



**SOMAIYA**  
VIDYAVIHAR

K J Somaiya College of Science & Commerce  
Autonomous (Affiliated to University of Mumbai)



## **S. Y. B.Sc. Zoology**

Undergraduate Programme

from

Academic year 2022- 23





**S. Y. B.Sc. Zoology SEMESTER III**

**Core course - I**

**COURSE TITLE: Adaptation in Non-chordates, Chordates and**

**Comparative Vertebrate Embryology**

**COURSE CODE: 22US3ZOCC1NCC**

**[CREDITS - 02]**

**Course Learning Outcomes**

After the successful completion of the Course, the learner will be able to:

1. Compare asexual and sexual modes of reproduction and skeleton in Protozoa, Porifera and Annelida
2. Draw schematic representations of different types of canal system in sponges and show route of flow of water
3. Justify physiological and morphological adaptations in parasitic helminths
4. Enlist functions of shell and foot in Mollusca
5. Discuss the morphology of different larval stages of Arthropod
6. Explain the process of retrogressive metamorphosis
7. Discuss various adaptations in fish, amphibia and reptiles
8. Describe the migratory patterns in birds
9. Elaborate on egg laying, marsupials and aquatic mammals
10. Define Fertilization, Syngamy, Parthenogenesis, Morula, Blastula, Blastomeres, Gastrula, Morphogenetic movements
11. Describe the process of internal and external fertilization
12. Classify the type of egg based on the amount and position of the yolk.
13. Identify the type of cleavage and type of blastula based on the type of egg.



Module 1	Adaptation in Non-Chordates	[12 L]
<p><b>Learning Objectives:</b></p> <p>This module is intended to:</p> <ol style="list-style-type: none"> <li>1. Explain specific morphological, physiological and anatomical adaptations in invertebrates.</li> <li>2. Make learners aware about diversity in adaptations in invertebrates.</li> </ol>		
<p><b>Learning Outcomes:</b></p> <p>After the successful completion of the module, the learner will be able to</p> <ol style="list-style-type: none"> <li>1. Describe various adaptations in invertebrate phyla</li> <li>2. Justify the requirement of certain adaptations in invertebrate phyla</li> </ol>		
	<ol style="list-style-type: none"> <li>1. Protozoa: Skeleton and Sexual Reproduction.</li> <li>2. Porifera: Canal Systems, Spicules and Reproduction.</li> <li>3. Coelenterata: Polymorphism, Types, theories of formation, distribution and significance of coral reefs.</li> <li>4. Helminthes: Parasitic adaptations in Helminthes.</li> <li>5. Annelida: Reproduction in Nereis, earthworm and leech</li> <li>6. Arthropoda: Parthenogenesis</li> <li>7. Mollusca: Shell and Foot, Torsion</li> <li>8. Echinodermata: Water Vascular System</li> </ol>	<p>2L</p> <p>2L</p> <p>2L</p> <p>1L</p> <p>1L</p> <p>1L</p> <p>1L</p> <p>2L</p>

**References:**

- Zoology., Stephen A. Miller, John P. Harley, —Tenth edition. ISBN978-0-07-783727-3
- Invertebrates. Richard C. Brusca, Wendy Moore, Stephen M. Shuster. Third edition. I Sunderland, Massachusetts U.S.A.: Sinauer Associates, Inc., Publishers, 2016. Identifiers: LCCN 2015038708 | ISBN 9781605353753

<b>Module 2</b>	<b>Adaptation in Urochordate and Chordates</b>	<b>[12 L]</b>
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**Learning Objectives:**

This module is intended to:

1. Elaborate about the adaptation in chordate animals mentioned
2. Teach adaptations required for survival on land and in water
3. Explain phenomenon of migration in birds

**Learning Outcomes:**

After the successful completion of the module, the learner will be able to

1. Identify the different adaptations in urochordates and chordates
2. Differentiate between venomous and non-venomous snakes
3. Relate adaptation to the animal morphology
4. Compare adaptations between animals
5. Investigate the phenomenon of migration in birds.

	1. Retrogressive metamorphosis in Ascidiarians.	2L
	2. Swim bladder, Breeding and Parental Care in Fishes.	2L
	3. Neoteny and Parental Care in Amphibians.	1L



	4. Adaptive Radiations in Reptiles – running, aquatic, arboreal, burrowing, flying, desert	1L
	5. Venomous and Non- Venomous snakes.	1L
	6. Migration in Birds.	1L
	7. Egg laying Mammals and Marsupials.	2L
	8. Aquatic Mammals.	2L

**References:**

- Chordate Zoology - Jordan and Verma. Fifth edition
- Vertebrates - R.L. Kotpal. Second reprint 2017. Rastogi Publication ISBN 973-93-5078-003-9

<b>Module 3</b>	<b>Comparative vertebrate Embryology</b>	<b>[12 L]</b>
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**Learning Objectives:**

The module is intended to

1. Make learners understand various concepts in vertebrate embryology.
2. Make learners aware of the Developmental processes in vertebrate embryology and their significance.
3. Show the comparison between different developmental processes in different groups of vertebrates.

