?

Solution :

Red : Pink = 1:1

4. 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 cows are expected in the offsprings of any one group of cows?

Solution :

Roan bull X Roan cow = 1 red : 2 roan : 1 white
Roan bull X Red cow = 1 red : 1 roan
Roan bull X White cow = 1 roan : 1 white

5. A couple preparing for marriage both have blood group AB. 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 :

Blood group of children can be A, AB or B.

6. A man has blood group A and his wife has blood group B. They have four children, all having different blood groups i.e. A, B, AB and O. Is it possible? How?

Solution :

Yes, it is possible. Heterozygous parents.

7. In man, the difference in skin colour between whites and negroes is due to two pairs of factors, AABB is "black" and aabb is "white". Any three of the colour producing factors produce dark skin, any two medium and any one light colour. What will be the skin colour of the offspring from a mating of white with black and from a mating of two F_1 individuals?

Solution :

Parents genotype = aabb X AABB
F_1 offspring skin colour = medium
F_2 = 1:4:6:4:1 (black:dark:medium:light:white)

ST. XAVIER'S COLLEGE (AUTONOMOUS), AHMEDABAD
B.Sc. Zoology, Semester-2
Choice Based Credit System (CBCS)
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

COURSE OUTCOME (CO)

On Completion of this course, the Student will be able to-

CO1 study the structure and functions of blood

CO2 have profound knowledge of organic evolution as they will understand the process of origin of life and how variations and mutations are operated by natural selections.

CO3 have profound knowledge and understanding of Hydra as an animal type.

CO4 Continuing from what they have grasped about the basics of CYTOLOGY during their Sem-1, the students will progress further by studying some more advanced instruments like TEM, SEM and Centrifuges alongwith some more organelles like Ribosomes, Mitochondria and Golgi complex.

CO5 study Human genetics

CO6 understand Non-allelic gene interaction

CO7 understand applications of animal biotechnology

CO8 Knowledge of requirements for animal tissue culture

Unit I ***HUMAN BLOOD PHYSIOLOGY*:**

A) Composition of blood**:**

1.Blood Plasma - Water
- Dissolved solids **:**Blood proteins, Supplies for the cells, Cellular products, Cellular waste-products.
- Dissolved gases.

2.Blood cells -

a) RBC
- Structure, Total count, Functions
- Haemoglobin
- Effect of isotonic, hypotonic and hypertonic solutions.
- Development & Life history
- Factors affecting Erythropoiesis.
- Anaemia**:**
- General symptoms.
- Types**:** Nutritional, Pernicious, Haemorrhagic, Haemolytic, Aplastic and Sickle-cell

b) WBC - Structure, Total count, Functions
- Classification
- Development & Life history
- A very brief concept of Leukaemia

c) Platelets - Structure, Total count, Functions
- Development & Life history

B) Blood coagulation**:**

1. Brief introduction and significance
2. Factors involved in blood clotting.
3. Intrinsic & Extrinsic pathways of blood coagulation
4. Haemophilia
5. Basic concept of Intravascular blood clotting.

C) Blood grouping/typing**:**

– Classification of blood groups **:**
- ABO grouping system
- Rh system

Unit II (A) ***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**:**

a) Introduction
b) Origin of Life :
- Chemical evolution & Spontaneous origin of life
- Oparin's theory of Coacervate droplets
- Miller's experiment
- Protenoid microspheres
- 'RNA world' hypothesis

c) Theories of Organic Evolution:
- Lamarckism
- Darwinism

d) Natural Selection and its types:
- Stabilizing selection
- Directional selection
- Disruptive selection

Unit III ***CYTOLOGY*** **:**

A) Structure & working of the TEM & SEM.

B) *Centrifugation* **:**

– Introduction.
– Low speed centrifugation.
– Ultracentrifugation.

C) *Eukaryotic Ribosomes* **:**

– Introduction and Occurrence
– Types of Ribosomes (70S, 80S)
– Structure, Ultrastructure and general functions.

D) *Mitochondria* **:**

– Introduction and Occurrence
– Morphology - Shape, Size, Number
– Ultrastructure and general functions.
– Mitochondrial DNA, Mitochondrial Ribosome

E) *Golgi complex* **:**

- Introduction and Occurrence
- Morphology/Ultrastructure and general functions.

Unit IV*GENETICS* and*ANIMAL BIOTECHNOLOGY*:

A) *Genetics* **:**

1. Complementary genes (e.g. Pea plant – Purple & White flowers)
2. Epistasis – Dominant (e.g. Dog)
   – Recessive (e.g. Mice)
3. Sex-linked inheritance **:**
   - X-linked (dominant) e.g. enamel of tooth)
   - X-linked (recessive) (e.g. colour blindness in man, haemophilia in man, eye-colour in *Drosophila*)
   - Y-linked (Holandric genes) (e.g. Hypertrichosis)
   - XY-linked inheritance
   - Completely and incompletely sex-linked inheritance
4. Sex-influenced inheritance **:**
   - Baldness in man

B) *Animal Biotechnology* **:**

1. Fields/Applications of Animal Biotechnology.
2. Some important requirements for cell & tissue culture (***maxi. 5-7 sentences each***) **:**
   a) pH
   b) CO_2 and Bicarbonate
   c) Buffer
   d) O_2
   e) Temperature
   f) Balanced Salt Solution (BSS)
   g) Antibiotics
   h) Serum
   i) Gas phase
   j) Media (Natural/Defined, Liquid/Solid)

ST. XAVIER'S COLLEGE (AUTONOMOUS), AHMEDABAD
B.Sc. Zoology, Semester-2
Choice Based Credit System (CBCS)
PAPER – ZO 2502L (Practical)
Effective from June-2018

No. of Credits: 02

COURSE OUTCOME (CO)

On Completion of this course, the Student will be able to-

CO1 learn practical aspects of haematology

CO2 have profound knowledge of organic evolution as they will understand the process of origin of life and how variations and mutations are operated by natural selections.

CO3 practically understand various structural details of *Hydra* by observing it and its different parts under microscope.

CO4 Whatever the students have learnt about CYTOLOGY in theory, they will understand the same practically.

CO5 understand pattern of inheritance different from Mendelism

CO6 apply knowledge of genetics in problem solving

CO7 study laboratory set up of animal tissue culture laboratory

1. *HUMAN BLOOD PHYSIOLY:*

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

2. *HYDRA*:

Study by permanant 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)

APPENDIX for PAPER – ZO 2502L

(GENETIC PROBLEMS)

1. Two white flowered varieties of pea plants when crossed produced purple flowered F_1 plants. Selfing of F_1 plants produced 112 progeny, 62 plants with purple flower and 50 with white flowers.
a) What type of interaction is involved?
b) Give a phenotype ratio approximated by the F_2 progeny.
Solution :
a) Complementary gene action
b) 9:7 ratio

2. When dogs from a true breeding brown coatline were mated to dogs from a true breeding white coatline, all the F_1 progeny were white coat colour. Male and female mating of F_1 progeny produced F_2 progeny in the ratio of 130 white : 35 black : 11 brown. Explain these results.
Solution :
130:35:11 = 12:3:1 Dominant epistasis

3. Mating between two agouti guinea pigs of the same genotype produced offsprings in the ratio of 45 agouti : 15 black : 19 albino.
a) Give the approximate phenotype ratio of these offsprings.
b) Give the type of interaction between the non-allelic genes responsible for the ratio calculated in (a).
c) Give the genotype of the parents and offsprings.
Solution :
a) 9:3:4
b) Supplementary gene interaction, recessive epistasis
c) CcAa CcAa

4. From a marriage, all the daughters are normal sighted whereas all the sons are colourblind.
a) Give the genotype of the parents.
b) If both the parents were colourblind, can they give rise to normal children?
Solution :
a) Genotype of parents **:** Mother = XcXc (colourblind)
Father = XY (normal)
b) If both are colourblind, they cannot give rise to normal children.

