

**The Kelkar Education Trust's
V G Vaze College of Arts, Science and Commerce
(Autonomous)**



**The Kelkar Education Trust's
V G Vaze College of Arts, Science and Commerce
(Autonomous)**

Syllabus for T.Y.B.Sc.
(June 2020 Onwards)
Program: B.Sc.
Semester – V and VI
Course: Zoology

SEMESTER V

Course code	Paper Title	Credit
SZO501	Taxonomy and Type Study I	2.5
SZO502	Haematology and Immunology	2.5
SZO503	Mammalian Histology, Basic Toxicology, General Pathology and Biostatistics	2.5
SZO504	Integumentary system, Human Osteology, Limb Muscles and Developmental Biology of Chick	2.5
SZOP501	Practical based on Paper I (Course 11)	02
SZOP502	Practical based on Paper II (Course 12)	02
SZOP503	Practical based on Paper III (Course 13)	02
SZOP504	Practical based on Paper IV (Course 14)	02

SEMESTER VI

Course code	Paper Title	Credit
SZO601	Taxonomy and Type Study II	2.5
SZO602	Enzymology, Homeostasis, Endocrinology and Animal Tissue Culture	2.5
SZO603	Molecular Biology, Genetic Engineering, Human Genetics and Bioinformatics	2.5
SZO604	Environment and Wildlife Management, Bioprospecting, Zoopharmacognosy and Zoogeography	2.5
SZOP601	Practical based on Paper I (Course 15)	02
SZOP602	Practical based on Paper II (Course 16)	02
SZOP603	Practical based on Paper III (Course 17)	02
SZOP604	Practical based on Paper IV (Course 18)	02



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1. Syllabus as per Choice Based Credit System

- i) Name of the Programme : T.Y.B.Sc. Zoology
- ii) Course Code : **Semester-V**
SZO501 (Course 11), SZO502 (Course 12), SZO503 (Course 13) and SZO504 (Course 14)
Semester-VI
SZO601 (Course 15), SZO602 (Course 16), SZO603 (Course 17) and SZO604 (Course 18)
- iii) Course Title : Zoology
- iv) Semester-wise Course Contents : Copy of the Syllabus enclosed
- v) References and Additional References : Enclosed in the Syllabus
- vi) Credit Structure
- | | |
|-----------------------------|----|
| No. of Credits per Semester | 16 |
|-----------------------------|----|
- vii) No. of lectures per Unit : 15
- viii) No. of lectures per week : 16
- ix) No. of Tutorial per week : --
- x) No. of practical per week : 04 (per batch)

2. Scheme of Examination

: Internal Assessment (40 marks):

Class Test 20 marks,

Assignment: 15 marks

Class Participation: 05 marks

External Assessment (60 marks)

Semester End Exam:

Subjective:

12 Marks - One question each from 4 Units / Two questions of 6 marks each from 4 units

12 Marks - Two/Three questions each from 4 Units (Any 4 out of 6)

3. Special notes, if any : No

4. Eligibility, if any : As laid down in the College Admission brochure/website

5. Fee Structure : As per College Fee Structure specifications

6. Special Ordinances / Resolutions, if any : No



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Programme:T.Y.B.Sc.

Semester:V

Course:Zoology-I(Course11)

Course code:SZO501

Teaching Scheme (Hrs/Week)				Continuous Internal Assessment (CIA) 40 marks					End Semester Examination	Total
L	T	P	C	CIA-1	CIA-2	CIA-3	CIA-4	Lab	Written	
8	-	1	4	20	15	05		-	60	100
Max. Time, End Semester Exam (Theory) -2Hrs.										

Prerequisite 1. Basic knowledge about the concepts in Zoology
2. Skills in exploring the diverse fields of Zoology.

Course Objectives

1. To introduce the principles of taxonomy and modern system of classification in animal kingdom so as to give the students with evolution point of view
2. To enhance the ability to identify the animals pertaining to different ecosystem and thus, highlighting the hierarchy of animal classification system.
3. To acquaint the learner with the internal structural organization and the mechanism of different systems in Invertebrates.
4. To introduce the learners to the modern system of animal classification.
5. To describe the distinguishing characters of major invertebrate phyla and their adaptive features with reference to their habitat.
6. To introduce basic concepts of invertebrate classification in animal kingdom from phylum Annelida to Echinodermata.
7. To study general characteristics and salient features of animals belonging to Phylum Annelida to Hemichordata and Minor phyla.



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SEMESTER V

COURSE CONTENT			
Unit No.	Module no.	Content	Lectures
		SZO501 (Paper I-Course 11): TAXONOMY AND TYPE STUDY I	
1		Principles of Taxonomy	15
	I	Levels of Organization: i. Unicellularity, colonization of cells, multicellularity ii. Levels of Organization: Acellular, Cellular, Tissue level, Organ level and 'Organ-system level	
	II	Symmetry i. Basic concept and definition ii. Types: a. Asymmetry: e.g. <i>Amoeba</i> b. Radial symmetry: i. Biradial symmetry: eg. Sea anemone ii. Pentaradial symmetry: e.g. Starfish c. Bi-lateral symmetry: d. e.g. Invertebrate – Planaria Vertebrate – Man iii. Evolutionary significance of symmetry	
	III	Coelom i. Basic concept and definition ii. Formation of coelom iii. Types: a. Acoelomate: Platyhelminthes e.g. Liverfluke b. Pseudocoelomate: Nematoda e.g. <i>Ascaris</i> c. Coelomate: e.g. Frog iv. Evolutionary significance of coelom	
	IV	Metamerism i. Basic concept and definition ii. Types: a. Pseudometamerism: e.g. Tapeworm b. True metamerism: i. Homonomous – Annelida e.g. <i>Nereis</i> ii. Heteronomous – Cephalization – Insecta e.g. Dragonfly iii. Cephalothorax – Crustacean e.g. Lobster iii. Evolutionary significance of metamerism	



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Unit No.	Module no.	Content	Lectures
1	V	Taxonomy a) Basic concept, definition and objectives b) Linnaean Hierarchy, Binomial Nomenclature c) Six Kingdom classification: General characters of each Kingdom with examples: i. Kingdom Archaeobacteria ii. Kingdom Eubacteria iii. Kingdom Protista iv. Kingdom Fungi v. Kingdom Plantae vi. Kingdom Animalia	
	VI	Kingdom Protista: Animal like Protists: Protozoa a) General characters of Protozoa b) Classification of Protozoa with distinguishing features and suitable examples: <ul style="list-style-type: none"> • Phylum Sarcomastigophora Class Sarcodina e.g. <i>Amoeba</i> Class Mastigophora e.g. <i>Trypanosoma</i> • Phylum Ciliophora Class Ciliata e.g. <i>Opalina</i> Class Phyllopharyngea e.g. <i>Dysteria</i> • Phylum Sporozoa □ Class Aconoidasida e.g. <i>Plasmodium</i> □ Class Conoidasida e.g. <i>Toxoplasma</i> 	
2.		Kingdom Animalia I	15
	I	Phylum Porifera a) General characters b) Classification up to class with distinguishing features and suitable examples: <ul style="list-style-type: none"> ○ Class Calcarea e.g. <i>Leucosolenia</i> ○ Class Hexactinellida e.g. <i>Hyalonema</i>(Glass-ropesponge) ○ Class Demospongia e.g. <i>Euspongia</i>(Bath sponge) 	Q
	II	Phylum Cnidaria a) General characters b) Classification up to class with distinguishing features and examples <ul style="list-style-type: none"> ▪ □ Class Hydrozoa e.g. <i>Hydra</i> ▪ Class Scyphozoa e.g. <i>Aurelia</i> (Jelly fish) ▪ Class Anthozoa e.g. <i>Meandrina</i>(Maze Coral) 	



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	<p style="text-align: center;">III</p> <p style="text-align: center;">IV</p>	<p>Phylum Platyhelminthes</p> <p>a) General characters b) Classification up to class with distinguishing features and examples</p> <ul style="list-style-type: none"> ▪ Class Turbellaria e.g. Planaria ▪ Class Trematoda e.g. <i>Schistosoma</i> (Blood-fluke) ▪ Class Cestoda e.g. <i>Taenia</i> sp. (Tapeworm) <p>c) Morphology, life cycle and pathogenicity of <i>Fasciola</i> sp.</p> <p>Phylum Nematoda</p> <p>a) General characters b) Classification up to class with distinguishing features and examples</p> <ul style="list-style-type: none"> ▪ Class: Aphasmida / Adenophorea e.g. <i>Trichinella</i> (Trichina worm) ▪ Class: Phasmida / Secernentea e.g. <i>Ascaris</i> (Roundworm) 	
3		Kingdom Animalia II	15
	<p style="text-align: center;">I</p> <p style="text-align: center;">II</p>	<p>Phylum Annelida</p> <p>a) General characters b) Classification up to class with distinguishing features and examples</p> <ol style="list-style-type: none"> i. Class Polychaeta e.g. <i>Nereis</i> (Clamworm) ii. Class Oligochaeta e.g. <i>Pheretima</i> (Earthworm) iii. Class Hirudinea e.g. <i>Hirudinaria</i> (Leech) <p>Phylum Arthropoda</p> <p>a) General characters b) Classification up to class with distinguishing features and examples</p> <p>A. <u>Subphylum Chelicerata</u></p> <ol style="list-style-type: none"> i. Class Arachnida e.g. <i>Hottentotta tamulus</i>(Indian Red Scorpion) ii. Class Merostomata e.g. <i>Limulus</i> (Horse-shoe crab) iii. Class Pycnogonida e.g. <i>Nymphon</i>(Sea spider) <p>B. <u>Subphylum Crustacea</u></p> <ol style="list-style-type: none"> i. Class Malacostraca e.g. <i>Scylla serrata</i> (Giant Mud Crab) ii. Class Maxillipoda e.g. <i>Balanus</i> (Barnacle) <p>C. <u>Subphylum Uniramia</u></p> <ol style="list-style-type: none"> i. Class Chilopoda e.g. Centipede ii. Class Diplopoda e.g. Millipede iii. Class Insecta e.g. <i>Attacus atlas</i> (Atlas moth) 	



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Unit No.	Module no.	Content	Lectures
3	III	Phylum Mollusca a) General characters of the Phylum. b) Classification up to class with distinguishing features and examples <i>i.</i> Class Aplacophora e.g. <i>Chaetoderma</i> <i>ii.</i> Class Polyplacophora e.g. <i>Chiton</i> (Coat-of-mail shells) <i>iii.</i> Class Monoplacophora e.g. <i>Neopilina</i> <i>iv.</i> Class Gastropoda e.g. <i>Nerita</i> <i>v.</i> Class Pelecypoda e.g. <i>Solen</i> (Razor clam) <i>vi.</i> Class Scaphopoda e.g. <i>Dentalium</i> (Tusk shell) <i>vii.</i> Class Cephalopoda e.g. <i>Nautilus</i> (Pearly nautilus)	
	IV	Phylum Echinodermata a) General characters b) Classification up to class with distinguishing features and examples <i>i.</i> Class Asterozoa e.g. <i>Protoreaster</i> (Starfish) <i>ii.</i> Class Ophiurozoa e.g. <i>Ophiothrix</i> (Brittle star) <i>iii.</i> Class Echinozoa e.g. <i>Clypeaster</i> (Sand dollar) <i>iv.</i> Class Holothurozoa e.g. <i>Cucumaria</i> (Sea cucumber) <i>v.</i> Class Crinozoa e.g. <i>Antedon</i> (Sea lily)	
	V	Minor phyla a) General characters b) Classification up to class with distinguishing features and examples <i>i.</i> Phylum Acanthocephala e.g. <i>Moniliformis</i> <i>ii.</i> Phylum Onychophora e.g. <i>Peripatus</i> (Velvetworm) <i>iii.</i> Phylum Chaetognatha e.g. <i>Sagitta</i> (Arrowworm) c) Peripatus, a connecting link	
	VI	Phylum Hemichordata a) General characters b) Classification with distinguishing features and examples <i>i.</i> Class Enteropneusta e.g. <i>Balanoglossus</i> (Acorn worm) <i>ii.</i> Class Pterobranchia e.g. <i>Rhabdopleura</i> <i>iii.</i> Class Planctosphaerozoa e.g. <i>Planctosphaera</i>	
	VII	Basic concepts of phylogeny: Phylogenetic tree of invertebrate	



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Unit No.	Module no.	Content	Lectures
4		Type study: Sepia	15
	I	General characters and classification, Habit and habitat, External characters, mantle cavity, locomotion, economic importance	
	II	<ul style="list-style-type: none"> i. Digestive system ii. Respiratory system iii. Circulatory system iv. Excretory system v. Nervous system and Sense organs vi. Reproductive system 	
		Total No. of lectures	60

Beyond the Syllabus

Tutorial Activities: Students' Presentations, Brain storming sessions, Group Discussions, Use of E-learning, Workshops, Hands-on training practicals, Field data collection of fauna

SZOP501 (SEMESTER V)
Based on Paper I-COURSE 11

List of Experiments

Sr. No.	Description
1	Classification of phyla up to class and study of the general characters up to class. Kingdom Protista – Animal-like Protists: Phylum Protozoa A. Phylum: Sarcomastigophora <input type="checkbox"/> Class Sarcodina e.g. <i>Amoeba</i> <input type="checkbox"/> Class Mastigophora e.g. <i>Euglena</i> B. Phylum: Ciliophora <input type="checkbox"/> Class Ciliata e.g. <i>Paramecium</i> <input type="checkbox"/> Class Phyllopharyngea e.g. <i>Dysteria</i> C. Phylum: Apicomplexa / Sporozoa, <input type="checkbox"/> Class Aconoidasida e.g. <i>Eimeria</i> <input type="checkbox"/> Class Conoidasida e.g. <i>Sarcocystis</i>
2	Kingdom Animalia D. Phylum: Porifera <ul style="list-style-type: none"> i. Class Calcarea e.g. <i>Scypha</i> ii. Class Hexactinellida e.g. <i>Hyalonemma</i> iii. Class Demospongia e.g. <i>Spongilla</i>



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E. Phylum Cnidaria

- i. Class Hydrozoa e.g. *Vellela*
- ii. Class Scyphozoa e.g. *Rhizostoma*
- iii. Class Anthozoa e.g. *Corallium*

F. Phylum Platyhelminthes

- i. Class Turbellaria e.g. *Dugesia tigrina*
- ii. Class Trematoda e.g. *Fasciola hepatica*
- iii. Class Cestoda e.g. *Taenia solium*