**Learning Outcomes:**

After the successful completion of the module, the learner will be able to

1. Describe the developmental processes such as gametogenesis, fertilization, cleavage, blastulation, gastrulation
2. Compare the above processes in different groups of vertebrates



3. State the fate of germinal layers and theories of coelom formation

	1. Gametogenesis – Oogenesis and spermatogenesis.	2L
	2. Fertilization – types, process, significance	2L
	3. Eggs – structure and types	2L
	4. Cleavage – structure and types	1L
	5. Types of blastulae	2L
	6. Processes during gastrulation in brief	1L
	7. Fate of germinal layers and theories of coelom formation	2L

**References:**

- Gilbert SF. Developmental Biology. 6th edition. Sunderland (MA): Sinauer Associates; 2000. Oogenesis. Available from: <https://www.ncbi.nlm.nih.gov/books/NBK10008/>
- MODERN TEXTBOOK OF ZOOLOGY VERTEBRATES I ANIMAL DIVERSITY - II | RL Kotpal, Rastogi Publications, ISBN No. :978-81-7133-891-7
- Zoology., Stephen A. Miller, John P. Harley, —Tenth edition. ISBN978-0-07-783727-3
- Invertebrates. Richard C. Brusca, Wendy Moore, Stephen M. Shuster. Third edition. I Sunderland, Massachusetts U.S.A. : Sinauer Associates, Inc., Publishers, 2016. Identifiers: LCCN 2015038708 | ISBN 9781605353753





**Question Paper Template**

**S. Y. B.Sc. Zoology SEMESTER III**

**Core Course- I**

**COURSE TITLE: Adaptation in Non-chordates, Chordates and**

**Comparative Vertebrate Embryology**

**COURSE CODE: 22US3ZOCC1NCC [CREDITS - 02]**

<b>Module</b>	<b>Remembering/ Knowledge</b>	<b>Understanding</b>	<b>Applying</b>	<b>Analysing</b>	<b>Evaluating</b>	<b>Creating</b>	<b>Total marks</b>
<b>I</b>	<b>15</b>	<b>10</b>	<b>5</b>	<b>-</b>	<b>-</b>	<b>-</b>	<b>30</b>
<b>II</b>	<b>15</b>	<b>10</b>	<b>5</b>	<b>-</b>	<b>-</b>	<b>-</b>	<b>30</b>
<b>III</b>	<b>20</b>	<b>5</b>	<b>5</b>	<b>-</b>	<b>-</b>	<b>-</b>	<b>30</b>
<b>Total marks per objective</b>	<b>50</b>	<b>25</b>	<b>15</b>	<b>-</b>	<b>-</b>	<b>-</b>	<b>90</b>
<b>% Weightage</b>	<b>55</b>	<b>28</b>	<b>17</b>	<b>-</b>	<b>-</b>	<b>-</b>	<b>100</b>

**S. Y. B.Sc. Zoology SEMESTER III**

**Core course - II**

**COURSE TITLE: Cell biology and Genetics**

**COURSE CODE: 22US3ZOCC2CBG**

**[CREDITS - 02]**

**Course Learning Outcomes**

After the successful completion of the Course, the learner will be able to:

1. Elaborate on structure and function of Plasma membrane, Endoplasmic reticulum, Ribosomes, Golgi complex, Mitochondria, Lysosomes
2. Discuss on disorders of Plasma membrane, Endoplasmic reticulum, Ribosomes, Golgi complex, Mitochondria, Lysosomes
3. Differentiate between various staining techniques, stains and microscope used in cell biology
4. Define and elaborate stages of cell cycle
5. Compare and contrast between mitosis and meiosis
6. describe the structure and functions of the nucleus
6. Comment on the structure, types and role of chromosomes.
7. Elaborate the steps of DNA replication
8. Compare different types of sex determination in insects, reptiles, birds and mammals.
9. Explain dosage compensation, multiple alleles, polygenic inheritance, X- or Y-linked genes, Y and Z chromosome and its inheritance pattern with examples
10. Differentiate between sex-limited traits and sex-influenced traits
11. Describe the concept of linkage, its types and process of crossing over
12. Apply recombination frequency concept to map genes present on a chromosome.



Module 1	Cell organelles	[12 L]
<p><b>Learning Objectives:</b></p> <p>This module is intended to</p> <ol style="list-style-type: none"> <li>1. Introduce learner to various cell organelles</li> <li>2. Discuss various functions of cell organelles</li> <li>3. Make learner understand about various diseases related to cell organelles</li> <li>4. Explain use of microscope and different staining techniques used in study of cell organelles to the learner.</li> </ol>		
<p><b>Learning Outcomes:</b></p> <p>After the successful completion of the module, the learner will be able to</p> <ol style="list-style-type: none"> <li>1. Elaborate on various cell organelles</li> <li>2. Discuss functions of cell organelles</li> <li>3. Explain the cause of diseases which are related to cell organelles malfunctioning</li> <li>4. Differentiate between different types of microscope and staining techniques used in cell biology</li> </ol>		
1.	Basic study of cell biology using microscope –historical perspective, different stains and staining techniques	2L
2.	Structure and functions of <ol style="list-style-type: none"> <li>a. Plasma membrane</li> <li>b. Endoplasmic reticulum</li> <li>c. Ribosomes</li> </ol>	2L 2L 1L



	d. Golgi complex	
	e. Mitochondria	1L
	f. Lysosomes	1L
	3. Cell organelles and disorders.	1L
		2L