5. Early baldness in man is due to an autosomal gene and is dominant in males. The homozygous recessive results in late baldness or non-baldness. If the heterozygous persons marry and beget children,
a) What are the phenotypes of the male and female children?
b) What will be the phenotype ratio among the male children?
c) What will be the phenotype ratio among the female children?
Solution :
a) Bb Bb
b) Male children = Bald : Normal = 3:1
c) Female children = Bald : Normal = 1:3

----------x----------

ST. XAVIER'S COLLEGE AUTONOMOUS)

AHMEDABAD

Choice based credit system

ZOOLOGY SYLLABUS

(Semesters III and IV)

ST. XAVIER'S COLLEGE (AUTONOMOUS)
GUJARAT UNIVERSITY
3rd Semester B.Sc.
ZOOLOGY
(Effective from June 2019)

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

Examination	Duration	External Marks	Internal Marks	Total Marks
Theory-Paper ZO-3501 (Animal diversity (nonchordates) and Genetics & Animal biotechnology)	3 hours	70	30	100
Theory-Paper ZO-3502 (Animal diversity (chordates), Cytology and Human Histology)	3 hours	70	30	100
Theory (Total)		140	60	200
Practical-Paper ZO-3503L (A) (Based on Theory Paper ZO-3501)		35	15	50
Practical-Paper ZO-3503L (B) (Based on Theory Paper ZO-3502)		35	15	50
Practicals (Total)		70	30	100

INSTRUCTIONS

1. Each theory question paper comprises of FIVE QUESTIONS. Each QUESTION carries equal marks, i.e. 14 marks (hence, 14 x 5 = 70 marks) in the Final/End-Sem Examinations.
2. In order to be qualified to appear in the Final/End-Sem Practicals Examination, the student must submit his/her duly certified journal during the examination.

ST. XAVIER'S COLLEGE (AUTONOMOUS), AHMEDABAD
B.Sc. Zoology, Semester-3
Choice Based Credit System (CBCS)
PAPER – ZO 3501 (Theory)
(ANIMAL DIVERSITY (Nonchordates) and GENETICS & ANIMAL BIOTECHNOLOGY)

No. of Credits: 04

Learning Hours: 60 hrs

COURSE OUTCOME (CO)

On Completion of this course, the Student will be able to-

CO1 understand ancient as well as modern trends of Invertebrate classification by which they could distinguish and compare different characters across various Invertebrate taxa.

CO2 understand characteristics of invertebrate animals as well as their affinities with one another.

CO3 imbibe anatomy of earthworm and will have general idea of annelids

CO4 study human chromosomal aberrations and related abnormalities

CO5 gain knowledge of extranuclear inheritance

CO6 be introduced to modern methods of tissue preservation

CO7 know advantages and disadvantages of animal tissue culture

Unit I ANIMAL *DIVERSITY* (Nonchordates):

A. Brief history and significance of classification
B. Five kingdom classification by R. H. Whittaker (1969)
C. Three-domain system by Carl Woese (1977)
D. Outline classification of Invertebrates
E. Salient features and Classification of Invertebrates, starting from Kingdom up to Classes, giving reasons & suitable examples (***as per practical syllabus***):

Phylum**:**

1) Protozoa
2) Porifera
3) Coelenterata
4) Platyhelminthes
5) Nematoda

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

Salient features and Classification of Invertebrates, starting from Kingdom up to Classes, giving reasons & suitable examples (***as per practical syllabus***):

Phylum**:**

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

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

<u>Unit III</u> 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.

<u>Unit IV</u> ***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. Elements 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.

ST. XAVIER'S COLLEGE (AUTONOMOUS), AHMEDABAD
B.Sc. Zoology, Semester-3
Choice Based Credit System (CBCS)
PAPER – ZO 3502 (Theory)

(ANIMAL DIVERSITY (chordates), CYTOLOGY and HUMAN HISTOLOGY)

No. of Credits: 04

Learning Hours: 60 hrs

COURSE OUTCOME (CO)

On Completion of this course, the Student will be able to-

CO1 describe general taxonomic rules on animal classification.

CO2 classify phylum Protochordates to Mammalia

CO3 understand the distribution of fauna

CO4 differentiate between nonchordates and chordates

CO5 distinguish between venomous and nonvenomous snakes

CO6 understand anatomy of cartilagenous fishes (Shark)

CO7 further enhance their understanding of CYTOLOGY.

CO8 study structure of human lung, bone and cartilage

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

A. Outline classification of Chordates
B. 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, Brain and 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 and General functions
3. Cytoskeleton:
   Microtubules, Microfilaments and Intermediate filaments
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
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
   Pneumocytes, Clara cells and Dust cells

(B) Bone:

1. General organization from external to internal surface.
2. Types of bones:
   Compact bone and 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, Osteocytes, Osteoclasts and Osteoprogenitor cells

(C) Cartilage:

1. Introduction to general functions
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.

ST. XAVIER'S COLLEGE (AUTONOMOUS), AHMEDABAD
B.Sc. Zoology, Semester-3
Choice Based Credit System (CBCS)
PAPER – ZO 3503L (Part A and B) (Practical)
Effective from June-2018

PAPER – ZO 3503L (Part A)

(*Based on Theory Paper ZO-3501*)

No. of Credits: 2.5/2

COURSE OUTCOME (CO)

On Completion of this course, the Student will be able to-

CO1 have profound understanding of invertebrate animals as they will be able to identify and classify representatives animals from Invertebrate phyla.

CO2 study the organ systems of Earthworm

CO3 Whatever they have learnt about CYTOLOGY in theory, the students will understand the same practically.

Co4 study autosomal and sex-chromosomal abnormalities in Human

CO5 comprehend about the basic instrumentation of biotechnology

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

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

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

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

1. Study of external characters.
2. Study of Digestive system, Circulatory system, Reproductive systems and Nervous system.
3. Study of Setae, Septal nephridia, Blood glands, Ovaries and Spermatheca.

Permanent slides of Earthworm:

T.S. passing through pharynx, T.S. passing through gizzard, T.S. passing through typhlosole, L.S. of earthworm

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. *GENETICS*

Study of genetics through charts:

1. Nonepistatic interaction / Collaboration of genes (e.g. Comb shapes in hen)
2. Duplicate genes (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.

PAPER ZO-3503L (B)
(*Based on Theory Paper ZO-3502*)

PAPER – ZO 3503L (Part B)

No. of Credits: 2.5/2

COURSE OUTCOME (CO)

On Completion of this course, the Student will be able to-

CO1 learn how to identify different chordate animals practically

CO2 understand anatomy of a cartilagenous fish (Shark)

CO3 learn histological structure of mammalian lung, bone and cartilage

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 ray fish, Electric ray fish, Sea horse, Flying fish, Sucker fish, *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, Squirrel, Indian hare, Pangolin.