G. Phylum Nematoda

- i. Class Aphasmida / Adenophoreae.g. *Trichinella*
- ii. Class Phasmida / Secernentea e.g. *Ascaris*

H. Phylum Annelida

- i. Class Polychaeta e.g. *Arenicola*
- ii. Class Oligochaeta e.g. *Tubifex*
- iii. Class Hirudinea e.g. *Pontobdella*

I. Phylum Arthropoda

- a) Subphylum: Chelicerata
 - i. Class Arachnida e.g. (Scorpion)
 - ii. Class Merostomata e.g. *Limulus*
 - iii. Class Pycnogonida e.g. (Sea spider)
- b) Subphylum Crustacea
 - i. Class Malacostraca e.g. Lobster
 - ii. Class Maxillipoda e.g. Copepods
- c) Subphylum Uniramia
 - i. Class Chilopoda e.g. Centipedes
 - ii. Class Diplopoda e.g. Millipedes
 - iii. Class Insecta e.g. Moth

J. Phylum Mollusca

- i. Class Aplacophora e.g. *Chaetoderma*
- ii. Class Polyplacophora e.g. *Tonicella*
- iii. Class Monoplacophora e.g. *Neopilina*
- iv. Class Gastropoda e.g. *Turbo*
- v. Class Pelycypoda e.g. *Donax*
- vi. Class Scaphopoda e.g. *Dentalium*
- vii. Class Cephalopoda e.g. *Octopus*

K. Phylum Echinodermata

- i. Class Asteroidea e.g. Starfish
- ii. Class Ophiuroidea e.g. Brittle star
- iii. Class Echinoidea e.g. *Echinus* (Sea urchin)
- iv. Class Holothuroidea e.g. *Holothuria* (Sea cucumber)
- v. Class Crinoidea e.g. *Crinoid* (Sea lily)



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Sr. No.	Description
	L. Phylum Hemichordata i. Class Enteropneusta e.g. <i>Saccoglossus</i> ii. Class Pterobranchia e.g. <i>Rhabdopleura</i> iii. Class Planctosphaeroidea e.g. <i>Planctosphaera</i>
4.	Minor Phyla i. Acoelomate i. Phylum Acanthocephala e.g. <i>Echinorhynchus</i> ii. Coelomate J. Phylum Chaetognatha e.g. <i>Sagitta</i> . iii. Phylum Onychophora e.g. <i>Peripatus</i>
5.	Study of Sepia with the help of diagram / Photograph / Simulation whichever possible. No animal shall be dissected. a) Digestive system, b) Reproductive system, c) Nervous system d) Jaws e) Radula f) Chromatophores g) Spermatophores h) Statocyst
6	I. Mounting of Spiracles of Cockroach II. Mounting of Cornea of Cockroach III. Mounting of mouth parts of Cockroach
7.	Study tour – Visit to fish market / Aquarium / Any other place to observe invertebrates and submit a report.

**Semester V: Taxonomy and Type Study I
SZO501:Paper I(Course11)**

(Internal Assessment Pattern)

Marks: 40

1 Class Test : (Based on Theory Unit 1,2,3and4)	20 marks
2 Assignment:	15 marks
3 Class Participation and Overall conduct	05 Marks

**Semester V: Taxonomy and Type Study I
SZO501:Paper I(Course11)**

(Internal Class Test Paper Pattern)

Duration: **Marks:20**

Q.1 a) Fill in the blanks: (1 or 2 questions each from Unit 1,2,3,4) 05marks

b) Match the column: (1 or 2 questions each from Unit 1,2,3,4) 05 marks

Column A	Column B
1.	a)
2.	b)
3.	c)
4.	d)
5.	e)



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Q 2. Write short note on:(Any two) a) Unit1 b) Unit2 c) Unit3 d) Unit4	10 Marks
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Semester V: Taxonomy and Type Study I	
SZO501:Paper I(Course11)	
(Theory PaperPattern)	
Duration: 2 hours	Marks: 60
Q1 a) Answer the following: (Unit1) <p style="text-align: center;">OR</p> a) Answer in brief: (Unit1) b) Answer in brief: (Unit1)	12 Marks 6Marks 6Marks
Q 2 a) Answer the following: (Unit2) <p style="text-align: center;">OR</p> a) Answer in brief: (Unit2) b) Answer in brief: (Unit2)	12 Marks 6Marks 6Marks
Q 3 a) Answer the following: (Unit3) <p style="text-align: center;">OR</p> a) Answer in brief: (Unit3) b) Answer in brief: (Unit3)	12 Marks 6Marks 6Marks
Q 4 a) Answer the following: (Unit4) <p style="text-align: center;">OR</p> a) Answer in brief: (Unit4) b) Answer in brief: (Unit4)	12 Marks 6Marks 6Marks
Q.5 Write Short notes on: Any four out six (1 or 2 questions each from Unit 1,2,3,4)	12 Marks

Semester V: Taxonomy and Type Study I	
SZOP501:Paper I(Course11)	
(Practical PaperPattern)	
Duration: 5 hours	Marks: 50
Q.1 Sepia: Sketch and label the system (Digestive / Reproductive system / Nervous system) <p style="text-align: center;">OR</p> Identify and Describe: a & b (Jaws / Radula / Chromatophores / Spermatophores / Statocyst)	04 marks



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Q.2 Identify and classify giving reasons: a) Protozoa / Porifera /Cnidaria b) Platyhelminthes /Nematoda c) Annelida /Arthropoda d) Mollusca /Echinodermata	12 marks
Q.3 Identify, classify and describe a) Acanthocephala / Chaetognatha /Onychophora b) Hemichordata c) Observe the animal* (photo/existing preserved specimen) and identify phylum giving reasons. *A suitable animal which is not prescribed in the syllabus	06 marks
Q4. Mounting of Spiracle of Cockroach/ OR Mounting of Cornea of Cockroach OR Mounting of mouth parts of Cockroach	03 Marks
Q.5. Field report	10 marks
Q.6 Viva based on Paper I (Course 11)	05 Marks
Q.7 Journal with neatly drawn and labelled diagrams	10 Marks

SZO501:Paper I-Course 11
Course outcome

After the completion of the course, students will able to

CO1 apprehend the basis of classification and modern classification up to class of the lower invertebrate animals.

CO 2 Classify each organism based on the characteristics and its structural organization

CO3 Develop the idea of working of the different systems within the Invertebrates and thus, gain the knowledge about the life history and the peculiar adaptations of the Invertebrates.

CO4 Understand that scientific classification of animals is based on certain characteristics they have in common.

CO5 Recall characteristics features and examples of each phylum.

CO6 Get an idea of higher groups of invertebrate animal life and their classification pertaining to different aspects.

CO7 Correlate the behavioural aspects and phylogenetic relationships between Invertebrates.



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Recommended Resources

**Reference
Books**

1. Invertebrate Zoology: E.L. Jordan and P.S.Verma
2. A manual of Zoology - Part I, Invertebrata; Ayyar, M.Ekambaranath
3. Invertebrate Zoology – Volumes of different Phyla; HymanL.H.
4. Instant Notes in Animal Biology by Richard D.Jurd.
5. Zoology For Degree Students: Dr. V. K. Agarwal, S. Chand publication.
6. Introduction to Zoology – Vol I: K. K. Chaki, G. Kundu and S.Sarkar, New Crystal Book Agency.
7. Modern text book of Zoology – Invertebrates; Eleventh;Edition Professor R. L. Kotpal; Rastogi publication
8. Phylum Sarcomastigophora viz. Protozoology, by S. V. Nikam & S.T. Tanveer; ed. 2011, Pub. Oxford Book.
9. Invertebrate Zoology by E. L. Jordan &P. S. Verma Rev.edition,2009, Chand publications
10. Invertebrate Zoology by P. S. Verma, edition,2009, Chand publications
11. Zoology for degree students, Non chordates-1 by V.K. Agarwal 2017, S. Chand publications
12. Zoology for Degree Students-I, B.Sc. First Year, by V. K. Agarwal, Pub. S. Chand Coy.
13. B. Sc. Zoology, Invertebrate Zoology by V. K. Aggarwal 2017, S.Chand publications
14. Invertebrate Zoology by Fatik Baran 2012, PHI Learning
15. A Textbook of Invertebrates by N.C. Nair et al. 2010 Saras publications
16. Practical Zoology: Invertebrate, by S. S. Lal,2016
17. Invertebrate Zoology by Ruppert, Fox, Barnes,7thedition,2003 publications Cen gageL earning
18. Invertebrate Zoology by D.T. Anderson 2nd edition 2002,publications Oxford
19. Invertebrates by Richard C. Brusca et. al, 3rdedition2016,publications Oxford
20. Biology of the invertebrates by Jan A. Pechenik, 7thedition,2014 publications Mc Graw Hill
21. An introduction to the invertebrates by Janet Moore,2ndedition2006, publications Cambridge
22. Protozoology, by S. V. Nikam & S. T. Tanveer ed. 2011, Pub. Oxford Book Company (N.B.: This book includes Phylum Sarcomastigophora)



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E-Resources

<https://www.earthlife.net/inverts/annelida.html>
<http://www.biologydiscussion.com/invertebrate-zoology/invertebrates-phyla/study-notes-on-invertebrates-phyla/28077>
<http://www.asfa.k12.al.us/ourpages/auto/2014/4/23/64232119/invertebrate-animal-phyla-notes.pdf>
<http://www.biology-pages.info/I/Invertebrates.html>
<https://portals.iucn.org/library/sites/library/files/documents/2012-064.pdf>
<http://instruction2.mtsac.edu/mcooper/Biology%202/Labs/ProtistaLab1.pdf>
<http://www.faculty.ucr.edu/~legnerref/invertebrate/inverteb.htm>
<http://www.cbv.ns.ca/mchs/diversity/ProtozoansPage1.html>
http://bioweb.uwlax.edu/bio203/s2009/maiers_andr/Classification.htm
<https://www.earthlife.net/inverts/annelida.html>
<https://manoa.hawaii.edu/exploringourfluidearth/biological/invertebrates/worms-phyla/platyhelminthes-nematoda-and-annelida>
http://www.fossilmuseum.net/Tree_of_Life/Phylum-Echinodermata.htm



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Programme:T.Y.B.Sc.

Semester:V

Course: Zoology-II(Course12)

Course code: SZO502

Teaching Scheme (Hrs/Week)				Continuous Internal Assessment (CIA) 40 marks					End Semester Examination	Total
L	T	P	C	CIA-1	CIA-2	CIA-3	CIA-4	Lab	Written	
8	-	1	4	20	15	05		-	60	100
Max. Time, End Semester Exam (Theory) -2Hrs.										

Prerequisite 1. Basic knowledge about the concepts in Zoology
2. Skills in exploring the diverse fields of Zoology.

Course Objectives

1. To introduce to the learner the composition of blood, haemorrhage and haematopoiesis
2. To acquaint the learner with the physiology of blood clotting and clinical aspects of haematology,
3. To introduce to the learner the basics of applied haematology and to impart knowledge of diagnostic techniques used in pathology
4. To acquire the knowledge of lab pathology and its diverse career aspects
5. To introduce the topic of immunology by emphasizing the basic concepts to build a strong foundation and to give an overview of the immune system that plays an important role in disease resistance.
6. To introduce immunopathology and the concept of vaccines and vaccination.



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SEMESTER V

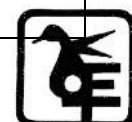
COURSE CONTENT

Unit No.	Module no.	Content	Lectures
		SZO502 (Paper II-Course 12): HAEMATOLOGY AND IMMUNOLOGY	
1		Paper Title: Basic Haematology	15
	I	Composition of plasma: Water, respiratory gases, dissolved salts, plasma proteins, nutrients, enzymes, hormones, nitrogenous waste products	
	II	Haematopoiesis: Erythropoiesis, leucopoiesis and thrombopoiesis	
	III	Erythrocytes: Structure and functions, abnormalities in structure, total count, variation in number; ESR; types of anaemia	
	IV	Haemoglobin: Structure, formation and degradation; variants of haemoglobin (foetal, adult), abnormalities in haemoglobin (Sickle cell and Thalassemia)	
	V	Leucocytes: Types and functions, total count and variation in number; leukaemia and its types	
	VI	Thrombocytes: Structure, factors and mechanism of clotting, failure of clotting mechanism	
	VII	Blood volume: Total quantity and regulation; haemorrhage	
2		Applied Haematology	15
	I	Introduction and scope of Applied Haematology: Clinical, microbiological, oncological and forensic Haematology	
	II	Clinical significance of Diagnostic Techniques i. Microscopic examination of blood: a) Blood cancer (lymphoma, myeloma), b) Infectious diseases (malaria, leishmaniasis), c) Haemoglobinopathies (sickle cell anaemia, thalassemia) ii. Coagulopathies: Haemophilia and purpura iii. Biochemical examination of blood: a) Liver function tests: AST, ALT, LDH, Alkaline phosphatase, Total and direct bilirubin b) Kidney function test: Serum creatinine, Blood Urea Nitrogen (BUN) c) Carbohydrate metabolism tests: Blood sugar, Glucose tolerance test, Glycosylated haemoglobin test d) Other biochemical tests: Blood hormones - TSH, FSH, LH.	