**References:**

- Cell biology by Gerald Karp 7th edition
- Cell Biology by P.S. Verma and V.K. Agarwal
- e book: Biology 2e by Mary Ann Clark, Texas Wesleyan University, Matthew Douglas, Grand Rapids Community College and Jung Choi, Georgia Institute of Technology; OpenStax

<b>Module 2</b>	<b>Cell cycle and cell division</b>	<b>[12 L]</b>
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**Learning Objectives:**

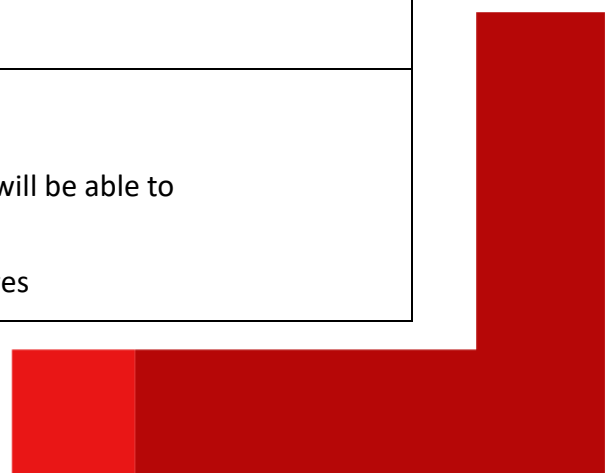
This module is intended to

1. Explain to the learner the stages in cell cycle, cell division and their significance
2. Familiarise the learner with important elements of the cell such as nucleus, chromosomes and DNA.
3. Make the learner understand the role of microtubular elements and cell poisons during cell division

**Learning Outcomes:**

After the successful completion of the module, the learner will be able to

1. Schematically explain cell cycle, its stages and features



2. Define mitosis and meiosis
3. Describe with labelled diagrams the stages of mitosis and meiosis
4. Explain with diagrams, structure and functions of the nucleus
5. Elaborate on the structure, types and role of chromosomes.
6. Enlist various models of replication.
7. Describe DNA replication in prokaryotes
8. Enumerate enzymes of replication in eukaryotes
9. State the effect of cell poisons on cell division, with examples

	1. Cell cycle and its significance	2L
	2. Study of nucleus and chromosomes	2L
	3. Replication of DNA during cell cycle	2L
	4. Study of microtubules	2L
	5. Cell division: Meiosis and mitosis	2L
	6. Cell poisons	2L

**References:**

- Cell and Molecular Biology- DeRobertis 8th Edition
- Cell Biology, Genetics, Molecular Biology, Evolution & Ecology Paperback – 1 by Verma P.S. and Agarwal V.K.

**Module 3**

**Fundamentals of Genetics**

**[12 L]**

**Learning Objectives:**

The module is intended to

1. Introduce learner with methods of Sex determination, Lyon's hypothesis.



2. Discuss X linked, Y linked, and Z linked inheritance, Sex influenced genes and sex-limited genes and their examples
3. Discuss Multiple alleles, polygenic inheritance
4. Explain Linkage and crossing over.

**Learning Outcomes:**

After the successful completion of the module, the learner will be able to

1. Elaborate on different methods and types of sex determination along with their examples
2. Explain Lyon’s hypothesis
3. Elaborate on X-linked, Y linked, and Z linked inheritance pattern
4. Compare between sex limited and sex influenced genes
5. Explain multiple alleles along with example
6. Describe polygenic inheritance
7. Discuss linkage and crossing over
8. Solve problems based on X linked inheritance, Multiple alleles, Polygenic inheritance, linkage and crossing over

	<ol style="list-style-type: none"> <li>1. Sex determination           <ol style="list-style-type: none"> <li>1.1 Methods of sex determination: Chromosomal- XX, XO, XX-XY and ZZ-ZW.</li> <li>1.2 Genic Balance Theory of Sex determination in Drosophila</li> <li>1.3 Environmental sex determination</li> <li>1.4 Lyon’s Hypothesis of X chromosome inactivation.</li> </ol> </li> <li>2. Inheritance related to Sex chromosome           <ol style="list-style-type: none"> <li>2.1 X Linked X- Linked Dominant inheritance X- Linked</li> </ol> </li> </ol>	3L
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	<p>Recessive inheritance Y linked inheritance Z linked inheritance</p> <p>2.2 Sex limited and Sex influenced Genes</p>	3L
	<p>3. Multiple Alleles</p> <p>3.1 Concept, definition, characters and symbolism</p> <p>3.2 Coat colour in rabbit, eye colour and Vestigial wing alleles in Drosophila</p> <p>3.3 ABO blood group system and Rh factor in humans.</p>	2L
	<p>4. Quantitative or Polygenic Inheritance</p> <p>4.1 Concept and definition</p> <p>4.2 Skin colour, Eye colour.</p>	2L
	<p>5. Linkage and Crossing over</p> <p>5.1 Linkage Theories, types of linkage</p> <p>5.2 Crossing over- Mechanism, Significance, three-point cross</p>	2L

**References:**

- Genetics by P.K Gupta, 2018, Rastogi Publications
- Cell Biology, Genetics, Molecular biology, Evolution and Ecology by P.S Verma, Verma, V.K Agrawal
- Principles of Genetics by Peter Snustad and Michael Simmons