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. ANATPMY OF BIRDS
Types of beaks, Types of feet

5. *HUMAN HISTOLOGY*:
Identification & histological study of the following organs by permanent slides of:
T.S. of Lung, Bone and Cartilage (Hyaline, Elastic, Fibrous)

----------x----------

ST. XAVIER'S COLLEGE (AUTONOMOUS)
GUJARAT UNIVERSITY
4th Semester B.Sc.
ZOOLOGY
(effective from June 2019)

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

Examination	Duration	External Marks	Internal Marks	Total Marks
Theory-Paper ZO-4501 (Animal Biochemistry, Biophysics, Histology and Animal Physiology)	3 hours	70	30	100
Theory-Paper ZO-4502 (Applied Zoology)	3 hours	70	30	100
Theory (Total)		140	60	200
Practical-Paper ZO-4503L (A) (Based on Theory Paper ZO-4501)		35	15	50
Practical-Paper ZO-4503L (B) (Based on Theory Paper ZO-4502)		35	15	50
Practicals (Total)		70	30	100

INSTRUCTIONS

1. Each theory question paper comprises of FIVE QUESTIONS. Each QUESTION carries equal marks, i.e. 14 marks (hence, 14 x 5 = 70 marks) in the Final/End Sem Examinations.
2. In order to be qualified to appear in the Final/End Sem Practical Examination, the student must submit his/her duly certified journal during the examination.

ST. XAVIER'S COLLEGE (AUTONOMOUS), AHMEDABAD
B.Sc. Zoology, Semester-4
Choice Based Credit System (CBCS)
PAPER – ZO 4501 (Theory)
(ANIMAL BIOCHEMISTRY, BIOPHYSICS and ANIMAL PHYSIOLOGY)

No. of Credits: 04

Learning Hours: 60 hrs

COURSE OUTCOME (CO)

On Completion of this course, the Student will be able to-

CO1 get their first exposure to elementary biochemistry by understanding the basics of proteins

CO2 understand applications of basic principles of physics to biological processes: osmosis, adsorption *etc*.

CO3 understand and differentiate histology of mammalian digestive organs

CO4 understand and appreciate mammalian neurophysiology

CO5 gain knowledge of types and structure of Human receptors organs

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:
   Chemical Bonds: a) Primary - Peptide bond
   b) Secondary - Disulfide, Hydrogen, Hydrophobic and Ionic.
5. Protein Configuration:
   a) Primary structure (Amino acid sequence)
   b) Secondary structure (α-helix)
   c) Tertiary structure (Folding of the peptide chain)
   d) Quaternary structure (Protein-protein interactions)
6. Classification of proteins:
   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

8. 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.

<u>Unit II</u> ***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

<u>Unit III</u> ***MAMMALIAN HISTOLOGY*:**

Histology and general functions of the following organs **:**
Tongue, Stomach, Small Intestine, Liver, Gall bladder and Pancreas.

<u>Unit IV</u> ***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**:**
   Acetylcholine, Epinephrine, 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.

ST. XAVIER'S COLLEGE (AUTONOMOUS), AHMEDABAD
B.Sc. Zoology, Semester-4
Choice Based Credit System (CBCS)
PAPER – ZO 4502 (Theory)
(APPLIED ZOOLOGY)

No. of Credits: 04

Learning Hours: 60 hrs

COURSE OUTCOME (CO)

On Completion of this course, the Student will be able to-

CO1 understand the economic importance of insect groups and their control

CO2 study fishing Nets and Boats

CO3 identify economically important fishes

CO4 basic knowledge of Home aquarium

CO5 know induced breeding technique in fishes

CO6 understnd the lifecycles and their pathogenicity of some of the most common parasites. This will prepare them to do some research and design ways for their eradication therby increasing the students' scope of employability

Unit I ***APPLIED ENTOMOLOGY*:**

1. Brief introduction and importance of studying Applied Entomology
2. Study of the following pests**:**
   I. Groundnut**:** White grub, Red hairy caterpillar.
   II. Cotton**:** Spotted bollworm, Cotton leaf roller.
   III. Wheat**:** Cut worm.
   IV. Paddy**:** Rice bug
   V. Miscellaneous Pests**:** Rice weevil, Red flour beetle, Pulse beetle
3. Insect-pest Control**:** - control methods
   - Physical controls
   - Mechanical controls
   - Chemical control methods
   - Biological control methods

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.

<u>Unit II</u> ***FISHERY SCIENCE*:**

1. Fisheries development in Gujarat
2. Study of fishing gears**:**

   <u>Nets</u>**:**

   a) Passive netting: Hook & Line gear, Gill nets, Trap nets
   b) Active netting: Trawl nets, Seine nets
   c) Miscellaneous netting: Cast net, Dip net, Bag net

   <u>Boats</u>**:**

   1) Catamaran
   2) Canoes: Dugout canoes, Plank-built canoes, Out rigger canoes
   3) Built-up boats: Machwa, Satpati
   4) Mechanical boat: Trawler
4. Identification & Classification of the following fishes from Kingdom to Family**:**
   Catla, Rohu, Mrigal, Hilsa, Dara, Ghol, Bombay duck, Pomfret and Surmai.
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.
4. Fish and Fisheries. Pandey and Shukla, Rastogi Publication, Meerut.

<u>Unit III</u> ***WILDLIFE of* India:**

1. Introduction to the Protected Areas**:**
   - National Parks, Wildlife Sanctuaries, Conservation reserve, Community reserve, Marine protected area
2. Sites of conservation**:**
   - Tiger reserve
   - Elephant reserve
   - Biosphere reserve
   - Ramsar wetland site
   - Natural world heritage site
   - Important Coastal and marine Biodiversity Areas (ICMBA)
   - Important Bird Areas (IBA)
   - Key Biodiversity Area
   - Biodiversity Heritage Site
3. 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

4. IUCN & Red Data Book

Reference books and weblinks for Unit III:

1. ENVIS Centre on Wildlife & Protected areas.
   http://www.wiienvis.nic.in/Database/Protected_Area_854.aspx
2. IUCN. i) https://www.iucn.org/about ii) https://www.iucnredlist.org/
3. Indian Wildlife, Srilanka. Nepal, APA Publications.
4. Wildlife of India. Mark E. Trisch, Harper Collins Pub.
5. Threatened Animals of India. B. K. Tikader, ZSI, Calcutta.

Unit IV ***HUMAN PARASITOLOGY*:**

1. Definitions**:** Parasite, Host and Parasitology.
2. Types of Parasites**:**
   Facultative parasites, Obligate parasites, Endoparasites and Ectoparasites
3. Types of Hosts**:**
   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,

==========

ST. XAVIER'S COLLEGE (AUTONOMOUS), AHMEDABAD
B.Sc. Zoology, Semester-4
Choice Based Credit System (CBCS)
PAPER – ZO 4503L (Part A and B) (Practical)
Effective from June-2019

PAPER – ZO 4503L (Part A)

(***Based on Theory Paper ZO-4501*** **)**

No. of Credits: 2.5/2

COURSE OUTCOME (CO)

On Completion of this course, the Student will be able to-

CO1 confirm whether any given unknown solution contains proteins in it or not by some fundamental qualitative biochemical tests.

CO2 understand applications of basic principles of physics to biological processes: osmosis, adsorption etc. practically.

CO3 understand and differentiate histology of mammalian digestive organs practically.

CO4 understand mechanism of nerve impulse conduction through neurons and synapse

CO5 study receptor organs in Human

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. Study of Epithelio-sensory cells
7. Study of Neuro-sensory cells
8. Study of Thermo-receptors
9. Study of Mechano-receptors

10. Study of Chemo-receptors

11. Study of Photo-receptors

12. Study of the structures of types of neurons**:**
Unipolar, Bipolar, Non-myelinated & Myelinated Multipolar

13. Study of conduction of nerve impulse by charts:
- Propagation in non-myelinated nerve-fibre.
- Propagation in myelinated nerve-fibre.
- Transmission through synapse.