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Unit No.	Module no.	Content	Lectures
3		Basic Immunology	15
	I	<p>Overview of Immunology</p> <p>i. Concept of immunity</p> <p>ii. Innate immunity – Definition, factors affecting innate immunity, Mechanisms of innate immunity – First line of defence – physical and chemical barriers; Second line of defence- phagocytosis, inflammatory responses and fever</p> <p>iii. Adaptive or Acquired immunity, Antibody mediated and cell mediated immunity; Active Acquired immunity – Natural and Artificial; Passive Acquired immunity – Natural and Artificial</p>	
	II	<p>Cells and Organs of immune system</p> <p>i. Cells of immune system – B cells, T cells and null cells, macrophages, dendritic cells and mast cells</p> <p>ii. Organs of immune system</p> <p>a) Primary: Thymus and bone marrow</p> <p>b) Secondary: Lymph nodes and spleen</p>	
	III	Antigens: Definition and properties; haptens	
	IV	Antibodies: Definition, basic structure, classes of antibodies – IgG, IgA, IgM, IgD and IgE	
	V	<p>Antigen processing and presentation</p> <p>a) Endogenous antigens – cytosolic pathways</p> <p>b) Exogenous antigens – endocytic pathways</p>	
4		Applied Immunology	15
	I	<p>Antigen-Antibody interaction</p> <p>i. General features of antigen-antibody interaction</p> <p>ii. Precipitation reaction – Definition, characteristics and mechanism.</p> <p>a) Precipitation in gels (slide test)</p> <p>b) Radial immunodiffusion (Mancini method)</p> <p>c) Double immunodiffusion (Ouchterlony method)</p> <p>iii. Immunoelectrophoresis – Counter-current and Laurel's Rocket electrophoresis</p>	



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Unit No.	Module no.	Content	Credit
		iv. Agglutination reaction definition, characteristics and mechanism. a) Haemagglutination (slide and micro-tray agglutination) b) Passive agglutination c) Coomb's test v. Immunoassay-ELISA Vaccines and Vaccination i. Principles of vaccines – active and passive immunization, ii. Routes of vaccine administration iii. Classification of vaccines: a) Live attenuated b) Whole-Killed or inactivated c) Sub-unit vaccines: Toxoids, Protein vaccines, Viral-like particles, DNA vaccines iv. Adjuvants used for human vaccines: a) Virosomes and Liposomes b) Saponins c) Water-in-oil emulsions v. Vaccines against human pathogens: a) Polio b) Hepatitis A and B c) Tuberculosis (BCG) Transplantation Immunology: Introduction to transplantation; Types of grafts; Immunologic basis of graft rejection: MHC compatibility in organ transplantation, Lymphocyte and Antibody mediated graft rejection; Precautionary measures against graft rejection	
		Total no. of lectures:	60

Beyond the Syllabus

Tutorial Activities: Students' Presentations, Brain storming sessions, Group Discussions, Use of E-learning, Workshops, Hands-on training practicals, Field data collection of fauna



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**SZOP502 (SEMESTER V)
Paper II-Based on COURSE 12**

List of Experiments	
Sr. No.	Description
1	Enumeration of Erythrocytes – Total Count.
2	Enumeration of Leucocytes – Total Count.
3	Differential count of Leucocytes.
4	Erythrocyte Sedimentation Rate by suitable method – Westergren or Wintrobe method.
5	Estimation of haemoglobin by Sahli's acid haematin method.
6	Determination of serum LDH by using colorimeter/ spectrophotometer.
7	Estimation of total serum/ plasma proteins by Folin's method.
8	Estimation of serum/ plasma total triglycerides by Phosphovanillin method.
9	Latex agglutination test – Rheumatoid Arthritis.
10	Determination of bleeding and clotting time.

**Semester V: Haematology and Immunology – SZO502:Paper II (Course 12)
(Internal Assessment Pattern)**

	Marks: 40
1 Class Test : (Based on Theory Unit 1.2and 3)	20marks
2Assignment:	15marks
3 Class Participation and Overall conduct	05Marks



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Semester V: Haematology and Immunology – SZO502:Paper II (Course 12) (Internal Class Test Paper Pattern)	
Duration:	Marks:20
Q.1 a) Fill in the blanks: (1 or 2 questions each from Unit 1,2,3,4)	05marks
b) Match the column: (1 or 2 questions each from Unit 1,2,3,4)	05 marks
Column A	Column B
1.	a)
2.	b)
3.	c)
4.	d)
5.	e)
Q 2. Write short note on:(Any two)	10Marks
a) Unit1	
b) Unit2	
c) Unit3	
d) Unit4	

Semester V: Haematology and Immunology – SZO502:Paper II (Course 12) (Theory Paper Pattern)	
Duration:	Marks: 60
Q1.a) Answer the following: (Unit1)	12 Marks
OR	
a) Answer in brief: (Unit1)	6Marks
b) Answer in brief: (Unit1)	6Marks
Q2.a) Answer the following: (Unit2)	12 Marks
OR	
a) Answer in brief: (Unit2)	6Marks
b) Answer in brief: (Unit2)	6Marks
Q3.a) Answer the following: (Unit3)	12 Marks
OR	
a) Answer in brief: (Unit3)	6Marks
b) Answer in brief: (Unit3)	6Marks
Q4.a) Answer the following: (Unit4)	12 Marks
OR	
a) Answer in brief: (Unit4)	6Marks
b) Answer in brief: (Unit4)	6Marks
Q.5 Write Short notes on: Any four out of six (1 or 2 questions each from Unit 1,2,3,4)	12 Marks



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Semester V: Haematology and Immunology – SZOP502: Paper II (Course 12) (Practical Paper Pattern)	
Duration: 5 hours	Marks: 50
Q.1 Enumerate erythrocytes in the given sample and comment on clinical condition. OR Enumerate leucocytes in the given sample and comment on clinical condition. OR Present a report on differential count of leucocytes and comment on clinical condition	15 marks
Q.2 Estimate total plasma proteins by Folin's method. OR Estimate serum / plasma total triglycerides by Phosphovanillin method.	10 marks
Q.3 Estimate haemoglobin by Sahli's acid haematin method. OR Record Erythrocyte Sedimentation Rate by Westergren / Wintrobe method. OR Determine serum LDH by colorimetric/spectrophotometric method.	10 marks
Q.4. Perform Latex agglutination test – Rheumatoid Arthritis. OR Record bleeding/clotting time and comment on clinical significance	05 marks
Q.5 Viva voce based on theory	05 Marks
Q.6 Journal	05 Marks

SZO502: PaperII-Course12	Course outcome
After the completion of the course, students will able to	
CO1 Comprehend basic haematology and identify various components of haemostatic systems	
CO2 The learner will be familiar with the terminology used and diagnostic tests performed in a pathological laboratory.	
CO3 Acquaint with diagnostic approaches in haematological disorders and better equipped for further pathological course or working in a diagnostic laboratory.	
CO4 Comprehend the types of immunity and the components of immune system.	
CO5 Realize the significant role of immune system in giving resistance against diseases.	
CO6 Understand immunopathology and the principles and applications of vaccines and develop basic understanding of immunology of organ transplantation.	



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Recommended Resources

**Reference
Books**

1. Practical Hematology; Dacie J V; Churchill Livingstone; 2006
2. Lecture Notes: Haematology; Hatton, Chris S. R. Hughes-Jones, Nevin C. Hay, Deborah; Wiley-Blackwell
3. ABC series : ABC of Clinical Haematology; Provan; Drew Publisher: BMJ Books
4. Principles of Anatomy & Physiology; Thirteenth Edition; Gerard J. Tortora & Bryan Derrickson; Biological Science Textbooks, Inc.; 2012
5. Biochemistry; Fourth Edition; U. Satyanarayana & U. Chakrapani; Elsevier; 2013
6. Immunology - Introductory Textbook; Shetty N.; New Age International; 2005
7. Immunology - Essential and Fundamental; Pathak S., & Palan U.; Science Publishers; 2005
8. Immunology: A textbook; Rao C. V.; Alpha Science Int'l Ltd.; 2005
9. Ananthanarayan and Paniker's textbook of Microbiology; C. J. Paniker (Ed.); Ananthanarayan R.; Orient Blackswan; 2005
10. Textbook of Immunology; Haleem Khan, Rajendra Sagar, Sadguna
11. Prescott's Microbiology; Ninth Edition; Joanne M. Willey, Linda M. Sherwood &
12. Christopher J. Woolverton; McGraw-Hill Education; 2014
13. Immunology; Third Edition; Janis Kuby; W.H. Freeman; 1997
14. Kuby Immunology; Sixth Edition; Thomas J. Kindt, Richard A. Goldsby, Barbara Osborne & Janis Kuby; W.H. Freeman; 2007
15. Concepts in Biochemistry; Third Edition; Rodney Boyer; John Wiley & Sons, Inc.; 2006
16. Medical Biochemistry; Fourth Edition; John Baynes & Marek Dominiczak; Saunders (Elsevier); 2014
17. Cellular and Molecular immunology; Abbas A. K., Lichtman A. H. & Pillai S.; Elsevier Health Sciences; 2014
18. Roitt's Essential Immunology – Vol. 20; Delves P. J., Martin S. J., Burton D. R., & Roitt I. M.; John Wiley & Sons; 2011
19. The Elements of Immunology; Khan F.H.; Pearson Education, India; 2009
20. Kuby Immunology; Sixth Edition; Thomas J. Kindt, Richard A. Goldsby, Barbara A. Osborne & Janis Kuby; W.H. Freeman; 2007
21. Janeway's Immunobiology; Murphy K. & Weaver C.; Garland Science; 2016
22. Fundamental Immunology; Paul W. E.; Philadelphia: Lippincott-Raven; 1999
23. Immunology - Introductory Textbook; Shetty N.; New Age



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- International; 2005
24. Prescott's Microbiology; Ninth Edition; Joanne M. Willey, Linda M. Sherwood & Christopher, Woolverton; McGraw-Hill Education; 2014
 25. Medical Biochemistry; Fourth Edition; John Baynes & Marek Dominiczak; Saunders (Elsevier); 2014
 26. Lehninger's Principles of Biochemistry; David Lee Nelson, A.L. Lehninger, Michael M Cox;
 27. W.H. Freeman, New York; 2008
 28. Biochemistry; 5th ed.; J M Berg, J L Tymoczko and Lubert Stryer; W.H. Freeman, New York; 2002
 29. Biochemistry; 2nd edition; Donald Voet and Judith G Voet; J. Wiley and Sons, New York; 1995

E-Resources

1. Nanoparticle vaccine shows potential as immunotherapy to fight multiple cancer types';
2. UT Southwestern Medical Center; Science Daily, April 24 2017; <https://www.sciencedaily.com/>
3. Articles on "Blood groups"; (1) The Indian Express, August 15, 2012/ Times of India,
4. August 16, 2012; (2) Times of India, September 11, 2014
5. 'India facing shortage of life-saving albumin serum'; written by Abantika Ghosh, New
6. Delhi; The Indian Express, October 16, 2014, 2:25am



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Programme:T.Y.B.Sc.

Semester:V

Course: Zoology-III(Course13)

Course code:SZO503

Teaching Scheme (Hrs/Week)				Continuous Internal Assessment (CIA) 40 marks					End Semester Examination	Total
L	T	P	C	CIA-1	CIA-2	CIA-3	CIA-4	Lab	Written	
8	-	1	4	20	15	05		-	60	100
Max. Time, End Semester Exam (Theory) -2Hrs.										

Prerequisite 1. Basic knowledge about the concepts in Zoology
2. Skills in exploring the diverse fields of Zoology.

Course Objectives

1. To familiarize the learner with the cellular architecture of the various organs in the body and understand the importance of different types of tissues in the vital organs and their functions
2. To introduce the learner to the principles of toxicology with particular emphasis on toxic responses to chemical exposures, nature and effect of toxicity and toxicity testing and develop amongst students an introductory understanding of regulatory affairs in toxicology.
3. It also intends to develop amongst students an introductory understanding of regulatory affairs in toxicology.
4. To introduce the learner to basics of general pathology and impart knowledge of retrogressive, necrotic, pathological conditions in the body, thus explaining repair mechanism of the body.
5. To make learner familiar with biostatistics as an important tool of analysis and its applications.
6. To inculcate research aptitude by introducing advanced techniques and ideas.



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SEMESTER V
COURSE CONTENT

Unit No.	Module no.	Content	Lectures
		SZO503 (Paper III-Course 13: Mammalian Histology, Basic Toxicology, General Pathology and Biostatistics)	
1		Mammalian Histology	15
	I	Vertical section (V.S.) of skin: Layers and cells of epidermis; papillary and reticular layers of dermis; sweat glands, sebaceous glands and skin receptors	
	II	Digestive System i. Vertical section (V.S.) of tooth; hard tissue – dentine and enamel; soft tissue – dentinal pulp and periodontal ligaments ii. Transverse section (T.S.) of tongue – mucosal papillae and taste buds iii. Alimentary canal – Transverse section (T.S.) of stomach, small intestine, large intestine of mammal. iv. Glands associated with digestive system – Transverse section (T.S.) of salivary glands, liver.	
2		Toxicology	15
	I	Basic toxicology i. Introduction to toxicology – brief history, different areas of toxicology, principles and scope of toxicology ii. Toxins and Toxicants – Phytotoxins (caffeine, nicotine), Mycotoxins (aflatoxins), Zootoxins (cnidarian toxin, bee venom, scorpion venom, snake venom) iii. Characteristics of Exposure – Duration of exposure, Frequency of exposure, Site of exposure and Routes of exposure iv. Types of Toxicity – Acute toxicity, Sub-acute toxicity, Sub-chronic toxicity and Chronic toxicity	



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Unit No.	Module no.	Content	Lectures
	II	<p>v. Concept of LD50, LC50, ED50</p> <p>vi. Dose Response relationship – Individual / Graded dose response, Quantal dose response, shape of dose response curves, Therapeutic index, Margin of safety</p> <p>vii. Dose translation from animals to human – Concept of extrapolation of dose, NOAEL (No Observed Adverse Effect Level), Safety factor, ADI (Acceptable Daily Intake)</p> <p>Regulatory toxicology</p> <p>i. OECD guidelines for testing of chemicals (an overview)</p> <p>ii. CPCSEA guidelines for animal testing centre, ethical issues in animal studies</p> <p>iii. Animal models used in regulatory toxicology studies</p> <p>iv. Alternative methods in toxicology (in vitro tests)</p>	
3		General pathology	15
	I	Infectious diseases: aetiology, infectious agents, viruses - hepatitis, bacteria - tuberculosis, fungi - skin diseases	
	II	Cell injury: Mechanisms of cell injury: ischemic, hypoxic, free radical mediated and chemical	
	III	Retrogressive changes Definition, cloudy swelling, degeneration: fatty, mucoid and amyloid (causes and effects)	
	IV	Disorders of pigmentation Endogenous: Brief ideas about normal process of pigmentation, melanosis, jaundice (causes and effects)	
	V	Necrosis Definition and causes; nuclear and cytoplasmic changes; Types: Coagulative, Liquefactive, Caseous, Fat and Fibroid	
	VI	Gangrene Definition and types (dry, moist and gas gangrene)	



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Unit No.	Module no.	Content	Lectures
4		Biostatistics	15
	I	Probability Distributions: Normal, Binomial, Poisson distribution, Z-transformation, p-value, Probability Addition and multiplication rules and their applications.	
	II	Measures of Central Tendency and Dispersion: Variance, standard deviation, standard error	
	III	Testing of Hypothesis: Basic concepts, types of hypothesis: Null hypothesis and Alternate hypothesis, Levels of significance and testing of hypothesis	
	IV	Parametric and non-parametric test: Parametric tests: two-tailed Z-test and t-test	
	V	Non-parametric test: Chi-square test and its applications Correlation: Correlation coefficient and its significance	
		Total No. of lectures	60
Beyond the Syllabus:			
Tutorial Activities: Students' Presentations, Brain storming sessions, Group Discussions, Use of E-learning, Conferences and Hands-on training practicals			

SZOP503 (SEMESTER V)
Based on Paper III-COURSE 13

List of Experiments	
Sr. No.	Description
1	Study of mammalian tissues: V.S. of Tooth, T.S. of Stomach, T.S. of small intestine, T.S. of Liver.
2	Microtomy: Tissue preservation and fixation, dehydration, infiltration, paraffin embedding and block preparation, sectioning, staining.
3	Identification of diseases or conditions (from slides or pictures): Vitiligo, Psoriasis, Bed sores, Necrosis, Oedema
4	To study the effect of CCl ₄ on the level of enzyme activity in liver on aspartate and



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	alanine amino transferase, alkaline phosphatase (<i>in vitro</i> approach).
5	Study and interpretation of pathological reports: Blood, Urine and Stool (faeces).
6	Following biostatistics practicals will be done using data analysis tool of Microsoft Excel (DEMONSTRATION in regular practicals) & manually: a. Problems based on Z test b. Problems based on t test c. Problems based on Chi square test d. Correlation, regression analysis – demonstration only. e. Problems based on ANOVA – demonstration only. (Learner is expected to identify appropriate test for the given problem) ination of LC50 for a suitable pollutant (any one salt of a heavy metal dissolved in water) on Daphnia, Probit analysis.