**Question Paper Template**

**S. Y. B.Sc. Zoology SEMESTER III**

**Core Course- II**

**COURSE TITLE: Cell biology and Genetics**

**COURSE CODE: 22US3ZOCC2CBG**

**[CREDITS - 02]**

Module	Remembering/ Knowledge	Understanding	Applying	Analysing	Evaluating	Creating	Total marks
I	15	10	5	-	-	-	30
II	15	10	5	-	-	-	30
III	20	5	5	-	-	-	30
<b>Total marks per objective</b>	<b>50</b>	<b>25</b>	<b>15</b>	<b>-</b>	<b>-</b>	<b>-</b>	<b>90</b>
<b>% Weightage</b>	<b>55</b>	<b>28</b>	<b>17</b>	<b>-</b>	<b>-</b>	<b>-</b>	<b>100</b>





**S. Y. B.Sc. Zoology SEMESTER III**

**Core course - III**

**COURSE TITLE: Economic entomology, Animal Farming, Aquaculture and fisheries**

**COURSE CODE: 22US3ZOCC3EFF**

**[CREDITS - 02]**

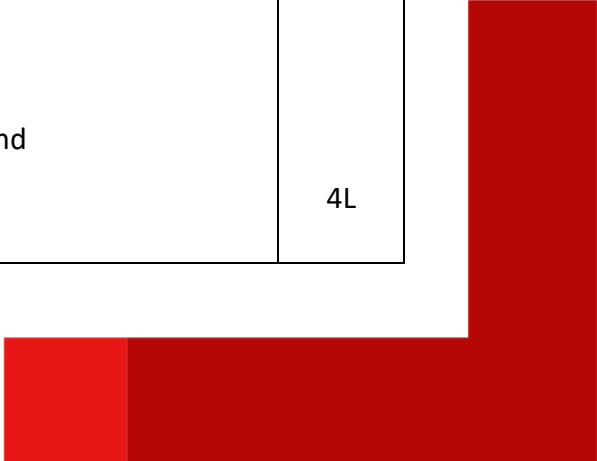
**Course Learning Outcomes**

After the successful completion of the Course, the learner will be able to:

1. Describe the life cycle of various insects and culturing techniques of useful insects
2. Enlist the control measures for harmful insects
3. Differentiate between the various types of communication in Honey bee.
4. Differentiate between economically useful and harmful insects with respect to morphology and behaviour
5. Explain the concept of aquaculture and different types of aquacultures.
6. Describe several aquaculture practices in India and various types of fisheries
7. Enlist the examples of crafts and gears used in fisheries.
8. Summarize important capture fisheries of India.
9. State different strategies involved in successful fin-fisheries, crustacean fisheries and molluscan fisheries system with examples
10. Discuss management of various farm animals and the concept of integrated farming.
11. Identify the opportunities of financial independence by fish culturing methods and their products.



Module 1	Economic entomology	[12 L]
<p><b>Learning Objectives:</b></p> <p>This module is intended to</p> <ol style="list-style-type: none"> <li>1. Explain the concept and importance of economic entomology</li> <li>2. Develop skill for handling and culturing the insects</li> <li>3. Describe harmful and useful insects</li> </ol>		
<p><b>Learning Outcomes:</b></p> <p>After the successful completion of the module, the learner will be able to</p> <ol style="list-style-type: none"> <li>1. Explain the culturing techniques of bees and silkworm</li> <li>2. Describe the life cycle of insects</li> <li>3. Differentiate between useful and harmful insects.</li> <li>4. Discuss the importance of economic entomology</li> </ol>		
1.	<p>Study of Useful Insects:</p> <p>A) Honeybee: Social life, Communication, Apiculture and Economic importance.</p> <p>B) Silk Moth: Life history, Sericulture, Economic importance.</p>	4L
2.	<p>Study of Destructive Insects: Aphids, Locust, Rice weevil, Termite.</p> <p>Methods of Insect Control: Chemical Control and</p>	4L
3.		4L







	Biological control.	
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**References:**

- Elements of Economic Entomology by B. Vasantharaj David, V.V. Ramamurthy
- A Text-book of Economic Entomology M. Dayib

<b>Module 2</b>	<b>Animal farming</b>	<b>[12 L]</b>
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**Learning Objectives:**

This module is intended to

1. Explain the learner the basic requirements for successful working of various animal farms
2. Describe various methods of milk preservation and processes for making milk products

**Learning Outcomes:**

After the successful completion of the module, the learner will be able to

1. Describe the strategies for management of various animal farms
2. Explain the methods of milk preservation and processing

1.	Definition and basic requirements of animal farming	1L
2.	Poultry: a) types of breeds b) poultry products, egg quality, egg hatching and equipment c) brood management and diseases (one protozoan, one viral) Goat, Sheep, Cattle, buffalo farming: a) breeds b) artificial insemination, breeding management and diseases	3L





5. Interpret different strategies involved in successful fin-fisheries, crustacean fisheries, and molluscan fisheries systems with examples.

**Learning Outcomes:**

After the successful completion of the module, the learner will be able to

1. define aquaculture
2. discuss various aquaculture practices in India.
3. recall the examples of different crafts and gears used in fisheries.
4. distinguish several types of aquacultures.
5. explain the process of several aquaculture systems such as culturing of fin-fisheries, crustacean fisheries and molluscan fisheries.
6. conclude the strategies which can be used to enhance aquaculture systems from an economic point of view.