14. Histological study of the following mammalian organs by permanent slides:
Tongue
Stomach
Small intestine
Liver
Pancreas
Gallbladder

PAPER ZO-4503L (B)

(*Based on Theory Paper ZO-4502*)

PAPER – ZO 4503L (Part B)

No. of Credits: 2.5/2

COURSE OUTCOME (CO)

On Completion of this course, the Student will be able to-

CO1 identify insect pests of certain crops and stored food materials

Co2 identify fishes of commercial value practically

CO3 understand structure and operation of fishing Boats and Nets

CO4 learn about some important fauna and sites of conservation

CO5 whatever the students have learn about parasitology in theory, they will understand the same practically

1. *APPLIED ENTOMOLOGY* :

Study of the following 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.
IV. Paddy**:** Rice bug
V. Miscellaneous Pests**:** Rice weevil, Red flour beetle, Pulse beetle

2. *FISHERY SCIENCE* :

1. Study of fishing gears**:**
   - Nets**:** Hook & Line gear, Stringed Cast net, Gill net, Dole net, Drag net, Seine net, Trawl net.
   - Boats**:** Catamaran, Canoes (Dugout canoe, Plank-built canoe, Outrigger canoe), Miscellaneous type (Masula boat, Nauka, Tutikorin boat Machhwa), Trawler.
2. Identification & Classification of the following fishes upto Family **(*as per Dey*) :** Catla, Rohu, Mrigal, Hilsa, Dara, Ghol, Bombay duck, Pomfret and Surmai.
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, along with scientific names**:**

Asiatic lion, Tiger, Leopard, Snow leopard, Blackbuck, Indian Bison, Indian wildass, Indian One-horned Rhino, Great Indian Bustard, Great Indian Hornbill, Peacock, Gangetic dolphin, Indian White-backed vulture, Asian King vulture and Egyptian Vulture.

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*

----------x----------

ST. XAVIER'S COLLEGE AUTONOMOUS)

AHMEDABAD

Choice based credit system

ZOOLOGY SYLLABUS

(Semesters V and VI)

ST. XAVIER'S COLLEGE (Autonomous), AHMEDABAD
ZOOLOGY

ST. XAVIER'S COLLEGE (AUTONOMOUS)

GUJARAT UNIVERSITY

5th Semester B.Sc.

ZOOLOGY

(effective from June 2020)

The syllabus is to be completed by assigning FOUR hours for each Theory Paper/TWO hours for each SEC Paper and a total of TWELVE hours for the Practical Papers, per week.

Examination	Duration	External Marks	Internal Marks	Total Marks
Theory-Paper ZO-5501 (Animal diversity (nonchordates))	3 hours	70	30	100
Theory-Paper ZO-5502 (Animal diversity (chordates))	3 hours	70	30	100
Theory-Paper ZO-5503 (Animal Biochemistry & Metabolism)	3 hours	70	30	100
Theory-Paper ZO-5504 (Cytology, Developmental Biology)	3 hours	70	30	100
SEC Paper ZO-5401	3 hours	70	30	100
Theory (Total)		350	150	500
Practical-Paper ZO-5505L (A-1) (Based on Theory Paper ZO-5501)	5 hours	35	15	50
Practical-Paper ZO-5505L (A-2) (Based on Theory Paper ZO-5502)	5 hours	35	15	50
Practical-Paper ZO-5505L (B-1) (Based on Theory Paper ZO-5503)	5 hours	35	15	50
Practical-Paper ZO-5505L (B-2) (Based on Theory Paper ZO-5504)	5 hours	35	15	50
Practicals (Total)		140	60	200

INSTRUCTIONS

1. Each theory question paper comprises of FIVE QUESTIONS. All questions carry equal marks, i.e.14 marks. (Hence 14 x 5 = 70 marks) in the End-Sem/Final Examinations.
2. In order to be qualified to appear for the Final Practical Examinations, the student must submit his/her duly certified journals during the examinations.

ST. XAVIER'S COLLEGE (AUTONOMOUS), AHMEDABAD

B.Sc. Zoology, Semester-5

Choice Based Credit System (CBCS)

PAPER – ZO 5501 (Theory)

(ANIMAL DIVERSITY (nonchordates))

No. of Credits: 04

Learning Hours: 60 hrs

COURSE OUTCOME (CO)

On Completion of this course, the Student will be able to-

CO1 understand the structural organisation of nonchordates

CO2 learn the anatomical-adptative features in nonchordates

CO3 know key nonchordates of minor phyla with their general characteristics

Unit I ***Animal Type study*****:** *Leucosolenia* and Sheep Liver Fluke

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

Porifera **:** Type – *Leucosolenia* - Classification, Habits & Habitat, External 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 Fluke (*Fasciola hepatica*) – Classification, Habits & Habitat, Ext. characters, Histology of Body Wall, Digestive system, Excretory system, Respiration, Nervous system, Reproductive systems & Reproduction.

Unit II ***Animal Type study*****:** Scorpion and General topics of nonchordates

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.

<u>Unit III</u> ***Animal Type study*:** Cuttlefish and General topics of nonchordates

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 and Excretory organs
2. *Mollusca* **:** Foot (classwise) and Torsion & Detorsion.

<u>Unit IV</u> ***Animal Type study*:** Starfish and General topics of nonchordates

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* **:** Echinodermata larvae
2. *Minor phyla* **:** General characters with suitable examples 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.

ST. XAVIER'S COLLEGE (AUTONOMOUS), AHMEDABAD

B.Sc. Zoology, Semester-5

Choice Based Credit System (CBCS)

PAPER – ZO 5502 (Theory)

(ANIMAL DIVERSITY (chordates))

No. of Credits: 04

Learning Hours: 60 hrs

COURSE OUTCOME (CO)

On Completion of this course, the Student will be able to-

CO1 understand anatomy of bony fishes (*Labeo*)

CO2 understand anatomy of reptiles (*Calotes*)

CO3 understand anatomy of birds (Pigeon)

CO4 know general topics of fishes, amphibia, reptiles, birds and mammals

CO5 Compare internal structure of organs systems of vertebrates and its significance in understanding organic evolution

Unit I ***Animal Type study*****:** *Labeo and General topics of Fishes*

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 Type study*****:** *Calotes and General topics of Amphibians and Reptiles*

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

<u>Unit III</u> ***Animal Type study*****:** *Pigeon and General topics of Aves and Mammals*

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).

<u>Unit IV</u> Comparative anatomy of vertebrates

a) Alimentary canal
b) Heart
c) Aortic arches
d) Venous system
e) Urinogenital system
f) 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.

ST. XAVIER'S COLLEGE (AUTONOMOUS), AHMEDABAD

B.Sc. Zoology, Semester-5

Choice Based Credit System (CBCS)

PAPER – ZO 5503 (Theory)

(ANIMAL BIOCHEMISTRY and METABOLISM)

No. of Credits: 04

Learning Hours: 60 hrs

COURSE OUTCOME (CO)

On Completion of this course, the Student will be able to-

CO1 enhance their knowledge of the remaining major biomolecules viz., Carbohydrates, Lipids and Enzymes.

CO2 understand the significance of the biomolecules and how they interact amongst themselves in a complex biological system and will also realize, to some extent, their day-to-day role in our diet & health.

CO3 understand the metabolism of the biomolecules and the energetics involved.