Semester V: Mammalian Histology, Basic Toxicology, General Pathology and Biostatistics

– SZO503:Paper III(Course13)

(Internal AssessmentPattern)

	Marks: 40
1 Class Test : (Based on Theory Unit 1.2and 3)	20marks
2 Assignment:	15marks
3 Class Participation and Overall conduct	05Marks

Semester V: Mammalian Histology, Basic Toxicology, General Pathology and Biostatistics

– SZO503:Paper III(Course13)

(Internal Class Test PaperPattern)

Duration:	Marks:20
Q.1 a) Fill in the blanks: (1 or 2 questions each from Unit1,2,3)	05marks
b) Match the column: (1 or 2 questions eachfromUnit1,2,3)	05 marks
Column A	Column B
1.	a)
2.	b)
3.	c)
4.	d)
5.	e)
Q2 Write short note on:(Any two)	10Marks
a) Unit1	
b) Unit2	
c) Unit3	
d) Unit4	



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Semester V: Mammalian Histology, Basic Toxicology, General Pathology and Biostatistics	
- SZO503:Paper III(Course13)	(Theory PaperPattern)
Duration: 2 hours	Marks: 60
Q1.a) Answer the following: (Unit1) OR a) Answer in brief: (Unit1) b) Answer in brief: (Unit1)	12 Marks 6Marks 6Marks
Q2.a) Answer the following: (Unit2) OR a) Answer in brief: (Unit2) b) Answer in brief: (Unit2)	12 Marks 6Marks 6Marks
Q3.a) Answer the following: (Unit3) OR a) Answer in brief: (Unit3) b) Answer in brief: (Unit3)	12 Marks 6Marks 6Marks
Q4.a) Answer the following: (Unit4) OR a) Answer in brief: (Unit4) b) Answer in brief: (Unit4)	12 Marks 6Marks 6Marks
Q.5 Write Short notes on: Any four out of six (1 or 2 questions each from Unit 1,2,3,4)	12 Marks

Semester V: Mammalian Histology, Basic Toxicology, General Pathology and Biostatistics	
- SZOP501:Paper III(Course13)	(Practical PaperPattern)
Duration: 5 hours	Marks: 50
Q.1 Demonstrate the effect of CCl ₄ on the level of enzyme activity of Aspartate/Alanine amino transferase/ alkaline phosphatase in liver (in-vitro approach)	10 marks
Q.2 From the infiltrated tissue prepare block, trim and mount it on the block holder. OR Mount the ribbon on slide from the given block. OR Stain the given histological slide and identify the tissue.	06 marks
Q.3 Identify and describe a, b, c, d. a) & b) based on study of mammalian tissues c) & d) based on diseases or conditions	08 marks



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Q.4. Interpret the pathological report – blood / urine / stool.	03 marks
Problems in Biostatistics (anyone)	08Marks
Viva-voce:	05Marks
Q.7 Journal	10 Marks

SZO503: Paper III-Course 13

Course outcome

After the completion of the course, students will able to

CO1 appreciate the well-planned organization of tissues and cells in the organ systems.

CO2 Create awareness to acquire knowledge about precautionary measures and remedial treatment, thus promoting healthy impact on the society.

CO3 Develop broad understanding of the different areas of toxicology and develop critical thinking and assist students in preparation for employment in pharmaceutical industry and related areas.

CO4 familiar with various medical terminology pertaining to pathological condition of the body caused due to diseases.

CO5 Collect, organize and analyse data using parametric and non-parametric tests and set up a hypothesis and verify the same using limits of significance.

CO6 Enhance research aptitude and implement innovative ideas for future aspects.

Recommended Resources

Reference Books

1. A Textbook of Histology; Deshmukh Shivaji; Dominant Pub.
2. Colour Textbook of Histology; Gartner, Leslie P.;Saunders.
3. A Textbook of Histology; Mathur Ramesh; Anmol Pub.
4. A Textbook of Histology and A Practical Guide; Gunasegaran J.P.;Elsevier.
5. A Textbook of Histology; Khanna D.R.; SonaliPub
6. Practical Zoology; Second Edition; Dr. K.C. Ghose & Dr. B. Manna; New Central Book Agency Pvt. Ltd. , Kolkata;1999.
7. Casarett and Doulls Toxicology – The basic science of poisons; Edited by Curtis Klaassen; McGraw-Hill;2001.
8. Public Health & Sanitation Part I &II: The All India Institute of Local Self Government. Sthanikraj Bhavan, C.D.Barfiwala Marg,



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- Andheri (W), 400058,
9. Park's Textbook of Preventive & Social Medicine, 7th E.d: K.Park, M/S Banarsidas Bhanot Publishers, 1167, Premnagar, Jabalpur,482001.
 10. Toxicological testing handbook – Principles, applications and data interpretation
 11. A Text book of Modern Toxicology: E.Hodgson and P.E.Levi, Tata McGraw Hill. on; David Jacobson-Kram and Kit Keller; CRC Press;2006
 12. Principles and methods of toxicology; A. Wallace Hayes; CRC Press;2007
 13. Toxicology – principles and methods; M.A. Subramanian; MJP Publishers, Chennai;2004
 14. Fundamentals of Toxicology; Kamleshwar Pandey and JP Shukla; New Central book agency Ltd., Kolkata;2011
 15. Elements of Toxicology; Kamleshwar Pandey and JP Shukla; Wisdom Press, New Delhi;2010
 16. Principles and Applications of Toxicology; Lahir Y.K.; Seekay Publications;2013
 17. Essentials of Clinical Toxicology; Lall S.; Narosa Publishing House;1998.
 18. A Textbook of Veterinary and General Pathology; Second edition; J. L. Vagad; IBDC Publishers
 19. Clinical Pathology; Guru G.; NCERT;1988.
 20. Clinical Pathology; Batra Neelam; Vikas Publishing House Pvt. Ltd.; Nov.1982.
 21. Essentials of General Pathology; Dr. Sudha Shivraj, Dr. Satish Kumar Amarnath, Dr. Sudha Shivraj, Dr. Satish Kumar Amarnath, Sheela Devi; Exclusively distributed by CBS Publishers & Distributors
 22. Textbook of Pathology; Harsh Mohan; Jaypee Publishers
 23. Biostatistics – The Bare Essentials; Third Edition; Geoffrey R. Norman, David L. Streiner; B.C. Decker, Inc., Hamilton;2008
 24. Fundamentals of Biostatistics; Second Edition; Veer Bala Rastogi; Ane Books Pvt. Ltd., New Delhi; 2009 (Reprint2010)
 25. Fundamentals of Biostatistics; Second Revised Edition; Irfan Ali Khan and Atiya Khanum; Ukaaz Publications, Hyderabad;2004
 26. Instant Medical Biostatistics; Dr. Ranjan Das and Dr.Papri N. Das; Ane Books Pvt. Ltd., New Delhi;2009
 27. Primer of Biostatistics; Fifth Edition; Stanton A. Glantz; McGraw-Hill Companies, Inc.;2002
 28. Basic Biostatistics – Statistics for Public Health Practice; Second Edition; B. Burt Gerstman; Jones and Bartlett Learning Burlington;2015
 29. Biostatistics – A Guide to Design, Analysis, and Discovery; Second Edition; Ronald N. Forthofer, Eun Sul Lee and Mike Hernandez; Elsevier, Inc., (Academic Press), USA;2007
 30. Statistics in Biology and Psychology; Sixth Edition; Debajyoti Das and Arati Das; Academic Publishers, Kolkata



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Programme:T.Y.B.Sc.

Semester:V

Course: Zoology-IV(Course14)

Course code:SZO504

Teaching Scheme (Hrs/Week)				Continuous Internal Assessment (CIA) 40 marks					End Semester Examination	Total
L	T	P	C	CIA-1	CIA-2	CIA-3	CIA-4	Lab	Written	
8	-	1	4	20	15	05		-	60	100
Max. Time, End Semester Exam (Theory) -2Hrs.										

Prerequisite 1. Basic knowledge about the concepts in Zoology
2. Skills in exploring the diverse fields of Zoology.

Course Objectives

1. To introduce the learner to understand different integumentary structures and derivatives in the vertebrates and to acquaint learners with special derivatives of integument.
2. To introduce the learner to different bones of human skeleton and their functional importance and relate the arrangement with contraction and motion.
3. To identify various arrangements of the long limb muscles and to relate the arrangement with contraction and motion
4. To study muscle injuries and syndromes.
5. To introduce the learner to the basics of developmental biology with reference to chick as a model and also familiarize with experiments related to it.



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SEMESTER V

COURSE CONTENT			
Unit No.	Module no.	Content	Lectures
		SZO504 (Paper IV-Course 14): Integumentary system, Human Osteology, Limb Muscles and Developmental Biology of Chick	
1		Integumentary system and derivatives	15
	I	Basic structure of integument: Epidermis and dermis	
	II	Epidermal derivatives of Vertebrates i. Hair, hoof, horn, claw, teeth, beak and epidermal scales (small scales, large scales, modified scales - spine) ii. Glands - types (mucous, serous, ceruminous, poison, uropygial, and salt gland) and functions iii. Type of feathers	
	III	Dermal derivatives of Vertebrates: Scales in fish; scutes in reptiles and birds; dermal scales in mammals – Armadillo, Antler –Caribou	
	IV	Special derivatives of integument: Wart in toad, rattle in snake, whale bone in baleen whale, kneepads in camel.	
2		Human Osteology	15
	I	Introduction: Bone structure (Histology), physical properties, chemical composition and general functions of bones. Cartilage: General structure, functions	
	II	Introduction and types of long limb muscles Flexors, Extensor, Rotator, Abductors, Adductors	
	III	Axial skeleton i. Skull: General characteristics of skull bones - Cranial and facial bones ii. Vertebral column: General characteristics of a vertebra, structure of different types of vertebrae (cervical, thoracic, lumbar, sacrum and coccyx) iii. Ribs and sternum: General skeleton of ribs and sternum iv. Hyoid bone: Structure and function.	



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Unit No.	Module no.	Content	Lectures
2	IV	Appendicular skeleton i. Pectoral girdle and bones of forelimbs ii. Pelvic girdle and bones of hindlimbs	
3		Muscles of long bones of Human limbs	15
	I II III	Introduction and types of long limb muscles Flexors, Extensor, Rotator, Abductors, Adductors Muscles of forelimbs i. Muscles that move the arm (Humerus) – Triceps brachii, Biceps brachii, brachialis and brachioradialis ii. Muscles that move the forearm (Radius-ulna) – Flexor carpi radialis, Flexor carpi ulnaris and Extensor carpi ulnaris iii. Muscles that move the wrist, hand and fingers – Flexor digitorum superficialis, Extensor carpi radialis and Extensor digitorum Muscles of hind limbs i. Muscles that move the thigh (Femur) – Sartorius, Adductor group, Quadriceps group (Rectus femoris, Vastus lateralis, Vastus medialis), Hamstring group (Biceps femoris, Semimembranosus, Semitendinosus) ii. Muscles that move the lower leg (tibia-fibula) – Fibularis longus, Gastrocnemius, Tibialis anterior, Soleus, Extensor digitorum longus and Fibularis tertius iii. Muscles that move the ankle, foot and toes - Tibialis anterior, Extensor digitorum, Longus and Fibularis muscles	
4		Developmental Biology of Chick	15
	I II	Introduction to Developmental Biology: Basic concept and principles of developmental biology morphogenesis, organogenesis, fate maps, cell adhesion cell affinity and cell differentiation. Development of Chick embryo i. Structure of Hen's egg, physico-chemical nature and form of yolk- granular, platelets and spheres; fertilization, cleavage, blastulation, gastrulation i. Structure of chick embryo – 18 hours, 24 hours, 33 hours, 48 hours and 72hours	



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Unit No.	Module no.	Content	
4		iii. Extra embryonic membranes iv. Organizer: Introduction, Spemann Mangold experiment, Hensen's node as an organizer.	
	III	Fate Mapping Techniques	
		Total No. of lectures	

Beyond the Syllabus

Tutorial Activities: Students' Presentations, Brain storming sessions, Group Discussions, Use of E-learning, Conferences and Hands-on training practicals

SZOP504 (SEMESTER V)
Based on Paper IV-COURSE 14

List of Experiments

Sr. No.	Description
1	Study of integumentary systems – V. S. of Skin of Shark, Frog, <i>Calotes</i> , Pigeon and Human
2	Study of Human Axial Skeleton – Skull and Vertebral column
3	Study of Human Appendicular Skeleton – Pectoral and pelvic girdle with limb bones
4	Study of muscles of forelimbs – <i>Biceps brachii</i> , <i>Brachialis</i> , <i>Brachio radialis</i> , <i>Triceps brachii</i> , <i>Flexor carpi radialis</i> , <i>Flexor carpi ulnaris</i> and <i>Extensor carpi ulnaris</i>
5	Study of muscles of hind limbs – Sartorius, Adductor group, Quadriceps group
6	Rectus femoris, Vastus lateralis, Vastus medialis, Hamstring group (<i>Biceps femoris</i> , <i>Semimembranosus</i> , <i>Semitendinosus</i>), <i>Fibularis longus</i> , <i>Gastrocnemius</i>
7	<i>Tibialis anterior</i> , <i>Soleus</i> , <i>Extensor digitorum longus</i> , <i>Fibularis tertius</i>



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Sr No.	Description
8	Study of ontogeny of chick embryo using permanent slides – 18 hours, 24 hours, 33 hours, 48 hours and 72 hours.
9	Prepare permanent mounting of chick embryo up to 48 hours of incubation (demonstration).