	1. Introduction to aquaculture and aquaculture practices in India	2L
	2. Types of aquacultures: Freshwater aquaculture, Composite fish culture, Sewage- fed fish culture, integrated fish farming, Ornamental fish culture etc.	2L
	3. Types of Fisheries- Basic knowledge of crafts and gears used for various types of fisheries. Fresh water, Brackish Water, Marine: Coastal, Offshore and deep-Sea fisheries, Freshwater fisheries: Riverine - Major carps, Important Capture Fisheries of India	2L
	4. Fin- fish: Oil sardine, mackerel, Bombay duck, Pomfret and Shark	2L
	5. Crustacean fisheries: Prawns, crabs and lobsters.	2L



	6. Molluscan fisheries: Mussels and clams, Edible and pearl oyster, process of pearl formation	2L
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**References:**

- Aquaculture and Fisheries by N. Arumugam, Saras Publications.
- Aquaculture: Farming Aquatic Animals And Plants, Edited by John S Luca and Paul C Southgate, John Wiley Publications.
- Aquaculture in India by S.D.Tripathi, W.S.Lakra, N.K.Chadha, Narendra Publishing House.





**Question Paper Template**

**S. Y. B.Sc. Zoology SEMESTER III**

**Core Course- III**

**COURSE TITLE:**

**COURSE CODE: [CREDITS - 02]**

Module	Remembering/ Knowledge	Understanding	Applying	Analysing	Evaluating	Creating	Total marks
I	15	10	5	-	-	-	30
II	15	10	5	-	-	-	30
III	20	5	5	-	-	-	30
<b>Total marks per objective</b>	<b>50</b>	<b>25</b>	<b>15</b>	<b>-</b>	<b>-</b>	<b>-</b>	<b>90</b>
<b>% Weightage</b>	<b>55</b>	<b>28</b>	<b>17</b>	<b>-</b>	<b>-</b>	<b>-</b>	<b>100</b>

**S. Y. B.Sc. Zoology SEMESTER III**

**Practical Semester III**

**Course I:**

**22US3ZOCCP**

**Title of Experiment**

1. Observation of Binary fission and Conjugation in *Paramecium* [Permanent Slides]
2. Observation of L.S. of *Leucosolenia* (Asconoid) and L.S. of *Scypha* (Syconoid)
3. Observation of Polymorphism: Obelia Colony and medusa, *Physalia*, *Vellela*, *Porpita*
4. Observation of Corals: *Fungia*, *Madrepora*, *Meandrina* [Brain Coral], *Tubipora* and Sea Fan.
5. Observation of Liver fluke - T. S. and its Larvae.
6. Observation of *Heteronereis* and Trochophore Larva.
7. Study of Crustacean Larvae: Nauplius, Zoea, Megalopa, Alima, Mysis and Phyllosoma.
8. Study of Metamorphosis in insect:
  - a) Juvenile and adult of *Lepisma*
  - b) Life history of -
    - 1) House fly,
    - 2) Mosquito (*Culex* and *Anopheles*),
    - 3) Beetle,
    - 4) Butterfly.
9. Study of shells in Mollusca: *Chiton*, *Dentalium*, *Trochus*, *Placuna*, *Solen*, *Sepia*, *Nautilus*, Sinistral and Dextral Shells in gastropods.
10. Study of Echinoderm larvae: *Bipinnaria*, *Ohiopleuteus*, *Echinopleuteus*, *Auricularia*, *Doliolaria*.

11. Embryology: Study of blastula: Amphioxus, Frog, and Mammal Study of gastrulae:
  - a] Frog
  - b] Primitive streak of chick embryo
12. Study of swim bladder.
13. Parental Care and Breeding - Seahorse, Gourami, Siamese fighter, Catfish, Tilapia, Caecilian, Midwife toad, Neoteny (axolotl larva)
14. Adaptive radiation in reptiles: Turtle, Tortoise, Chameleon, Phrynosoma, Wall lizard, Rat Snake, Sea Snake, Crocodile.
15. Study of venomous snakes: Identification key for Krait, Cobra, Russell's viper, Saw scaled viper, Jaw of venomous snake.
16. Study of Adaptive Radiations in Mammals: Duck billed Platypus, Kangaroo, Bottlenose dolphin, Blue whale, Sea Cow [Dugong].
17. Field visit and submission of report - Coral Reefs



**Practical Semester III**

**Course II**

**22US3ZOCCP**

**Title of Experiment**

1. Study of Osmosis using RBCs
2. Study of ultrastructure of cell organelles using electron micrograph-Mitochondria, Endoplasmic reticulum, Golgi complex, Nucleus and Lysosomes
3. Study of chromosome morphology using onion root tip-squash preparation.
4. Study of mitosis using onion root tip-squash preparation.
5. Identification of various stages of meiosis.
6. Study of Polytene chromosome: Temporary preparation of salivary gland chromosome of Chironomous larvae/ drosophila/ mosquito.
7. Mounting of Barr body.
8. Observation of single nucleus, polymorphonuclear neutrophils, micro and macronucleus in Paramecium, micro nuclei in liver cells.
9. Problems in genetics – multiple alleles, X linked inheritance, Polygenic inheritance, linkage and crossing over