CO4 have a fundamental idea of Enzymology, without which biochemistry would be incomplete.

CO5 develop an ability to present their work through written, oral and visual presentations and will be prepared to pursue higher education in any biochemistry-related field of studies.

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

1. Asymmetry, Isomers, Optical isomerism and Mutarotation.
2. Introduction, definition and classification of Carbohydrates.
3. **Monosaccharides:**
   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, 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
5. **Properties:**
   a) *Physical* **-** Colour, Odour, Taste, Solubility, Melting point, Specific gravity, Insulation and Emulsification.
   b) *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 e) concentration, f) Substrate concentration

3. Some clinically important enzymes: *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* **:**

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 :

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

ST. XAVIER'S COLLEGE (AUTONOMOUS), AHMEDABAD

B.Sc. Zoology, Semester-5

Choice Based Credit System (CBCS)

PAPER – ZO 5504 (Theory)

(CYTOLOGY, DEVELOPMENTAL BIOLOGY)

No. of Credits: 04

Learning Hours: 60 hrs

COURSE OUTCOME (CO)

On Completion of this course, the Student will be able to-

CO1 have fundamental knowledge of different kinds of microscopes and their working viz., electron microscopes, phase contrast microscope and confocal microscopes; student will also have fundamental knowledge of biochemical techniques like various kinds chromatography and polyacrylamide gel electrophoresis.

CO2 have profound understanding of cytological structure viz., cilia, flagella, centrioles, chromosomes, plasma membrane etc.; student will have profound knowledge of cell division.

CO3 study concept of developmental biology (embryology) by studying various processes like gametogenesis, regeneration, embryonic Induction, kinds of eggs etc., Fundamental understanding of this will strengthen their basics for higher studies and research.

CO4 understand basics of embryology by studying chick embryology in detail.

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

1. Phase contrast microscope
2. Confocal microscope
3. Electron Microscopes (TEM, SEM)
4. Paper chromatography (Ascending, Descending and Circular)
5. TLC
6. Column Chromatography
7. General principles of Electrophoresis ; SDS - PAGE (vertical slab)

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

1. Karyotyping & Karyotype
2. Ultrastructure and functions of Plasma membrane **:**
   a) Brief concept of chemical composition.
   b) Fluid Mosaic model of plasma membrane
   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) Structural organization of Metaphase Chromosome
   B) Giant chromosomes - Polytene chromosome and Lampbrush chromosome.
5. Typical Cell Cycle
6. Mitosis
7. Meiosis
8. Ultrastructure & general functions of Centrioles/Basal bodies.
9. Ultrastructure & general functions of Cilia/Flagella.

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.

Unit III ***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. Types of Placentation in mammals (histological).

Unit IV ***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 :

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

ST. XAVIER'S COLLEGE (AUTONOMOUS), AHMEDABAD

B.Sc. Zoology, Semester-5

Choice Based Credit System (CBCS)

PAPER – ZO 5401 (Theory)

(BIOSTATISTICS, HUMAN REPRODUCTIVE HEALTH, ZOOLOGICAL PARKS, NUTRITION)

SUBJECT ELECTIVE COURSE (SEC)

No. of Credits: 02

Learning Hours: 30 hrs

COURSE OUTCOME (CO)

On Completion of this course, the Student will be able to-

CO1 learn application of statistical methods for experimental design and validation of practical data

CO2 gain proper scientific knowledge about human reproductive health which in turn can help in building a better society at large.

CO3 be aware about the zoological parks and their management

CO4 understand nutritional aspects of vitamins and minerals as well as major biomolecules, this can increase employability as a nutritional expert by gaining further qualification and knowledge of the field.

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).

Reference books for Unit II :

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

<u>Unit-III</u> ***ZOOLOGICAL PARKS*** **:**

1. History of Zoological parks in India
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
7. National Zoo Policies 1998

Reference book for Unit III:

Design Guidelines for Zoos. Rommel Mehta, D. N. Singh, Publ. Central Zoo Authority. 2018.

<u>Unit-IV</u> ***NUTRITION*** **:**

1. Macronutrients and their main sources :
   Carbohydrates, Proteins and Lipids
2. Micronutrients and their main sources **:** Vitamins and Minerals

Reference book for Unit IV:

Elementary Biochemisry by J L Jain, S. Chand Publication.

ST. XAVIER'S COLLEGE (AUTONOMOUS), AHMEDABAD
B.Sc. Zoology, Semester-5
Choice Based Credit System (CBCS)
PAPER – ZO 5505L (Parts A1, A2, B1 and B2) (Practical)

Course Code: ZO- 5505L

Total teaching hours: 12

PAPER – ZO 5505L (A-1)
(Based on Theory Paper ZO-5501)

COURSE OUTCOME (CO)

On Completion of this course, the Student will be able to-

CO1 learn anatomy of nonchordates of major phyla

CO2 learn the peculiarities of nonchordates

1. ***ANIMAL DIVERSITY*** **(Nonchordates) :**
Study of Leucosolenia by charts/models/specimens/ppt/ softwares:

1. W.M. of *Leucosolenia*
2. L.S. of *Leucosolenia*
3. Asexual and Sexual reproduction in *Leucosolenia*

2. ***ANIMAL DIVERSITY*** **(Nonchordates) :**
*Study of Sheep Liver Fluke by charts/models/specimens/ppt/softwares***:**

1. WM of liver fluke
2. T. S. through body wall 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/softwares***:**

1. External characters of scorpion
2. Digestive system of scorpion
3. Circulatory system of scorpion
4. Nervous system of scorpion
5. Male reproductive system of scorpion
6. Female reproductive system of scorpion
7. Book lungs and Pectine of scorpion

4. ***ANIMAL DIVERSITY*** **(Nonchordates) :**
*Study of Cuttlefish by charts/models/specimens/ppt/softwares***:**

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/softwares **:**

1. Study of external characters.
2. Study of Digestive system.
3. Study of Water-vascular system.
4. Tube feet.
5. Pedicellaria.

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*.

PAPER ZO-5505L (A-2)
(Based on Theory Papers ZO-5502)

COURSE OUTCOME (CO)

On Completion of this course, the Student will be able to-

CO1 study anatomy of vertebrate types

CO2 know about general topics of vertebrates- Respiratory organs in fishes, parental care in fishes and amphibians, skull in reptiles and it significance in classification, extinct reptiles, Dentition in mammals, Aquatic mammals

CO3 practically compare internal structure of organs systems of vertebrates and its significance in understanding organic evolution

1. *ANIMAL DIVERSITY* (Chordates) :

Study of Labeo by charts/models/specimens/ppt/softwares:
External characters, Digestive system, Arterial system, Respiratory system, Urinogenital system, Brain, Scales, Striated Muscle fibres, Medullated nerve fibres.

2. *ANIMAL DIVERSITY* (Chordates) :

Study of Calotes by charts/models/specimens/ppt/softwares:
External characters, Digestive system, Arterial system, Venous system, Urinogenital system, Brain, Hyoid Apparatus, Pecten, Columella auris.

3. *ANIMAL DIVERSITY* (Chordates) :

Study of Pigeon by charts/models/specimens/ppt/softwares of :
External characters, Digestive system, Arterial & Venous systems, Brain, Male & Female urinogenital systems, Air-sacs, Types of feathers.

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, Blue Whale, Walrus, Seal, Dugong)
- 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, Heart, Aortic arches, Venous systems, Urinogenital system, Brain.