Semester V: Integumentary system, Human Osteology, Limb Muscles and Developmental Biology of Chick – SZO504:Paper IV (Course 14)

	Marks: 40
1 Class Test : (Based on Theory Unit 1,2,3and4)	20marks
2 Assignment:	15marks
3 Class Participation and Overall conduct	05Marks

Semester V: Integumentary system, Human Osteology, Limb Muscles and Developmental Biology of Chick –SZO504: Paper IV (Course 14)

Duration:	Marks:20
Q.1 a) Fill in the blanks: (1 or 2 questions each from Unit 1,2,3,4)	05marks
b) Match the column: (1 or 2 questions each from Unit 1,2,3,4)	05 marks
Column A	Column B
1.	a)
2.	b)
3.	c)
4.	d)
5.	e)
Q.2 Write short note on:(Any two)	10Marks
a) Unit1	
b) Unit2	
c) Unit3	
d) Unit4	

Semester v: Integumentary system, Human Osteology, Limb Muscles and Developmental Biology of Chick – SZO504:Paper IV(Course14) (Theory Paper Pattern)

Duration:	Marks: 60
Q1.a) Answer the following: (Unit1)	12 Marks
OR	
a) Answer in brief: (Unit1)	6Marks
b) Answer in brief: (Unit1)	6Marks



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Q2.a) Answer the following: (Unit2) OR a) Answer in brief: (Unit2) b) Answer in brief: (Unit2)	12 Marks 6Marks 6Marks
Q3.a) Answer the following: (Unit3) OR a) Answer in brief: (Unit3) b) Answer in brief: (Unit3)	12 Marks 6Marks 6Marks
Q4.a) Answer the following: (Unit4) OR a) Answer in brief: (Unit4) b) Answer in brief: (Unit4)	12 Marks 6Marks 6Marks
Q.5 Write Short notes on: (Any four out of six) (1 or 2 questions from Unit 1,2,3 and 4)	12 Marks

**Semester V: Integumentary system, Human Osteology, Limb Muscles and
 Developmental Biology of Chick**
– SZOP504:Paper IV(Course14) (Practical PaperPattern)

Duration: 2 hours	Marks: 50
Identify and describe a) and b) Based on integumentary system c) and d) Based on forelimb muscle e) and f) Based on hind limbs muscle g) and h) Based on osteology – human axial skeleton i) Based on osteology – human appendicular skeleton	27 marks
Q.2 . Identify, sketch, label and describe the given stage of chick embryo	08 marks
Q 3. Viva-voce based on theory	05marks
Q 4. Journal	05marks



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SZO504: Paper IV-Course14

Course outcome

After the completion of the course, students will able to

CO1 Understand the importance of various types of epidermal and dermal derivatives along with their functions.

CO2 Acquire knowledge about the structure, types and functions of human skeleton, its arrangement and their role in body movements.

CO3 to understand the types of long limb muscles, its arrangement and their role in body movements

CO4 to gain knowledge about the muscle injuries and syndromes

CO5 Gain information pertaining to the processes involved in embryonic development and practical applications of studying the chick embryology.

Recommended Resources

Course 14

Reference Books

1. Comparative Anatomy of the Vertebrates; Ninth Edition; Kent, G.C. and Carr R.K.; The McGraw-Hill Companies; 2000
2. Text book of Chordates; Saras publication
3. Modern text book of Zoology; Prof. R.L.Kotpal
4. Integumentary system and its derivatives; Samuel D.Hodge
5. Atlas of Human Anatomy – Vol I; R.D. Sinelnikov; Mr. Publishers Moscow
6. A Guide of Osteology (for medical students); Prakash Kendra, Lucknow
7. Text Book of Comparative Anatomy and Physiology; Tortora
8. Human Osteology – Tim D White
9. Text Book of Human Osteology – Singh Inderbir
10. Mechanisms of Body Functions; Second Edition; Dexter M. Easton; Prentice-Hall of India Pvt. Ltd., New Delhi; 1978
11. Human Anatomy – John W. Hole, Jr., Karen A. Koos, Publisher: W. C. Brown Publisher, USA.
12. Practical Zoology; Second Edition; Dr. K.C. Ghose & Dr. B. Manna; New Central Book Agency Pvt. Ltd. , Kolkata; 1999.
13. Principles of Anatomy and Physiology – Gerard T. Tortora and Sandra Reynolds Grabowski. Publisher: Harpers Collins College Publishers (7th Edition).
14. Developmental biology – Gilbert
15. Development of Chick – Patten
16. Developmental Biology – Wolpert
17. Text book of Embryology – N.Arumugam
18. Chicken Development – Embryology; W.H. Freeman & B. Bracegirdle



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Programme:T.Y.B.Sc.

Semester: VI

Course: Zoology-I(Course15)

Course code:SZO601

Teaching Scheme (Hrs/Week)				Continuous Internal Assessment (CIA) 40 marks					End Semester Examination	Total
L	T	P	C	CIA-1	CIA-2	CIA-3	CIA-4	Lab	Written	
8	-	1	4	20	15	05		-	60	100
Max. Time, End Semester Exam (Theory) -2Hrs.										

Prerequisite 1. Basic knowledge about the concepts in Zoology
2. Skills in exploring the diverse fields of Zoology.

Course Objectives

1. To enhance the knowledge of Classical Zoology, highlighting the hierarchy of the development of organisms.
2. To introduce basic concepts of modern Chordate classification with evolution point of view and to understand the concept of taxonomy in higher animal kingdom.
3. To introduce the learners to the distinguishing characters of diverse Phylum and their adaptive features with reference to their habitat.
4. To introduce the learners to the distinguishing characters of classes Reptilia, Aves and Mammalia and their adaptive features with reference to their habitat.
5. To study in depth about the general characteristics and salient features of Vertebrate-Shark.



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SEMESTER VI

COURSE CONTENT			
Unit No.	Module no.	Content	Lectures
		<u>SZ0601</u> (Paper I-Course 15): Taxonomy and Type Study II	
1		Chordata: Protochordata and Euchordata I	15
	I	General characters, Difference between non-chordates and chordates Origin of chordates: Annelids as ancestors, Arachnids as ancestors and affinities with Echinodermata	
	II	Protochordata i. General characters of Group Protochordata ii. Distinguishing characters of Subphylum Urochordata and Cephalochordata iii. Subphylum Urochordata ▪ Class Ascidiacea e.g. <i>Herdmania</i> ▪ Class Thaliacea e.g. <i>Salpa</i> ▪ Class Larvacea e.g. <i>Oikopleura</i> iv. Subphylum Cephalochordata Class Leptocardii e.g. <i>Branchiostoma</i> (Amphioxus)	
	III	Euchordata I i. Group Euchordata: General characters Subphylum Vertebrata: General characters Division Agnatha and Gnathostomata: Distinguishing characters. ii. General characters with examples of: Class Ostracodermii e.g. <i>Cephalaspis</i> <input type="checkbox"/> Class Cyclostomata e.g. <i>Petromyzon</i> (Lamprey) <input type="checkbox"/>	
2		Euchordata II	15
	I	Division: Gnathostomata i. Superclass: Pisces and Tetrapoda ii. Superclass – Pisces: Distinguishing characters Class Placodermi e.g. <i>Climatius</i> Class Chondrichthyes e.g. <i>Rhinobatus</i> (Guitar fish)	



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	III	Class Osteichthyes e.g. <i>Exocoetus</i> (Flying fish) Dipnoi (Lung fish): Distribution, habit and habitat, external and internal characters, affinities with super class Pisces, affinities and differences with class Amphibia	
	IV	Superclass Tetrapoda Class Amphibia: General characters Examples: a. Limbless amphibian e.g. <i>Ichthyophis</i> (Caecilian) b. Tailed amphibian e.g. <i>Amphiuma</i> c. Tailless amphibian e.g. <i>Hyla</i> (Treefrog)	
3		Group Euchordata II	15
	I	Class Reptilia: General characters Examples a. Extinct reptile e.g. <i>Ichthyosaurus</i> b. Living fossil e.g. <i>Sphenodon</i> c. Aquatic reptile e.g. <i>Chelonia sp.</i> (Seaturtle) d. Arboreal reptile e.g. <i>Chamaeleon</i>	
	II	Class Aves: General Characters Examples a. Arboreal bird e.g. <i>Melanerpes sp.</i> (Woodpecker) b. Terrestrial bird e.g. <i>Gallus sp.</i> (Jungle fowl) c. Swimming bird e.g. <i>Phalacrocorax sp.</i> (Cormorant) d. Shore birds and wading birds, e.g. Scolopacidae (Sandpiper), <i>Ardeolagrayii</i> (Pondheron) e. Birds of prey e.g. Strigiformes (Owl), Accipitriformes (Eagle) f. Flightless birds e.g. <i>Dromaius sp.</i> (Emu)	
	III	Class Mammalia: General characters Examples a. Egg-laying mammals e.g. <i>Ornithorhyncussp.</i> (Duck-billed platypus) b. Pouched mammals e.g. <i>Macropus sp.</i> (Kangaroo) c. Insect eating mammals e.g. <i>Sorex sp.</i> (Common shrew) d. Toothless mammals e.g. <i>Bradypus sp.</i> (Sloth) e. Gnawing mammals e.g. <i>Funambulus sp.</i> (Squirrel) f. Primates e.g. <i>Macaca sp.</i> (Monkey)	



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Unit No.	Module no.	Content	Lectures
3		Type study: Shark	15
	I	Habit & habitat, distribution, external characters, classification and economic importance.	
	II	Skin, exoskeleton, endoskeleton and systems a) Digestive system b) Respiratory system c) Blood vascular system d) Nervous system, Sense and receptor organs e) Urinogenital system, copulation, fertilization and development	
		Total No. of lectures	60

Beyond the Syllabus

Tutorial Activities: Students' Presentations, Brain storming sessions, Group Discussions, Use of E-learning, Conferences and Hands-on training practicals

SZOP601 (SEMESTER VI)
Based on Paper I -Course 15

List of Experiments

Sr. No.	Description
1	Group Protochordata i. Subphylum Urochordata a) Class Larvacea e.g. <i>Oikopleura</i> b) Class Ascidiacea e.g. <i>Ciona</i> c) Class Thaliacea e.g. <i>Salpa</i>
	ii. Subphylum Cephalochordata • Class Leptocardii e.g. <i>Branchiostoma</i> (Amphioxus)
	iii. Subphylum Vertebrata: Division Agnatha a) Class Ostracodermi e.g. <i>Pharyngolepis</i> b) Class Cyclostomata e.g. <i>Petromyzon</i>



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2	<p>Division Gnathostomata</p> <p>i. Superclass Pisces:</p> <p style="margin-left: 40px;">a) Class Placodermi e.g. <i>Bothriolepis</i> b) Class Chondrichthyes e.g. <i>Rhinobates, Chimaera</i> c) Class Osteichthyes e.g. <i>Protopterus, Catfish</i></p> <p>ii. Superclass Tetrapoda:</p> <p style="margin-left: 40px;">a) Class Amphibia, e.g. <i>Ichthyophis, Alytes</i> and <i>Triton</i> b) Class Reptilia: e.g. <i>Varanus</i> and <i>Crocodile</i></p>
3	<p>Class Aves:</p> <p>Examples: Penguin, Flamingo and Vulture</p>
4	<p>Class Mammalia:</p> <p>Examples: <i>Dasyurus</i>(Tiger cat), Flying Squirrel and Gorilla.</p>
5	<p>Study of Shark with the help of diagram / Photograph / Simulation whichever possible. No animal shall be dissected.</p> <p>a) Digestive system b) Heart and Aortic arches c) Urinogenital System d) Endoskeleton of Shark:</p> <p style="margin-left: 40px;">i. Axial – Skull and vertebral column ii. Appendicular – Pelvic and pectoral fins, pelvic and pectoral girdle</p>
6	<p>Visit to fish market / Aquarium / Zoo / National Park /Any other relevant place to observe chordates and prepare a report.</p>

**Semester VI: Taxonomy and Type Study II
-SZO601:Paper I(Course15)**

(Internal AssessmentPattern)

Marks: 40

1 Class Test : (Based on Theory Unit 1,2,3and4)

20marks

2 Assignment:

15marks

3 Class Participation and Overall conduct

05Marks



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Semester VI: Taxonomy and Type Study II -SZO601:Paper I(Course 15)		(Internal Class Test PaperPattern)
Duration:		Marks:20
Q.1 a) Fill in the blanks: (1 or 2 questions each from Unit 1,2,3,4)		05 marks
b) Match the column: (1 or 2 questions each from Unit 1,2,3,4)		05 marks
Column A	Column B	
1.	a)	
2.	b)	
3.	c)	
4.	d)	
5.	e)	
Q.2. Write short note on: (Any two)		10 Marks
a) Unit 1		
b) Unit 2		
c) Unit 3		
d) Unit 4		

Semester VI: Taxonomy and Type Study II -SZO601:Paper I(Course 15)		(Theory Paper Pattern)
Duration: 2 hours		Marks: 60
Q1.a) Answer the following: (Unit 1)		12 Marks
OR		
a) Answer in brief: (Unit 1)		6 Marks
b) Answer in brief: (Unit 1)		6 Marks
Q2.a) Answer the following: (Unit 2)		12 Marks
OR		
a) Answer in brief: (Unit 2)		6 Marks
b) Answer in brief: (Unit 2)		6 Marks
Q3.a) Answer the following: (Unit 3)		12 Marks
OR		
a) Answer in brief: (Unit 3)		6 Marks
b) Answer in brief: (Unit 3)		6 Marks
Q4.a) Answer the following: (Unit 4)		12 Marks
OR		
a) Answer in brief: (Unit 4)		6 Marks
b) Answer in brief: (Unit 4)		6 Marks
Q.5 Write Short notes on: Any four out six (1 or 2 questions each from Unit 1,2,3,4)		12 Marks



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Semester VI: Taxonomy and Type Study II		(Practical Paper Pattern)
-SZOP601: Paper I (Course 15)		
Duration: 5 hours		Marks: 50
Q1. Identify, classify giving reasons		06 marks
a) Urochordata / Cephalochordata / Ostachodermi / Cyclostomata		
b) Observe the animal* (photo/existing preserved specimen) and state its class giving reasons.		
* The animal should be other than prescribed in the syllabus		
Q2. Identify, classify and describe		15 marks
a) Pisces		
b) Amphibia		
c) Reptilia		
d) Aves		
e) Mammalia		
Q.3 Study of shark with the help of Specimen / Photograph / Simulation (Digestive system / Urinogenital system / Heart and aortic arches		06 marks
Q.4. Identify, sketch and label/ Identify and describe marked portion in given diagram Skull or vertebra of shark/ Fin of shark (Pectoral / Pelvic) / Girdle of shark (Pectoral / Pelvic)		03 marks
Q.5 Field report and viva based on Paper I Course 15		10 Marks
Q.6 Journal with neatly drawn and labelled diagrams		10 Marks

SZO601: Paper I-Course 15

Course outcome

After the completion of the course, students will able to

CO1 trained in identifying the fauna through key features, habitat and behavioural aspects which will enhance their knowledge in the subject of Zoology

CO2 get an idea of origin of Chordates, its taxonomy up to class with reference to phylogeny and their special features.