**Practical Semester III**

**Course III**

**22US3ZOCCP**

**Title of Experiment**

1. Economic entomology – pollinators, soil composters, bio control agents –allied economic insect services added.
2. Mountings of honeybee: Mouth parts, Legs of honeybee, Sting apparatus.
3. Study of Insects
  - I. Harmful insect –Locust/ Grasshopper, Aphids, Rice weevil, Termite, Lemon butterfly
  - II. Entomophagous insect – Dragonfly, tiger beetle
  - III. Insects of forensic importance – justification- understand the new field as well as importance of insects in crime investigation.
4. Animal husbandry
  - a) Poultry – Layers (Leghorn), Broiler (Kadakhnath)
  - b) Goat – Jamnapari, Surti
  - c) Sheep – Gaddi, Marwari
  - d) Cattle – i. Milch, Sahiwal ii. Dual purpose breed – Haryana iii. Draught purpose – Khillari e) Buffalo- Murrah, Jaffrabadi
5. Detection of adulterants in the milk.
6. Estimation of Milk density by lactometry.
7. Study of Crafts & Gears: Crafts:
  - 1) Dugout Canoe
  - 2) Out-rigger
  - 3) Satpati

4) Trawlers

5) Masula

Gears:

1) Cast net

2) Gill net

3) Dol net

4) Outrigger (Rampani)

8. Study of Fresh water & Marine fishes with respect to Aquaculture & Fishery  
Freshwater fishes- Rohu, Catla, Mrigal and Pangasius Marine Fishes- Mackerel, Oil  
Sardine, Pomfrets (Silver, Black and White) and Scoliodon
9. Study of Crustacean and Molluscan fishery Crustacean fishery- Prawn and Crab (one  
marine and one freshwater each) Molluscan fishery- Edible Oyster, *Sepia aculeata*,  
*Xanchus*
10. Field visit and submission of report –poultry farm, animal husbandry farm, apiary,  
sericulture plant, dairy farm, sheep farm, aquaculture farm, seashore, fish landing  
centre. [visit to minimum any one of them as a part of short or long tour – as per  
curriculum]



**S. Y. B.Sc. Zoology SEMESTER IV**

**Core course - I**

**COURSE TITLE: Ecosystems and Population dynamics, Animal behaviour, Study of tissue**

**COURSE CODE: 22US4ZOCC1EET**

**[CREDITS - 02]**

**Course Learning Outcomes**

After the successful completion of the Course, the learner will be able to:

1. Reiterate knowledge of ecosystems and their functions.
2. Extrapolate earned knowledge of ecosystems to analyze given field situations.
3. Differentiate between various ecological factors and their effects.
4. Discuss various behavioural patterns observed during animal development
5. Explain the components and types of communication in animals.
6. Identify and compare between four types of mammalian tissue.
7. Draw basic diagrams explaining their histology.
8. Comment on the differences between normal and cancerous tissue
9. Interpret various disorders found in tissues.

<b>Module 1</b>	<b>Ecosystem and Population dynamics</b>	<b>[12 L]</b>
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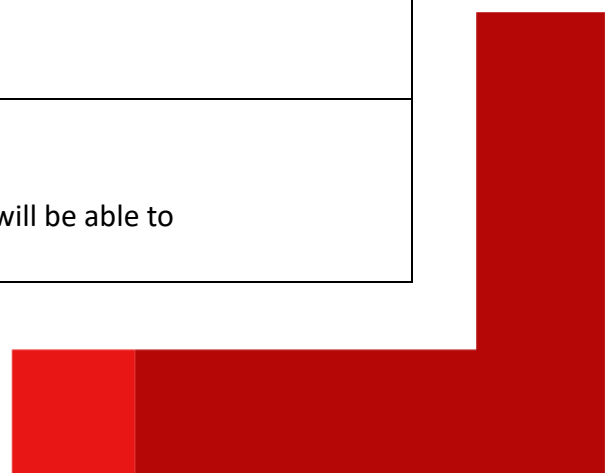
**Learning Objectives:**

This module is intended to

1. Expose stakeholders to the concept of ecosystem.
2. Educate stakeholders to abiotic factors.
3. Educate stakeholders to various biomes

**Learning Outcomes:**

After the successful completion of the module, the learner will be able to



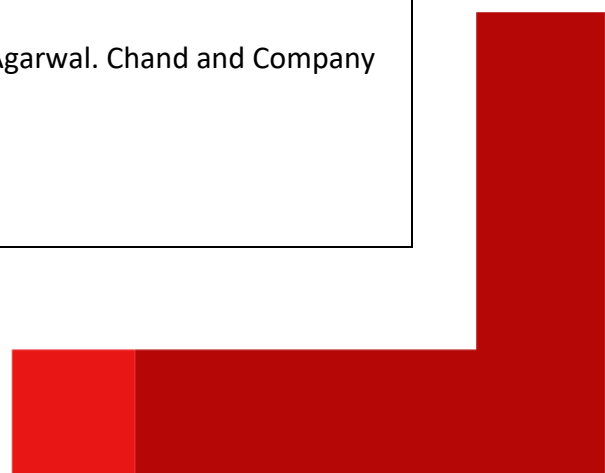


1. Define ecosystem and biome.
2. Identify abiotic components.
3. Describe components and structure of the ecosystem.
4. Distinguish between the effects of various abiotic factors.
5. Identify an ecosystem