PAPER ZO-5505L (B-1)
(Based on Theory Paper ZO-5503)

COURSE OUTCOME (CO)

On Completion of this course, the Student will be able to-

CO1 gain proficiency basic laboratory methodologies in biochemistry.

CO2 apply their scientific knowledge to biochemistry experimentations.

CO3 demonstrate excellent critical thinking abilities to interpret their experimental data.

1. *CARBOHYDRATES* :

Detection of Carbohydrates **:**

--- Monosaccharides – Glucose, Fructose and Galactose

--- Disaccharides – Maltose, Lactose and Sucrose

2. *PROTEINS* :

Detection of Amino acids – Cysteine, Arginine, Tyrosine, Tryptophan and Histidine

Detection of Proteins – Albumin and Casein

3. *COLORIMETRIC ESTIMATION OF* :

- Proteins (Preparation of Std. Curve by Biuret method)
- Glucose (Nelson-Somogyi method)
- Cholesterol (Ferric chloride method)
- Creatinine in urine.
- Uric acid
- Iron (α-α-dipyridyl method)
- Ribose (Orcinol method)

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 and Tributyrin

PAPER ZO-5505L (B-2)
(Based on Theory Paper ZO-5504)

COURSE OUTCOME (CO)

On Completion of this course, the Student will be able to-

CO1 practically perform paper chromatograph and Karyotyping and will have demonstration of PAGE, this will nurture them with practical skill which will be very helpful in their further study.

CO2 prepare slides of mitosis, Barr Body etc., which will boost them with practical aptitude.

CO3 explore concepts of developmental biology by models and charts.

CO4 observe slides of various hrs. chick development under the microscope which enable them to understand hour's wise difference in development.

***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. *Demonstrations* of Slab Gel Electrophoresis, TLC and Column chromatography

***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. Typical Cell cycle
6. Mitosis
7. Meiosis
8. Ultrastructure of Polytene chromosome and Lampbrush chromosome
9. Ultrastructure of a Centriole
10. T.S. of a cilium

3. *CYTOLOGY* :

Techniques **:**

1. Preparation of temporary slides of **:**
   a) Mitosis in Onion root tip
   b) Barr-body in cheek cells

2. a) Human Karyotyping (preparation of chart only) - Normal man, Normal woman,
   b) Identification of karyotypes of Down syndrome, Klinefelter syndrome, Turner syndrome.
3. Ascending Paper Chromatography.

4. *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*
   - Morphological Regeneration in *Salamander*
   - Histological process involved in regeneration in *Salamander*
6. Embryonic induction **:**
   - Spemann and Manglod's experiment of embryonic induction in *Triturus*
   - Curtis' experiment of embryonic induction in *Xenopus*
7. Types of placenta in mammals (histological).

5. *CHICK EMBRYOLOGY* :

1. *Study by charts/ppt of* **:** Blastula and Gastrula stage of chick embryo
2. *Study & preparation of permanent slides of* W.M. of 24, 33, 48 & 72 hrs. old chick embryos

----------x----------

ST. XAVIER'S COLLEGE (AUTONOMOUS)

GUJARAT UNIVERSITY

6th Semester B.Sc.

ZOOLOGY

(effective from June 2021)

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

Pattern of Examination :

Theory (Ext. 280 marks & Int. 120 marks)

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

Examination	Duration	External Marks	Internal Marks	Total Marks
Theory-Paper ZO-6501 **(** Ecology, Pollution, Animal diversity (chordates), Mol. Biol. & Genetics **)**	3 hours	70	30	100
Theory-Paper ZO-6502 **(** Human Physiology **)**	3 hours	70	30	100
Theory-Paper ZO-6503 **(** Toxicology, Animal Biotechnology, Animal Behaviour, Mammalian Histology **)**	3 hours	70	30	100
Theory-Paper ZO-6504 **(** Applied Zoology **)**	3 hours	70	30	100
SEC Paper ZO-6401	3 hours	70	30	100
Theory (Total)		350	150	500
Practical-Paper ZO-6505L (A-1) **(** Based on Theory Paper ZO-6501 **)**	5 hours	35	15	50
Practical-Paper ZO-6505L (A-2) **(** Based on Theory Paper ZO-6502 **)**	5 hours	35	15	50
Practical-Paper 6505L (B-1) **(** Based on Theory Paper ZO-6503 **)**	5 hours	35	15	50
Practical-Paper 6505L (B-2) **(** Based on Theory Paper ZO-6504 **)**	5 hours	35	15	50
Practicals (Total)		140	60	200

INSTRUCTIONS

1. Each theory question paper comprises of FIVE QUESTIONS. All questions carry equal marks, i.e. 14 marks (hence 14 x 5 = 70) in the End Sem/Final Examinations.
2. In order to be qualified to appear for the Final Practical Examinations, the student must submit his/her duly certified journals during the examinations.

ST. XAVIER'S COLLEGE (AUTONOMOUS), AHMEDABAD
B.Sc. Zoology, Semester-6
Choice Based Credit System (CBCS)
PAPER – ZO 6501 (Theory)
(ECOLOGY, POLLUTION, ANIMAL DIVERSITY (chordates),
MOLECULAR BIOLOGY & GENETICS)

No. of Credits: 04

Learning Hours: 60 hrs

COURSE OUTCOME (CO)

On Completion of this course, the Student will be able to-

CO1 learn ecological adaptations in animals with reference to habitats

CO2 learn abiotic and biotic factors and characteristics of terrestrial, freshwater and marine ecosystems

CO3 understand process of ecological succession

CO4 learn sources of environmental pollution

CO5 understand impact of environmental pollutants on animals and its control measures

CO6 know biological treatment of effluents

CO7 learn anatomy of Rat as representative of mammal

CO8 basic principles of bird watching

CO9 understand anatomical peculiarities of birds (beaks and feet) and mammals (skin – structure and its derivatives)

CO10 describe the fundamental molecular principles of genetics.

CO11 understand the structure and function of DNA, RNA and protein.

CO12 explain the way in which genes code for proteins.

CO13 understand the relationship between phenotype linkage and genotype.

CO14 learn mechanisms of gene linkage and crossing over

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. Adaptation of fauna of Rocky shore and Sandy shore
4. Pelagic animals (Planktons and Nectons)

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

a) Characteristics - Salinity, pH, Water current, Transparency, O2, CO2, 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)
Zonations (Flowing-water, Rapid/Riffle, Pool zones),
Types of river-beds (Eroding, Depositing, Sandy)

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.

Unit II POLLUTION

A) Various pollutants & their effects on animal life

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 Pollutant:
   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:
Trickling filters system, Stabilization Ponds and 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.

UNIT III CHORDATES

Type Study & General topics:

A) General structure and morphology with functional anatomy of the following animal**:** *Mammalia* Type **- Rat** (*Rattus rattus*) – Classificaton, External characters, Digestive system, Respiratory system, Heart, Arterial & Venous systems, Brain, Excretory System and Reproductive systems

B) General topics**:**

1) Types of beaks in birds
2) Types of Feet in birds
3) Basics of birding
4) V.S. of mammalian skin
5) Derivatives of mammalian skin (Claw, Nail, Hoof, Horn and Hair)
6) Integumentary glands (Sebaceous, sweat, mammary, scent and lacrimal)

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.

UNIT IV 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) Southern Blotting Technique
4) Northern Blotting Technique
5) Western Blotting Technique
6) Polymerase Chain Reaction (PCR)
7) Sanger's method of DNA Sequencing
8) 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.