CO3 understand the characteristic features and examples of different Phylum and emphasize on the examples which generates curiosity for further research.

CO4 understand the characteristic features and examples of class of Reptilia, Aves and Mammalia.

CO5 get an idea of vertebrate animal life of Shark elaborately with the classification and the systems in detail.



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Recommended Resources

- | | |
|------------------|---|
| Text | 1. Modern text book of Zoology – Vertebrates; Professor R.L. Kotpal; Rastogi publication; Third Edition 2012. |
| Books | |
| Reference | 3. Vertebrate Zoology for Degree students; V. K. Agarwal;S. Chand Publication;2012. |
| Books | 4. Fundamentals of Zoology, Dr. K. C. Ghosh and Dr.B. Manna, New Central book Agency (P)Ltd.
5. Chordate Zoology Volume II, Prof. N. Arumogam. Saras Publication.
6. Chordate Anatomy Mohan P. Arora, Himalaya Publishing House, First edition.
7. Chordate Zoology, E. L. Jordan, P.S. Verma, S. Chand& Company Ltd.
8. The life of Vertebrates; J.Z. Young; ELBS - Oxford University Press; Third edition,2006
9. Textbook of chordate Zoology, Vol. II, G.S. Sandhu, H. Bhaskar; Campus Book International, First edition, 2005.
10. Introduction to Zoology – Vol II: K. K. Chaki, G. Kundu and S. Sarkar, New Crystal Book Agency.
11. URL for search on net:
https://www.amazon.com/Protozoology-Susheel-Vilas-Nikam/dp/9350300044
12. Chordate Zoology by E. L. Jordan and P. S. Verma, edition,2009, Chand publications
13. Chordate Zoology by P. S. Verma, edition,2009,Chand publications
14. Modern Textbook of Zoology Vertebrates by R.L.Kotpal, edition Jan 2015, Rastogi publications
15. Practical Zoology: Vertebrate, by S. S. Lal,2015
16. A Textbook of Invertebrate Zoology & Cell Biology, by V.S. Kanwate, A. N. Kulkarni et al. ed. Alka Prakashan
17. The Animal Kingdom: An Elementary Textbook in Zoology; Specially Classified and Arranged for the Use of Science Classes, Schools and Colleges (Classic Reprint), by Ellis A. Davidson, Sept. 2015, Publisher: Forgotten Book. |



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**E-
Resources**

1. <http://www.ucmp.berkeley.edu/chordata/chordata.html>
2. <http://www.nhptv.org/wild/chordata.asp>
3. <http://www.ucmp.berkeley.edu/chordata/chordata.html>
4. <http://www.nhptv.org/wild/chordata.asp>
5. <https://www.shapeoflife.org/phylum-chordata-advanced>
6. <http://www.nhc.ed.ac.uk/index.php?page=493.450>
7. <https://www.earthlife.net/inverts/chordata.html>
8. <http://animaldiversity.org/accounts/Chordata/>9. <http://faculty.collegeprep.org/~bernie/sciproject/project/Kingdoms/Animal%20Kingdom%20%205/Local%20copy/classification/chordata.html>



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Programme: T.Y.B.Sc.

Semester: VI

Course: Zoology-II(Course16)

Course code: SZO602

Teaching Scheme (Hrs/Week)				Continuous Internal Assessment (CIA) 40 marks					End Semester Examination	Total
L	T	P	C	CIA-1	CIA-2	CIA-3	CIA-4	Lab	Written	
8	-	1	4	20	15	05		-	60	100
Max. Time, End Semester Exam (Theory) -2Hrs.										

Prerequisite 1. Basic knowledge about the concepts in Zoology
2. Skills in exploring the diverse fields of Zoology.

Course Objectives

1. To introduce to the learner the fundamental concepts of enzyme biochemistry and to enable the learner realize applications of enzymes in basic and applied sciences.
2. To introduce to the learner the concept of homeostasis thermoregulation and osmoregulation
3. To introduce to the learner the details of endocrine glands and its disorders.
4. To introduce to the learner the fundamental concepts of tissue culture and guide them progressively to certain areas of animal tissue culture.
5. To create interest in the techniques and methodology of tissue culture in research work



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SEMESTER VI

COURSE CONTENT			
Unit No.	Module no.	Content	Lectures
		<u>SZO602</u> (Paper II-Course 16): Enzymology, Homeostasis, Endocrinology and Animal Tissue Culture	
1		Enzymology	15
	I	Introduction and Nomenclature: Definition; concept of activation energy; nomenclature and classification (based on IUB – Enzyme Commission) of enzymes; chemical nature of enzyme, co-factors and co enzymes.	
	II	Enzyme Action and Kinetics: Mechanism; Factors affecting enzyme activity – substrate, pH and temperature. Derivation of Michaelis-Menten equation and Lineweaver Burk plot; Concept and significance of K_m , V_{max} and K_{cat} .	
	III	Enzyme Inhibition: Competitive and non-competitive inhibitors and their kinetics; therapeutic applications of enzyme inhibitors.	
	IV	Regulation of Enzyme Activity: Allosteric regulation and regulation by covalent modification of enzymes; Isozymes (LDH)	
	V	Industrial applications of enzymes: Food and detergents	
2		Homeostasis	15
	I	Homeostasis i. External and internal environment; Acclimation and acclimatization. ii. Body clock – Circadian & Diurnal rhythm.	
	II	Thermoregulation i. Endothermy and ectothermy ii. Temperature balance: Heat production – shivering and non-shivering thermogenesis; Brown fat, Mechanisms of heat loss. iii. Adaptive response to temperature - daily torpor, hibernation, aestivation	



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Unit No.	Module no.	Content	Lectures
2	III	Osmotic and Ionic Regulation <ol style="list-style-type: none"> i. Living in hypo-osmotic, hyper-osmotic and terrestrial environment – Water absorption, salt water ingestion and salt excretion, Salt glands, Metabolic water ii. Role of kidney in ionic regulation 	
3		Endocrinology	15
	I II III	General organization of mammalian endocrine system Hormones: Classification, properties, mechanism of hormone action. Histology, functions and disorders of the following endocrine glands: Pituitary Thyroid Parathyroid Pancreas Adrenal	
4		Animal Tissue Culture	15
	I II III	Aseptic techniques <ol style="list-style-type: none"> i. Sterilization – basic principles of sterilization, importance of sterility in cell culture ii. Sterile handling – swabbing, capping, flaming, handling bottles and flasks, pipetting, pouring. Culture media <ol style="list-style-type: none"> i. Types of media – Natural and Artificial media ii. Balanced Salt Solutions iii. Complete Media – amino acids, vitamins, salts, glucose, oxygen supplements, hormones and growth factors, antibiotics iv. Factors influencing cell culture – surface tension and foaming, viscosity, temperature, osmolality, pH, CO₂, bicarbonate and O₂ Advantages of tissue culture – control of the environment, <i>in vitro</i> modelling of <i>in vivo</i> conditions	



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IV	<p>Limitations of tissue culture techniques</p> <ul style="list-style-type: none"> i. Preparation of cells / organs for culture ii. Cover slip, Flask and Tube culture iii. Primary and established cell lines iv. Hybridoma technology 	
	Total No. of lectures	60

Beyond the Syllabus

Tutorial Activities: Students' Presentations, Brain storming sessions, Group Discussions, Use of E-learning, Conferences and Hands-on training practicals

**SZOP602 (SEMESTER VI)
Based on Paper II- Course 16**

List of Experiments	
Sr. No.	Description
1	Effect of varying pH on activity of enzyme Acid Phosphatase
2	Effect of varying enzyme concentration on activity of enzyme Acid Phosphatase
3	Effect of varying substrate concentration on activity of enzyme Acid Phosphatase
4	Effect of inhibitor on the activity of enzyme Acid Phosphatase
5	Separation of LDH isozymes by agarose / polyacrylamide gel electrophoresis
6	Histology of glands: T.S. of pituitary, thyroid, parathyroid, pancreas, adrenal.
7	Instruments for tissue culture- Autoclave, Millipore filter, CO2 incubator, Laminar air-flow. (Principle & use)
8	Packaging of glassware for tissue culture.
9	Aseptic transfer techniques.
10	Trypsinization and vital staining using Trypan blue stain.



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Semester VI: Enzymology, Homeostasis, Endocrinology and Animal Tissue Culture– SZO602:Paper II (Course 16)

(Internal Assessment Pattern)

	Marks: 40
1 Class Test : (Based on Theory Unit 1.2and 3)	20marks
2 Assignment:	15marks
3 Class Participation and Overall conduct	05Marks

Semester VI: Enzymology, Homeostasis, Endocrinology and Animal Tissue Culture– SZO602:Paper II (Course 16)

(Internal Class Test Paper Pattern)

Duration:		Marks:20
Q.1 a) Fill in the blanks: (1 or 2 questions each from Unit1,2,3,4)		05marks
b) Match the column: (1 or 2 questions each from Unit1,2,3,4)		05 marks
Column A	Column B	
1.	a)	
2.	b)	
3.	c)	
4.	d)	
5.	e)	
Q 2. Write short note on:(Any two)		10Marks
a) Unit1		
b) Unit2		
c) Unit3		
d) Unit4		

Semester VI: Enzymology, Homeostasis, Endocrinology and Animal Tissue Culture– SZO602:Paper II (Course 16)

(Theory Paper Pattern)

Duration: 2 hrs	Marks: 60
Q1.a) Answer the following: (Unit1)	12 Marks
OR	
a) Answer in brief: (Unit1)	6Marks
b) Answer in brief: (Unit1)	6Marks
Q2.a) Answer the following: (Unit2)	12 Marks
OR	
a) Answer in brief: (Unit2)	6Marks
b) Answer in brief: (Unit2)	6Marks
Q3.a) Answer the following: (Unit3)	12 Marks
OR	
a) Answer in brief: (Unit3)	6Marks
b) Answer in brief: (Unit3)	6Marks



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Q4.a) Answer the following: (Unit4) OR a) Answer in brief: (Unit4) b) Answer in brief: (Unit4)	12 Marks 6Marks 6Marks
Q.5 Write Short notes on: Any four out of six (1 or 2 questions each from Unit 1,2,3,4)	12 Marks

Semester VI: Enzymology, Homeostasis, Endocrinology and Animal Tissue Culture
– SZOP602:Paper II (Course 16)

(Practical Paper Pattern)

Duration: 5 hours

Q.1 Demonstrate the effect of _____ on the activity of acid phosphatase.

(Substrate concentration/ pH variation/ Enzyme concentration/ Inhibitor concentration)

OR

Perform trypsinization and show the isolated cells using suitable vital stain.

Q.2 Separate LDH isozymes from the given sample by Agarose / Polyacrylamide gel electrophoresis.

OR

Demonstrate the packaging of glassware for tissue culture (Any three)

OR

Demonstrate the technique of Aseptic transfer.

Identification:

a) Based on diseases

b) Based on diseases

c) Based on diseases

d) Any one instrument – Autoclave, Millipore filter, CO2 incubator, Laminar air-flow.

Q.4. Viva voce based on theory

Q.4 Journal

Marks: 50

15 marks

10 marks

15 marks

05 marks

05 Marks



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SZO602: Paper II-Course16

Course outcome

After the completion of the course, students will able to

CO1 Understand fundamentals of enzyme structure, action and kinetics and appreciate the enzyme assay procedures and the therapeutic applications of enzymes.

CO2 Comprehend the adaptive responses of animals to environmental changes for their survival.

CO3 understand the types and secretions of endocrine glands and their functions.

CO4 Understand the significance of tissue culture as a tool in specialized areas of research and will appreciate its applications in various industries.

CO5 Put theory into practice by improvising in the techniques and methodology of tissue culture.

Recommended Resources

Text Books

1. Text book of Comparative Physiology; R Nagabhushanam, Ms Kodarkar, Sarojini R India Book House Pvt. Ltd.

Reference Books

2. Comparative Animal Physiology; Knut Schmidt Nielson; Cambridge Press
3. Comparative Animal Physiology; Prosser and Brown
4. Comparative Animal Physiology; William S Hoar
5. Animal Physiology; N. Arumugam, A. Mariakuttikan; Saras Publication
6. Mechanisms of Body Functions; Second Edition; Dexter M. Easton; Prentice-Hall of India Pvt. Ltd., New Delhi;1978
7. Culture of animal cells – A manual of basic technique; R. Ian Freshney; John Wiley and Sons Publications;2005
8. Basic cell culture – A practical approach; J. M. Davis; Oxford University Press; Indian edition;2005
9. Animal cell culture – Biotechnology Series: Vol.1; Bina Mishra, B. P. Mishra, Pran P. Bhat, P.N. Bhat; Studium Press (India) Pvt. Ltd; 2011
10. Animal cell culture – Concept and Applications; Shweta Sharma; Oxford book Company;2012
11. Biotechnology of Animal Tissues; Dr. P.R. Yadav and Dr. Rajiv Tyagi; Discovery Publishing House, New Delhi;2006
12. A textbook of Enzymes: Shailendra Singh; Campus Book International, New Delhi2007.
13. Biochemical Adaptation: Mechanism and Process in Physiological Evolution: Peter W. Hochachka & George N. Somero, Oxford University Press.



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14. Text book of Endocrinology; Williams
15. Textbook of Endocrinology Hardcover; Dharmalingam;2010
16. Endocrinology; 6th Edition; Mac Hadley, Jon E. Levine
17. Bailey's textbook of histology Hardcover; Frederick R Bailey
18. Comparative Animal Physiology: P. C. Withers, Thomson Publishing Co.
19. Additional Reading: Prescott's Microbiology; Ninth Edition; Joanne M. Willey, Linda M. Sherwood & Christopher J. Woolverton; McGraw-Hill Education;2014
20. Biotechnology-an introduction: Second Edition:S. Ignacimuthu, S.J, Narosa Publications.
21. Animal Biotechnology: R. Sasidhara, MJP Publishers, Chennai. 2006



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Programme: T.Y.B.Sc.

Semester: VI

Course: Zoology-III(Course17)

Course code: SZO603

Teaching Scheme (Hrs/Week)				Continuous Internal Assessment (CIA) 40 marks					End Semester Examination	Total
L	T	P	C	CIA-1	CIA-2	CIA-3	CIA-4	Lab	Written	
8	-	1	4	20	15	05		-	60	100
Max. Time, End Semester Exam (Theory) -2Hrs.										

Prerequisite 1. Basic knowledge about the concepts in Zoology
2. Skills in exploring the diverse fields of Zoology.

Course Objectives

1. To introduce learner to chemical and molecular processes that affect genetic material and understand the concept of DNA damage and repair, and how gene control is necessary for cell survival.
2. To introduce learner to a set of techniques to modify an organism's genome to produce improved or novel genes and organisms.
3. To introduce learner with the concepts of genetics, genetic alterations in human genome and their diagnosis.
4. To introduce learner to bioinformatics – a computational approach to learning the structure and organization of genomes, phylogeny and metabolism.
5. To inculcate research-oriented activities by applying the theory into training and thus, emphasizing in overall development of the student.



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SEMESTER VI

COURSE CONTENT			
Unit No.	Module no.	Content	Lectures
		SZO603 (Paper III- Course 17): Molecular Biology, Genetic Engineering, Human Genetics and Bioinformatics	
1		Molecular Biology	15
	I	Types of mutation <ol style="list-style-type: none"> i. Point mutations – substitution, deletion and insertion mutations ii. Substitution mutations – silent (same-sense), missense and nonsense mutations, transition and transversion iii. Deletion and Insertion mutations – frameshift mutations iv. Trinucleotide repeat expansions – fragile X syndrome, Huntington disease v. Spontaneous mutation – tautomeric shifts, spontaneous lesions 	
	II	Induced mutations <ol style="list-style-type: none"> i. Physical agents: <ul style="list-style-type: none"> Ionizing radiation (X-rays, α, β and γ rays) Non-ionizing radiation (UV light) ii. Chemical agents: <ul style="list-style-type: none"> Base analogs (5-bromouracil) Intercalating agents (ethidium bromide) <input type="checkbox"/> Deaminating agents (nitrous acid) <input type="checkbox"/> Hydroxylating agents (hydroxylamine) <input type="checkbox"/> Alkylating agents (mustard gas) <input type="checkbox"/> Aflatoxin (aflatoxin B₁) 	
	III	Preventative and repair mechanisms for DNA damage <ol style="list-style-type: none"> i. Mechanisms that prevent DNA damage – superoxide dismutase and catalase ii. Mechanisms that repair damaged DNA – direct DNA repair (alkyl transferases, photoreactivation, excisionrepair) iii. Post-replication repair – recombination repair, mismatch repair, SOSrepair 	
	IV	Eukaryotic transcription: RNA Polymerases, types & subunits, Promoter elements for three polymerases, Activators, Enhancers, Repressors. Elongation and Termination of transcription and process of translation.	



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	V	Prokaryotic transcription –introduction Eukaryotic gene expression i. Regulatory protein domains– zinc fingers, helix-turn-helix domain and leucine zipper ii. DNA methylation	
2		Genetic Engineering	15
	I	Tools in Genetic Engineering i. Enzymes involved in Genetic Engineering: Introduction, nomenclature and types of restriction enzymes with examples, Ligases – E.coli DNA ligase, T4 DNA ligase, polynucleotide kinase, phosphatases, DNA polymerases, reverse transcriptase, terminal transferase ii. Vectors for gene cloning: General properties, advantages and disadvantages of cloning vectors plasmid vectors (pBR322), phage vectors (λ Phage), cosmid vectors(c2XB) iii. Cloning techniques: Cloning after restriction digestion – blunt and cohesive end ligation, creation of restriction sites using linkers and adapters, cloning after homopolymer tailing, cDNA synthesis (Reverse transcription), genomic and cDNA libraries	
	II	Techniques in Genetic Engineering i. PCR techniques: Principle of polymerase chain reaction (PCR), Applications of PCR ii. Sequencing techniques: DNA sequencing: Maxam-Gilbert method, Sanger's method Protein sequencing: Sanger's method, Edman's method Applications of sequencing techniques iii. Detection techniques: Blotting techniques – Southern blotting, Northern blotting and Western blotting Applications of blotting techniques	
3		Human Genetics	15
	I	Non-disjunction during mitosis and meiosis Chromosomal Aberrations: Structural: Deletion: types, effects and disorders; Translocation: types: Robertsonian and non-Robertsonian disorders;	



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		Inversion: types, effects and significance; Duplication and their evolutionary significance (multigene families) Numerical: Aneuploidy and Polyploidy (Autopolyploidy and Allopolyploidy)	
	II	Genetic Disorders i. Inborn Errors of Metabolism: Phenylketonuria, G-6-PD deficiency, Alkaptonuria, Albinism ii. Single gene mutation: Cystic fibrosis iii. Multifactorial: Breast Cancer iv. Uniparental Disomy: Angelman Syndrome and Prader-Willi Syndrome	
	III	Diagnosis i. Prenatal Diagnosis: Amniocentesis and Chorionic villus sampling, Banding techniques (G, C, Q), FISH, Protein truncation test (PTT), ii. Genetic counselling	
4		Bioinformatics	15
	I	Introduction i. Introduction to Bioinformatics and Bioinformatics web resource (NCBI, EBI, OMIM, PubMed) ii. Applications of Bioinformatics	
	II	Databases – Tools and their uses i. Biological databases; ii. Primary sequence databases: Nucleic acid sequence databases (GenBank, EMBL-EBI, DDBJ) Protein sequence databases (UniProtKB, PIR) Secondary sequence databases iii. Derived databases - PROSITE, BLOCKS, Structure databases and bibliographic databases High wireSci Direct	
	III	Sequence alignment methods i. BLAST, FASTA ii. Types of sequence alignment (Pairwise & Multiple sequence alignment) iii. Significance of sequence alignment	
	IV	Predictive applications using DNA and protein sequences i. Evolutionary studies: Concept of phylogenetic tree, convergent and parallel evolution ii. Pharmacogenomics: Discovering a drug: Target identification	



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	iii. Protein Chips in an infant stage and Functional Proteomics: Different types of protein chip (detecting and quantifying), applications of Proteomics Metabolomics: Concept and applications	
	Total no. of lectures	60

Beyond the Syllabus

Tutorial Activities: Students' Presentations, Brain storming sessions, Group Discussions, Use of E-learning, Conferences and Hands-on training practicals

SZOP603 (SEMESTER VI)
Based on Paper III- Course 17

List of Experiments

Sr. No.	Description
1	Quantitative Estimation of RNA by Orcinol method.
2	Quantitative Estimation of DNA by Diphenylamine method.
3	Separation of Genomic DNA by Agarose gel electrophoresis.
4	Colorimetric estimation of proteins from given sample by Bradford's/Folin's method.
5	Problems based on Restriction endonucleases.
6	Karyotype (Idiogram) analysis for the following syndromes with comments on numerical &/or structural variations in chromosomes (no cutting of chromosomes): a) Turner's syndrome b) Klinefelter's syndrome c) Down's syndrome d) Cri-du-chat syndrome e) D-G translocation f) Edward's syndrome g) Patau's syndrome
7	Interpretation of genetic formulae: Deletion, duplication, inversion and translocation
8	Calculation of mitotic index from the photograph or stained preparation of onion root tip or cancer cells.
9	Explore BLAST for nucleotide sequence comparison.
10	Explore the databases (Nucleotide, Protein) at NCBI for querying a nucleotide or protein sequence.
11	Exploring bibliographic database PubMed for downloading a research paper on subject of interest with the use of operators.



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Semester VI: Molecular Biology, Genetic Engineering, Human Genetics and Bioinformatics – SZO603:Paper III (Course 17)

(Internal Assessment Pattern)

	Marks: 40
1 Class Test : (Based on Theory Unit 1.2and 3)	20marks
2 Assignment:	15marks
3 Class Participation and Overall conduct	05Marks

Semester VI: Molecular Biology, Genetic Engineering, Human Genetics and Bioinformatics – SZO603:Paper III (Course 17)

(Internal Class Test Paper Pattern)

Duration:	Marks:20
Q.1 a) Fill in the blanks: (1 or 2 questions each from Unit1,2,3,4)	05marks
b) Match the column: (1 or 2 questions eachfromUnit1,2,3,4)	05 marks
Column A	Column B
1.	a)
2.	b)
3.	c)
4.	d)
5.	e)
Q 2. Write short note on:(Any two)	10Marks
a) Unit1	
b) Unit2	
c) Unit3	
d) Unit4	

Semester VI: Molecular Biology, Genetic Engineering, Human Genetics and Bioinformatics – SZO603:Paper III (Course 17)

(Theory Paper Pattern)

Duration: 2 hrs	Marks: 60
Q1. a) Answer the following: (Unit1)	12 Marks
OR	
a) Answer in brief: (Unit1)	6Marks
b) Answer in brief: (Unit1)	6Marks
Q2.a) Answer the following: (Unit2)	12 Marks
OR	
a) Answer in brief: (Unit2)	6Marks
b) Answer in brief: (Unit2)	6Marks
Q3.a) Answer the following: (Unit3)	12 Marks
OR	
a) Answer in brief: (Unit3)	6Marks
b) Answer in brief: (Unit3)	6Marks



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Q 4.a) Answer the following: (Unit4) OR a) Answer in brief: (Unit4) b) Answer in brief: (Unit4)	12 Marks 6Marks 6Marks
Q.5 Write Short notes on: Any four out of six (1 or 2 questions each from Unit 1,2,3,4)	12 Marks

Semester VI: Molecular Biology, Genetic Engineering, Human Genetics and Bioinformatics – SZOP603:Paper III (Course 17)

(Practical Paper Pattern)

Duration: 5 hours

Marks: 50

Q.1 Isolation & Estimation of RNA by Orcinol method.

15 marks

OR

Isolation & Estimation of DNA by Diphenylamine method.

Q.2 Separation of Genomic DNA by Agarose gel electrophoresis

08 marks

OR

Colorimetric estimation of proteins from given sample by Bradford's/Folin's method.

Q.3 A problem based on Restriction endonucleases.

06 marks

OR

Calculation of mitotic index from the photograph or stained preparation of onion root tip or cancer cells

OR

Q. 3 a) Analyse the given syndrome and comment on numerical and/or structural variations in chromosomes.

OR
03Marks

b) Interpretation of a genetic formula.

03 Marks

Q.4. Demonstrate the use of bioinformatics tool:

06 marks

BLAST for nucleotide sequence comparison.

OR

Databases at NCBI for querying a nucleotide/protein sequence with the help of suitable operator.

OR

PubMed for downloading a research paper of interest with the help of suitable operator

Q.5 Viva voce based on theory

05 Marks

Q.6 Journal

10 Marks



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SZO603: Paper III-Course 17

Course outcome

After the completion of the course, students will able to

CO1 Get an insight into the intricacies of chemical and molecular processes that affect genetic material and recognize the significance of molecular biology as a basis for the study of other areas of biology and biochemistry.

CO2 Understand related areas in relatively new fields of genetic engineering and biotechnology.

CO3 Get acquainted with the vast array of techniques used to manipulate genes which can be applied in numerous fields like medicine, research, etc. for human benefit.

CO4 Become aware of the impact of changes occurring at gene level on human health and its diagnosis.

CO5 Will contribute innovative ideas for research-based studies and thus, develop their intellectual ability.

Recommended Resources

Reference Books

1. Genetics – The continuity of life; Daniel Fairbanks and Ralph Andersen; Brooks/ Cole Publishing Company;1999
2. Introduction to Molecular Biology; Peter Paoella; Tata McGraw Hill;2010
3. Molecular Biology; David Freifelder; Narosa Publishing House; 2008
4. Genetics; Robert Weaver and Philip Hedrick; McGraw Hill;2001
5. iGenetics – A Molecular Approach; Third Edition; Peter J. Russell; Pearson Education, Inc. (Benjamin Cummings), San Francisco;2010
6. Molecular Biology – Academic Cell Update; Update Edition; David Clark; Elsevier, Inc.;2010
7. Genetics; M.W. Farnsworth; Harper and Row Publishers, Inc., USA;1978
8. Principles of Genetics; Eighth Edition; Gardner, Simmons and Snustad; John Wiley and Sons (Asia) Pte. Ltd., Singapore;2002
9. The Science of Genetics – An Introduction to Heredity; Fourth Edition; George W. Burns; Macmillan Publishing Co., Inc., New York;1980
10. Molecular Biology – Bios Instant Notes; Fourth Edition; Alexander McLennan, Andy Bates, Phil Turner & Mike White;Garland