ST. XAVIER'S COLLEGE (AUTONOMOUS), AHMEDABAD
B.Sc. Zoology, Semester-6
Choice Based Credit System (CBCS)
PAPER – ZO 6502 (Theory)
(HUMANHYSIOLOGY)

No. of Credits: 04

Learning Hours: 60 hrs

COURSE OUTCOME (CO)

On Completion of this course, the Student will be able to-

CO1 build a foundation of certain areas of Human Physiology

CO2 understand the basics of human Lymphatic System and Immunity and its role in the defence mechanisms of human health.

CO3 understand the basics of human Respiration and Cardiology.

CO4 explain the fundamentals of the physiology of human Reproduction and the role of various sex hormones during the important phases of our life.

CO5 describe the elementary structure of skeletal muscles and the physiology of their contraction.

Unit I 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 and Properdin
   Phagocytosis- Kinds of phagocytes and Mechanism
   Inflammation
   Fever
7. Functions of the Lymphatic system.

Unit II IMMUNITY

1. Brief introduction
2. Immunity (Specific Resistance to Disease)
   --- Antigens/Immunogens:
   Definition, Characteristics and Major Histocompatibility Complex Antigens

--- Antibodies/Immunoglobulins: Definition and 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 and SCID
4. Types of Immunity:
   - Naturally acquired active & passive immunities
   - Artificially acquired active & passive immunities
5. Functions of Immunity

<u>Unit III</u> RESPIRATION AND DIGESTION & ABSOPTION

A. Respiration**:**

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. (i) <u>Digestion</u>

- Digestion of carbohydrates, proteins and lipids

(ii) A<u>bsorption</u>

- Absorption of Monosaccharides, Amino acids, Fatty acids and Glycerol

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

6. T.S. of a skeletal muscle
7. Histology of a striated muscle fibre
8. Motor unit, NMJ
9. Mechanism of muscle contraction and relaxation

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

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

ST. XAVIER'S COLLEGE (AUTONOMOUS), AHMEDABAD

B.Sc. Zoology, Semester-6

Choice Based Credit System (CBCS)

PAPER – ZO 6503 (Theory)

(TOXICOLOGY, ANIMAL BIOTECHNOLOGY, ANIMAL BEHAVIOR, MAMMALIAN *HISTOLOGY)*

No. of Credits: 04

Learning Hours: 60 hrs

COURSE OUTCOME (CO)

On Completion of this course, the Student will be able to-

CO1 learn types of various toxicants and their impact on biological systems

CO2 learn techniques in biotechnology

CO3 understand types of behaviour in animals and learn habituation practically

CO4 study hormonal functions and structure of the endocrine glands

Unit I TOXICOLOGY

1. Brief Introduction
2. Definitions of Toxicology, Toxicity, Toxicants and Xenobiotics
3. Classification of Toxicants **:** Corrosives, Irritants, Neurotics and Cardiac poisons
4. Types of toxicity **:** Acute, Subacute, Chronic
5. Economic Toxicology**:**
   a. Food Toxicology (Major Food Contaminants)
   b. Drug Toxicology
6. Areas of Toxicology
   Mechanistic, Regulatory, Forensic, Clinical, Environmental, Industrial and Ethnic/Geographical
7. 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
8. Entry of toxicants into the animal's body **:** Gastro-intestinal route, Skin, Lungs, Parenteral administration

Reference Books for Toxicology:

1. Fundamentals of Toxicology, Pandey, Shukla and Trivedi, New Central Book Agency (P) Ltd., Kolkata.
2. Modern Toxicology. Volumes 1-3, P. K.Gupta and D. K. Salunkhe, Metropolitan Book Co. Pvt. Ltd., New Delhi.

Unit II 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.
2. 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
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
3. Reproductive behaviour 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. Hanging fly (*Hylobittacus apicalis*)
   Concept of Monogamy, Polygyny 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.

<u>Unit IV</u> MAMMALIAN HISTO- PHYSIOLOGY

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.

ST. XAVIER'S COLLEGE (AUTONOMOUS), AHMEDABAD

B.Sc. Zoology, Semester-6

Choice Based Credit System (CBCS)

PAPER – ZO 6504 (Theory)

(APPLIED ZOOLOGY)

No. of Credits: 04

Learning Hours: 60 hrs

COURSE OUTCOME (CO)

On Completion of this course, the Student will be able to-

CO1 gain fundamentals of apiculture; as a basics understanding provided with practical further skill in the profession can increase self-employability in field of honey and wax production.

CO2 Basic study and exploring sericulture industry can enable students to get employment in the field of sericulture and ever shining silk industry.

CO3 Having fundamental knowledge of poultry breeds, poultry house and other concepts of poultry industry can boost a student's own entrepreneurship in the poultry farming.

CO4 Having fundamental knowledge of fishery sciences like kinds of fisheries, fish pathology, fish by-products and other concepts of fishery science can boost a student's own aptitude as an entrepreneur in the fishery industry.

Unit-I APICULTURE

1. Introduction.
2. Classification of *Apis*
3. Different species of honey bees
4. Castes in honey bees: Queen, Drone and Workers
5. A typical natural bee hive/honey comb
6. Dance language of honey bee
7. Life cycle of honey bee
8. Apiculture - choice of flora
   - choice of bees
9. Apiculture methods **:** Old and Modern methods
10 Products and by products of Apiculture
11 Royal jelly
12 Economic importance of Apiculture

Unit-II SERICULTURE

1. Introduction
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
7. Central silk board and its services
8. Economic importance of Sericulture

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
2. Importance of Poultry Science
3. Different characters to be considered for selection of the perfect poultry birds
4. Poultry breeds
   a) American Breeds (Plymouth rock, New Hampshire)
   b) Mediterranean Breeds (White Leghorn)
   c) English Breeds (Sussex)
   d) Asiatic Breeds (Brahmas)
   e) Kadaknath
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. Economics of Fresh-water, brackish water and marine water fisheries of Gujarat
2. Role of fisheries in Indian economy
3. Mariculture with reference to Prawn culture and Pearl culture
4. Fish by-products (*as per practicals syllabus*)
5. Preservation & Processing of fishes and prawns
6. 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.

ST. XAVIER'S COLLEGE (AUTONOMOUS), AHMEDABAD

B.Sc. Zoology, Semester-6

Choice Based Credit System (CBCS)

PAPER – ZO 6401 (Theory)

(CANCER BIOLOGY, CYTOLOGICAL TECHNIQUES)

SUBJECT ELECTIVE COURSE (SEC)

No. of Credits: 02

Learning Hours: 30 hrs

COURSE OUTCOME (CO)

On Completion of this course, the Student will be able to-

CO1 get a basic idea of the different types of cancer and the different theories of carcinogenesis.

CO2 understand various mechanisms of carcinogenesis by chemicals and viruses

CO3 learn how to preserve animals and their body parts permanently

CO4 understand principles and methods of animal tissue fixation and staining by various methods

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 DNA viruses.
4. Oncogenic Retroviruses.