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- Science; 2013
11. <https://www.ncbi.nlm.nih.gov/books/>
 12. Current Protocols in Molecular Biology; Frederick M. Ausubel, Roger Brent, Robert E. Kingston, David D. Moore, Seidman J. G., John A. Smith and Kevin Struhl; John Wiley & Son, Inc.; 2003
 13. Introduction to Proteomics; Daniel C. Liebler; Humana Press; 2002
 14. Molecular cloning; Joseph Sambrook, David William Russell; Third Edition; CSHL Press; 2001
 15. Gene Cloning – An Introduction; Brown .T.A; Fourth Edition; Wiley-Blackwell; 2011
 16. Recombinant DNA - Genes and Genomes- A short course; 3rd Edition; Watson, J.D., Myers, R.M., Caudy A., Witkowski, J.K.; Freeman and Co. NY; 2007
 17. Principles Of Gene Manipulation & Genomics; Primrose S Band R. Twyman; Blackwell Science Publications; 2006
 18. Methods In Enzymology, Vol 152; Berger SI, KimmerAR; Academic Press; 1987
 19. Genomes 3; Third Edition; T.A. Brown; Garland Science Publishing; 2007
 20. Molecular Biotechnology - Principles and applications of recombinant DNA; Glick, B.R. and Pasternak, J. J.; ASM press, Washington; 2010
 21. Microbiology; Fifth Edition; Pelczar, M.J. et al; Tata McGraw-Hill Co., New Delhi; 2001
 22. Introduction to Protein Structure; Second Edition; Branden C. and Tooze J.; Garland Publishing; 1999
 23. Proteins; Second Edition; Creighton T.E.; W.H. Freeman; 1993
 24. Proteomics - Protein Sequence to Function; Pennington, S. and M.J. Dunn; Viva Books; 2002
 25. Genetic engineering – Principles and Practice; Sandhya Mitra; Macmillan India Ltd., New Delhi
 26. Biotechnology – Fundamentals and Applications; Third Enlarged Edition; S.S. Purohit; Student Edition, Jodhpur; 2005
 27. Biotechnology – Expanding Horizons; B.D. Singh; Kalyani Publishers, Ludhiana
 28. A textbook of Biotechnology; R.C. Dubey; S. Chand and Company Ltd., New Delhi
 29. Cell and Molecular Biology; Eighth Edition; E.D.P. DeRobertis, E.M.F. De Robertis Jr.; Info-Med Ltd.; 1988
 30. Genetics (Bios Instant Notes); Third Edition; G.I. Hickey, H.L. Fletcher and P. Winter; Taylor and Francis Group, New York; 2007
 31. Genetics – A Conceptual Approach; Third Edition; Benjamin A. Pierce; W.H. Freeman and Company, New York; 2008
 32. New Clinical Genetics; Second Edition; Andrew Read and Dian Donnai; Scion Publishing Ltd., UK; 2011
 33. Genetics; Third Edition; Robert F. Weaver and Philip W. Hedrick; Wm. C. Brown Publishers (The McGraw-Hill Companies, Inc.);



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1997

34. Human Molecular Genetics; Fourth Edition; Tom Strachan and Andrew Read; Garland Science, USA;2011
35. Genetics; M.W. Farnsworth; Harper and Row Publishers, Inc., USA;1978
36. Human Genetics – An Overview; Alice Marcus; Narosa Publishing House;2010
37. The Science of Genetics – An Introduction to Heredity;Fourth Edition; George W. Burns; Macmillan Publishing Co., Inc., New York; 1980

E-Resources

- <https://www.ncbi.nlm.nih.gov/books/>
- <https://ghr.nlm.nih.gov/>



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Programme: T.Y.B.Sc.

Semester: VI

Course: Zoology-IV(Course18)

Course code: SZO604

Teaching Scheme (Hrs/Week)				Continuous Internal Assessment (CIA) 40 marks					End Semester Examination	Total
L	T	P	C	CIA-1	CIA-2	CIA-3	CIA-4	Lab	Written	
8	-	1	4	20	15	05		-	60	100
Max. Time, End Semester Exam (Theory) -2Hrs.										

Prerequisite 1. Basic knowledge about the concepts in Zoology
2. Skills in exploring the diverse fields of Zoology.

Course Objectives

1. To understand different factors affecting the environment and various methods to improve environmental stewardship.
2. To introduce various ways that can help in the protection, conservation, management, and enhancement of wildlife populations and habitat.
3. To acquire knowledge about the geographic distribution (present and past) of animal species in correlation with distribution of animals.
4. To be conversant with scientific literature related to environment and wild life management, Bioprospecting and Zoopharmacognosy.
5. To create awareness about the process of discovery and commercialization of new products based on biological resources and various ethological aspects.



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SEMESTER VI

COURSE CONTENT			
Unit No.	Module no.	Content	Lectures
		SZO604 (Paper IV- Course 18): Environment and Wildlife Management, Bioprospecting, Zoopharmacognosy and Zoogeography	
1		Environment Management	15
	I	Natural resources and their Classification i. Forest resources, water resources (surface and ground) and mineral resources ii. Energy resources: renewable and non-renewable resources.	
	II	Exploitation and Modification of Natural Resources: Impact on climate, flora and fauna	
	III	Waste Management i. 3R's (Reduce, Reuse and Recycle) of solid waste management. ii. Recent technology in solid waste management: a) Traditional methods for solid waste management: Composting, Incineration, Landfill Recycling, Windrow composting b) Modern methods for solid waste management: Anaerobic digestion, ethanol production, biodrying, pyrolysis, Upflow anaerobic sludge blanket(UASB) technology, waste autoclave	
	IV	Water management i. Rainwater harvesting: Definition ways of harvesting, components, model of rain water harvesting: Rural and Urban, Advantages and disadvantages ii. Watershed management: Definition, need and objectives, classification (mini, micro, milli, sub-watershed, macro-watershed), Watershed management practices: Contour, gully control, stone bunds. Growing greenery and integrated watershed approach(IWA). iii. Case study: Ice-stupa artificial glaciers by Sonam Wangchuk iv. Effluent treatment, recycling plants, control and treatment of sewage water	
	V	Acts and Rules of Environment Management i. Environment Protection Act – 1986, Air (Prevention and Control of Pollution) Act – 1981, Water (Prevention and Control of Pollution) Act –1974	



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		<ul style="list-style-type: none"> ii. Hazardous Wastes (Management and Handling) Rules – 1989 iii. EIA (Environmental Impact Assessment) iv. Role of Central and State Government (Pollution Control Board) and NGOs 	
2		Wildlife Management	15
	I	Habit, Habitat, Territory and Niche of Wild Animals: Herbivores, carnivores, solitary, social (flock, pod, community), pack and herd, types of habitats and territories, niche concept	
	II	Threats to Wildlife <ul style="list-style-type: none"> i. Poaching and hunting, deforestation, encroachment, competition (intra-specific and inter-specific), overgrazing and climate change, diseases (zoonosis and reverse zoonosis) ii. Tourism and human animal conflict 	
	III	Wildlife Conservation <ul style="list-style-type: none"> i. Techniques and methods used for wildlife census: Aerial counts, camera trap, line transect census and track surveys, capture mark recapture method, wildlife radio telemetry ii. Forest management, policies and Acts: Harvesting Trees, Thinning harvest, Clearcut Harvest, Shelterwood harvest, Seed tree harvest, Group selection harvest, Single-tree selection harvest, Prescribed burning, Reforestation iii. Forest policy 1894, 1952, 1988; The Indian Forest Act, 1927; Forest (Conservation) Act, 1980. 	
3		Bioprospecting and Zoopharmacognosy	15
	I	Bioprospecting <ul style="list-style-type: none"> i. Traditional and modern bioprospecting, economic value of bioprospecting ii. Bioprospecting and conservation, advantages and disadvantages 	
	II	Zoopharmacognosy <ul style="list-style-type: none"> i. Definition and types ii. Self-medication and its mechanism 	



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		<ul style="list-style-type: none"> iii. Methods of self-medication through: <ul style="list-style-type: none"> a) Ingestion- ants and mammals b) Geophagy- invertebrates and birds c) Absorption and adsorption iv. Applications – Social and trans-generational aspects of insects, birds and mammals v. Contribution to human medicines 	
4		Zoogeography	15
	<ul style="list-style-type: none"> I II III 	<p>Introduction: Plate tectonics and continental drift theory</p> <p>Animal Distribution and Barriers</p> <ul style="list-style-type: none"> i. Patterns of animal distribution – continuous, discontinuous, isolation and bipolarity ii. Barriers of distribution –Topographic, climatic, vegetative, large water masses, land mass, lack of salinity and special characteristic habit (homing instinct). iii. Means of dispersal – land bridges, natural rafts and drift wood, favouring gales, migration by host, accidental transportation and by human agencies <p>Zoogeographical Realms: Palearctic, Ethiopian, Oriental, Australian, Neotropical, Nearctic and Antarctic</p>	

Beyond the Syllabus

Tutorial Activities: Students' Presentations, Brain storming sessions, Group Discussions, Use of E-learning, Conferences and Hands-on training practicals



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**SZOP604 (SEMESTER VI)
Based on Paper IV Course 18**

List of Experiments	
Sr. No.	Description
1	Estimation of phosphates from sample water.
2	Estimation of BOD from sample water.
3	Estimation of COD from sample water.
4	Estimation of Nitrates from sample water.
5	Estimation of acidity and alkalinity of sample water by methyl orange and phenolphthalein indicator.
6	Comparative study of sound intensity in different places by Decibel meter.
7	1. Study of bioprospecting: a. Tumour suppression compounds e.g.Sponges b. Skin erythema treatment from gel
8	Study of Zoopharmacognosy in ants, cats, elephants and dogs.
9	Indicate the distribution of fauna in the world map w.r.t. to its realm and comment on the pattern of distribution. a) Palearctic: Giant Panda and Japanese Macaque b) Ethiopian: Common ostrich and African bush elephant c) Oriental: Indian one-horned Rhinoceros and Gharial d) Australian: Platypus and Red Kangaroo e) Neotropical: Guanaco and South American Tapir f) Nearctic: Virginia opossum and Sea otter g) Antarctic: Emperor Penguin and Antarctic Minke Whale
13.	Long Excursion (Study tour / Visit) to Zoo / Sanctuary / National park / Research institute and submit a report.



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**Semester VI: Environment and Wildlife Management, Bioprospecting,
 Zoopharmacognosy and Zoogeography**
– SZO604: Paper IV(Course18) (Internal AssessmentPattern)

	Marks: 40
1 Class Test : (Based on Theory Unit 1,2,3and4)	20marks
2 Assignment:	15marks
3 Class Participation and Overall conduct	05Marks

**Semester VI: Environment and Wildlife Management, Bioprospecting,
 Zoopharmacognosy and Zoogeography**
– SZO604:Paper IV(Course18) (Internal Class Test PaperPattern)

Duration:	Marks: 20
Q.1 a) Fill in the blanks: (1 or 2 questions each from Unit1,2,3,4)	05marks
b) Match the column: (1 or 2 questions each from Unit1,2,3,4)	05 marks
Column A	Column B
1.	a)
2.	b)
3.	c)
4.	d)
5.	e)
Q 2. Write short note on:(Any two)	10Marks
a) Unit1	
b) Unit2	
c) Unit3	
d) Unit4	

**Semester VI: Environment and Wildlife Management, Bioprospecting,
 Zoopharmacognosy and Zoogeography**
– SZO604: Paper IV(Course18) (Theory PaperPattern)

Duration: 2 hrs	Marks: 60
Q1. a) Answer the following: (Unit1)	12 Marks
OR	
a) Answer in brief: (Unit1)	6Marks
b) Answer in brief: (Unit1)	6Marks
Q2.a) Answer the following: (Unit2)	12 Marks
OR	
a) Answer in brief: (Unit2)	6Marks
b) Answer in brief: (Unit2)	6Marks
Q3.a) Answer the following: (Unit3)	12 Marks
OR	
a) Answer in brief: (Unit3)	6Marks
b) Answer in brief: (Unit3)	6Marks



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Q4.a) Answer the following: (Unit4) OR a) Answer in brief: (Unit4) b) Answer in brief: (Unit4)	12 Marks 6Marks 6Marks
Q.5 Write Short notes on: (Any four out of six) (1 or 2 questions from Unit 1,2,3 and 4)	12 Marks

**Semester VI: Environment and Wildlife Management, Bioprospecting,
 Zoopharmacognosy and Zoogeography**
– SZOP604: Paper IV(Course14) (Practical PaperPattern)

Duration: 5 hours	Marks: 50
Q.1 Estimation of BOD / COD from the given water sample	10 marks
Q 2. Estimation of phosphates / nitrates from the given water sample OR Estimation of acidity / alkalinity of sample water by methyl orange and phenolphthalein indicator	10 Marks
Q.3 Identification a) Based on bioprospecting (Sponge / Aloe ferox / Aloe vera) b) Zoopharmacognosy (any one – ants, cats, elephants and dogs)	06 marks
Q.4 Identify the given animals (any 2) with respect to their realms and comment.	06 Marks
Q.4 Study tour visit report.	08 Marks
Q.5 Journal	10 Marks



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SZO604: Paper IV-Course 18

Course outcome

After the completion of the course, students will able to

CO1 Understand the different factors affecting environment, its impact and environment management laws.

CO2 Apply knowledge to overcome the issues related to wildlife conservation and management.

CO3 Become acquainted with how and why different animal species are distributed around the globe.

CO4 Understand the paradigms of discovery and commercialization of biological resources and knowledge gained by self-medication by animals

CO5 create awareness about the research studies of new products based on biological resources and various ethological aspects.

Recommended Resources

Reference Books

1. Essentials of Environmental Science; N. Vasudevan; Narosa Publishing House Pvt. Ltd. New Delhi110002
2. Environmental Biology; P.S Verma, V.K Agarwal; S. Chand& company Ltd. New Delhi110055
3. A textbook of Environmental Science; Arvind Kumar; A P H Publishing Corporation,New Delhi110002
4. Environmental Biotechnology - Basic Concepts and Application; Indu Shekhar Thakur; I. K. International Pvt. Ltd. New Delhi110016
5. Text book of environmental science; S. C.Santra
6. Wild life management; Rajesh Gopal
7. Wildlife Management and Conservation - Contemporary Principles and Practices; Paul R. Krausman and James W. Cain III
8. Wildlife Ecology, Conservation, and Management; John M. Fryxell, Anthony R. E. Sinclair, Graeme Caughley
9. Molecular Biotechnology – Principles and Practices; Channarayappa
10. Biotechnology - P. K.Gupta
11. Biotechnology - B. D.Singh
12. Biotechnology Fundamentals & Applications - S. S. Purohit
13. Pharmacognosy and Pharmaco biotechnology- Ashutosh Kar
14. Trease and Evans Pharmacognosy - Evans,W.C.
15. Pharmacognosy - Kokate, C. K. A. and Purohit, A.P.
16. Practical Pharmacognosy- Gokhale, S. B. and Kokate, C.K.
17. Text book of Pharmacognosy; T. E. Wallis



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18. Zoogeography – The Geographical Distribution of Animals; Philip J. Darlington JR;
19. Academic Publishers, Kolkata
20. Animal Geography -New begin
21. Vertebrate Paleontology -Romer
22. Ecological animal geography- Allee, Park and Schmidt
23. Zoogeography of India and South East Asia - Dr. S. K. Tiwari; CBS Publishers and Distributors, Delhi;1985



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