CYTOLOGICAL TECHNIQUES (Cytological study of dead cells):

Unit III

1. Introduction
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.

ST. XAVIER'S COLLEGE (AUTONOMOUS), AHMEDABAD
B.Sc. Zoology, Semester-6
Choice Based Credit System (CBCS)
PAPER – ZO 6505L (Parts A1, A2, B1 and B2) (Practical)
(Based on Theory Paper ZO-6501)

Course Code: ZO- 5505L

Total Credits: 5

Total teaching hours: 60

PAPER – ZO 6505L (A-1)

COURSE OUTCOME (CO)

On Completion of this course, the Student will be able to-

CO1 identify different animals and learn their ecological adaptations practically

CO2 understand physico-chemical characteristics of various ecosystems

CO3 able to evaluate chemical parameters of water quality

CO4 learn anatomical peculiarities of Rat as representative of mammal

CO5 understand detailed structure of nucleic acids and related molecular biology techniques

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	:	Sole fish, Sting ray fish
Arboreal	:	Hyla, Squirrel
Burrowing	:	Snake, Hedgehog
Volant	:	Bird, Bat,
Deep Sea	:	Chimera, *Lophius*
Cursorial	:	Horse, Cheetah
Dessert	:	Camel, Moloch

B) Study by charts of **:**

1. Summer & Winter Thermal stratifications in Fresh water ecosystem
2. Zonation in marine environment
3. Characteristics of freshwater pond

2. POLLUTION

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

1. Titrimetric – Acidity, Alkalinity (phenolphthalein, methyl orange indicators), Calcium hardness (using Murexide indicator),
Total Hardness (using Eriochrome Black T indicator), Dissolved oxygen(Winkler's method)
2. Colorimetric – Phosphate

3. CHORDATE ANATOMY

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

1 V.S. of mammalian skin.
2 Derivatives of mammalian skin (Claw, Nail, Hoof, Horn and Hair)
3. Integumentary glands
4. Types of beaks in birds
5. Types of feet in birds
6. Basics of birding

4. *CHORDATE ANATOMY*

RAT

1. External characters
2. Digestive system
3. Arterial system
4. Venous system
5. Respiratory system
6. Male and female urinogenital systems
7. Brain
8. Mountings; Striated muscle fibres, medullated nerve fibers

5. MOLECULAR BIOLOGY & GENETICS

A) MOLECULAR BIOLOGY

Study by charts of **:**

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

B) Study by charts of

Linkage- complete and incomplete linkage in *Drosophila*
Crossing over- Female *Drosophila*, Mechanism of crossing over
Construction of Chromosome maps

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

APPENDIX for Paper ZO-6506L (A-1)

GENETICS PROBLEMS

1. A female animal with genotype AaBb is crossed with a double recessive male aabb. Their progeny include **:**

AaBb - 442
Aabb - 458
aabB - 054
aabb - 046

Explain these results.

Solution :

Two genes linked 10 map units apart. The female parent was of the type AB/ab.

2. In man, three genes are linked in one chromosome. Assume one parent in dominant for all three genes, the other recessive. In test cross the following numbers were obtained **:**

ABC	-	225
Abc	-	245
aBc	-	098
AbC	-	102
ABc	-	144
abC	-	156
aBC	-	014
Abc	-	016
Total	-	1000

(a) Arrange the series in the correct linear order.
(b) What is the crossing over percentage?
(c) Is there interference?
(d) What is coefficient of coincidence ?

Solution :

a) CAB
b) Double crossing over, Percentage between 1 and 2 = 3%
c) There is interference
d) Co-efficient of co dominance = 0.4%

3. Assume that an individual homozygous for ++ is crossed with one homozygous for ab and that F_2 from this cross is as follows **:**

++	334
+b	37
+a	38
Ab	87

Is this result different from that which you would expect if segregation of a and b were independent?

Solution :

(a) Yes – Here phenomenon of linkage has occurred (b) 15% crossing over percentage.

4. In rabbit, two recessive genes produce a solid body colour and long-hair respectively in contrast to a spotted body colour and short-hair, which result from the dominant alleles. The result from

a cross between the heterozygous spotted short-haired rabbit and solid long-haired rabbits are as follows **:**

Spotted short	-	48
Spotted long	-	05

Solid short - 07 Solid long - 40

In terms of crossing over units, how far apart are these genes on the chromosome?

Solution :

These two genes are 12 units apart on the chromosome.

5. In rabbit , black and short-hair are characters resulting from two dominant genes. The recessive alleles of these genes produce brown and long-hair . When we mate homozygous black, short-haired with brown, long-haired rabbits and test cross the offsprings, we obtain the following results **:**

Black short-haired	-	29
Brown long-haired	-	33
Black long-haired	-	35
Brown short-haired	-	27

From these results, would you conclude that these genes are located on the same chromosome? Why? If your answer is yes, what is the percentage of crossing over?

Solution :

(a) These two genes are located on the same chromosome. Out of 124 offsprings - 62 offsprings are recombinants due to crossing over between black short-haired and brown long-haired. (b) 50% crossing over.

PAPER ZO-6505L (A-2)
(*Based on Theory Paper ZO-6502*)

COURSE OUTCOME (CO)

On Completion of this course, the Student will be able to-

CO1 gain expertise in certain basic laboratory methodologies in human haematology.

CO2 understand the significance of sterilization during the haematology practicals.

CO3 Easily prick their own fingers and collect blood for the various haematology practicals.

CO4 practically apply their theoretical knowledge of human haematology and demonstrate how to determine their own Total RBC/WBC counts, Hb concentration, identification of different types of WBC by preparing a blood smear as-well-as Bleeding Time & Clotting Time.

CO5 With some allied PG diploma course, all these techniques will help them in their employability in various pathology laboratories and institutes like Red Cross or similar places.

1. 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. 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. RESPIRATION, DIGESTION & ABSORPTION:

1. Study by charts/ppt of

i. Respiratory muscles
ii. Alveolar-capillary (respiratory) membrane
iii. Exchange of the respiratory gases
iv. Oxygen-haemoglobin dissociation curve

2. **DIGESTION & ABSORPTION :**

1. Effect of salivary amylase on starch
2. Digestion of proteins by pepsin

4. REPRODUCTION:

Study by charts/ppt of **:**

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

5. MUSCLE CONTRACTION:

Study by charts/ppt of **:**

1. T. S. of muscle.
2. Ultrastructure of sarcomere.
3. Ultrastructure of Neuro-muscular junction.

PAPER ZO-6505L (B-1)
(Based on Theory Paper ZO-6503)

COURSE OUTCOME (CO)

On Completion of this course, the Student will be able to-

CO1 learn aspects of histotechnology

CO2 identify the cells, tissues of endocrine glands

CO3 learn animal behavioural aspects specially learning-habituation

1. *HISTOTECHNOLOGY* :

1. Study of types of microtomes
2. Method of staining for preparation of permanent slides

2. *MAMMALIAN HISTOLOGY* :

Identification & histological study of the following organs by permanent 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

LC_{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 behaviour 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.

PAPER ZO-6505L (B-2)
(Based on Theory Paper ZO-6504)

COURSE OUTCOME (CO)

On Completion of this course, the Student will be able to-

CO1 gain fundamentals of apiculture practically; as a basics understanding provided with practical further skill in the profession can increase self-employability in field of honey and wax production.

CO2 Basic study and exploring sericulture industry can enable students to get employment in the field of sericulture and ever shining silk industry.

CO3 Having fundamental practical knowledge of poultry breeds, poultry house and other concepts of poultry industry can boost a student's own entrepreneurship in the poultry farming.

CO4 Having fundamental practical knowledge of fishery sciences like kinds of fisheries, fish pathology, fish by-products and other concepts of fishery science can boost a student's own aptitude as an entrepreneur in the fishery industry

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
8. Testing purity of honey

2. *SERICULTURE* :

Study by charts/ppt **:**

1. Life cycle of *Bombyx mori*
2. Chemistry of silk
3. Uses of silk (Silk mark)

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 silage, 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, products and by-products and mariculture.

----------x----------