	<ol style="list-style-type: none"> <li>1. Ecosystem- definition, structure of ecosystem, major and minor ecosystem, natural and artificial ecosystems.</li> <li>2. Abiotic factors- Atmosphere, Topography, Light, Temperature, and Precipitation. Soil – components and profile, minerals.</li> <li>3. Natural ecosystems- Marine, Freshwater, Terrestrial, Forest, grassland and desert biomes.</li> <li>4. Population Dynamics- Biotic factors: community ecology, concept of ecological niche and ecological succession.  Population ecology: concept of dynamic nature, Factors influencing population dynamics- Natality, mortality, survivorship curves, population growth and growth curves, migration.</li> </ol>	<p>2L</p> <p>3L</p> <p>2L</p> <p>5L</p>
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**References:**

- Fundamentals of Ecology by Eugene Odum and Gary Baret. Fifth Edition. India Edition. Cengage Learning Publications. 2011. ISBN 978-81-315-0020-0
- Concepts of Ecology by P.S. Verma and V.K. Agarwal. Chand and Company Publication. 1999. ISBN 81-219-1681-X



Module 2	Animal Behaviour	[12 L]
<p><b>Learning Objectives:</b></p> <p>This module is intended to</p> <ol style="list-style-type: none"> <li>1. Describe the use of various signals such as light, sound, chemicals for communication among animals.</li> <li>2. Teach the concepts with respect to animal behaviour</li> </ol>		
<p><b>Learning Outcomes:</b></p> <p>After the successful completion of the module, the learner will be able to</p> <ol style="list-style-type: none"> <li>1. Describe the use of various signals such as light, sound, chemicals for communication among animals.</li> <li>2. Explain the concepts with respect to animal behaviour such as imprinting, instinct, displacement and ritualization.</li> </ol>		
	<ol style="list-style-type: none"> <li>1. Behavioural patterns during development:               <ol style="list-style-type: none"> <li>(a) Instinct: IRM, FAP, significance of instinct</li> <li>(b) Imprinting: long term and functional aspect of imprinting, types of imprinting</li> <li>(c) Decision making: Prolonged conflict and stress</li> </ol> </li> <li>2. Displacement behaviour- causes and functional aspects of displacement, Ritualization of displacement activities</li> <li>3. Communication:               <ol style="list-style-type: none"> <li>a) Components of communications</li> <li>b) Signals- chemical, light and sound</li> <li>c) Mimicry, deception and honesty.</li> </ol> </li> <li>4. Altruism</li> </ol>	<p>4L</p> <p>2L</p> <p>4L</p>



		2L
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**References:**

- Engell, Miles. (2009). Animal Behaviour, Ninth edition. John Alcock. Integrative and Comparative Biology - INTEGR COMP BIOL. 49. 608-609. 10.1093/icb/icp058.
- Animal Behaviour by Reena Mathur, Rastogi Publications, 2014 edition

<b>Module 3</b>	<b>Study of Tissue</b>	<b>[12 L]</b>
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**Learning Objectives:**

The module is intended to

1. Explain in detail the histological structure and functions of mammalian tissue to the learner.
2. Help the learner understand the intricacies of tissue architecture.
3. Explain to the learner the underlying differences between normal and abnormal tissue.
4. Familiarise the learner with various tissue related disorders.

**Learning Outcomes:**

After the successful completion of the module, the learner will be able to

1. Identify and describe various types of mammalian tissue.
2. Draw neat, labelled diagrams describing tissue histology.
3. State the properties and functions of various tissues.
4. Compare between normal and abnormal tissue.
5. Elaborate on disorders related to tissue

	1. Introduction to tissue, properties of normal and abnormal tissue.	2L
	2. Types of tissue: Epithelial, Connective, Nervous and Muscular	2L



	1) Epithelial –  A. Simple- Squamous, Columnar, Ciliated, Glandular, Endothelial  B. Stratified	2L
	2) Connective tissue- [Areolar, Adipose, Blood, Bone, Cartilage]	2L
	3) Nervous - Myelinated, non-myelinated, Glial cells	2L
	4) Muscular – Striated, non-striated, Smooth/ Cardiac	2L
	3. Disorders related to Tissue	
<b>References:</b> <ul style="list-style-type: none"><li>● Textbook of Human Histology- Inderbir Singh, 7<sup>th</sup> Edition,</li><li>● <a href="http://www.histologyguide.com">www.histologyguide.com</a></li></ul>		





**Question Paper Template**

**S. Y. B.Sc. Zoology SEMESTER IV**

**Core Course- I**

**COURSE TITLE:**

**COURSE CODE: [CREDITS - 02]**

Module	Remembering/ Knowledge	Understanding	Applying	Analysing	Evaluating	Creating	Total marks
I	15	10	5	-	-	-	30
II	15	10	5	-	-	-	30
III	20	5	5	-	-	-	30
<b>Total marks per objective</b>	<b>5</b>	<b>25</b>	<b>15</b>	<b>-</b>	<b>-</b>	<b>-</b>	<b>90</b>
<b>% Weightage</b>	<b>55</b>	<b>28</b>	<b>17</b>	<b>-</b>	<b>-</b>	<b>-</b>	<b>100</b>



**S. Y. B.Sc. Zoology SEMESTER IV**

**Core course - II**

**COURSE TITLE: Homeostasis, Nutrition and Health, Human Genetic disorders**

**COURSE CODE: 22US4ZOCC2HNG**

**[CREDITS - 02]**

**Course Learning Outcomes**

After the successful completion of the Course, the learner will be able to:

1. Recall various concepts of homeostasis, thermoregulation, osmoregulation, feedback mechanism, extremophiles.
2. Distinguish between thermoregulators and poikilotherms, homeotherms and heterotherms; osmoregulators and osmoconformers.
3. Explain the adaptations of aquatic and terrestrial, invertebrates and vertebrates for thermoregulation.
4. Identify various factors affecting health with respect to nutrition and addiction.
5. Discuss dietary recommendations to a normal adult, infant, pregnant woman and aged.
6. Enlist various metabolic and nutritional disorders, their signs, symptoms, preventive measures, and treatment.
7. Explain defects of modern food habits and food additives.
8. Calculate BMI and enlist its significance and disadvantage
9. Enlist components, physiological effects, and treatment for alcoholism, smoking and recreational drugs.
10. Define chromosome, chromatin, chromatid, gene, nondisjunction.
11. Describe the steps in karyotype preparation and classify types of



chromosomes based on structure in normal human karyotype.

- 12. Analyse different banding techniques with respect to their applications.
- 13. Enlist causes and symptoms of following chromosomal disorders - Trisomy 21, 18, Klinefelter's, Turner's and Supermale and other chromosomal mutations.

<b>Module 1</b>	<b>Homeostasis</b>	<b>[12 L]</b>
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**Learning Objectives:**

This module is intended to

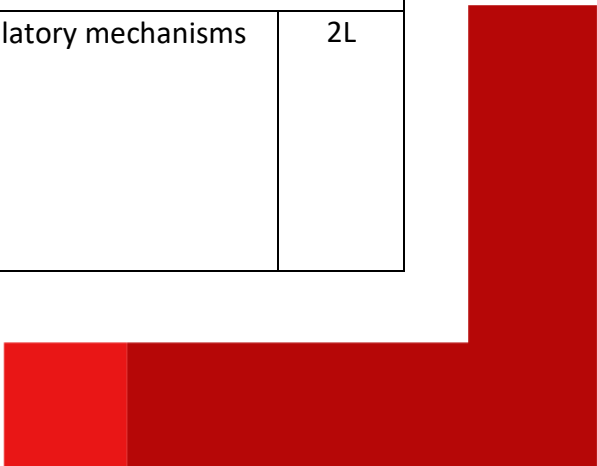
- 1. Understand the concepts in Homeostasis, thermoregulation, and osmoregulation
- 2. Make learners aware of the various adaptations in thermoregulation and osmoregulation in vertebrates and invertebrates in different environment
- 3. Make learners aware of the problems faced by invertebrate and vertebrates in order to survive in extreme conditions

**Learning Outcomes:**

After the successful completion of the module, the learner will be able to

- 1. Recall various concepts of homeostasis, thermoregulation, osmoregulation, feedback mechanism, extremophiles.
- 2. Distinguish between thermoregulators and poikilotherms, homeotherms and heterotherms; osmoregulators and osmoconformers.
- 3. Explain the adaptations of aquatic and terrestrial, invertebrates and vertebrates for thermoregulation.

	<ul style="list-style-type: none"> <li>1. Basic concept of Homeostasis and Regulatory mechanisms</li> <li>2. Osmotic and ionic regulation:               <ul style="list-style-type: none"> <li>2.1 Basic concept of osmoregulation</li> </ul> </li> </ul>	2L
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After the successful completion of the module, the learner will be able to

1. Elaborate on various factors affecting health with respect to nutrition and addiction.
2. Describe dietary recommendations to a normal adult, infant, pregnant woman, and aged people.
3. Define various metabolic and nutritional disorders, their signs, symptoms, preventive measures, and treatment.
4. Explain the concept of defects of modern food habits, food additives, BMI.
5. Enlist components, physiological effects, and treatment for alcoholism, smoking and recreational drugs.

	1. Introduction, dietary recommendations to a normal adult, infant, pregnant woman and aged.	2L
	2. Malnutrition disorders.	1L
	3. Significance of breastfeeding.	1L
	4. Importance of fibres in food.	1L
	5. Constipation, piles, anorexia and obesity, starvation, acidity, flatulence, ulcers.	2L
	6. Defects of modern food habits, BMI and its significance.	2L
	7. Lifestyle diseases- Type II diabetes, insulinoma, hyperinsulinism, PCOS.	2L
	8. Substance abuse	1L

**References:**

- Handbook of Nutrition and Food, Third Edition by Carolyn D. Berdanier (Editor); Johanna T. Dwyer (Editor); David Heber (Editor)
- Wiley Encyclopaedia of Food Science and Technology, 4 Volume Set by Frederick J. Francis (Editor)

Module 3	Human Genetic Disorder	[12 L]
<p><b>Learning Objectives:</b></p> <p>The module is intended to</p> <ol style="list-style-type: none"> <li>1. Make the learner understand the process of nondisjunction and its implications.</li> <li>2. Make learners aware of the techniques such as karyotyping, banding techniques etc.</li> <li>3. Teach the types of chromosomal mutations and their effects with examples</li> </ol>		
<p><b>Learning Outcomes:</b></p> <p>After the successful completion of the module, the learner will be able to</p> <ol style="list-style-type: none"> <li>1. Identify the abnormal Human karyotype.</li> <li>2. State the characteristics of chromosomal disorders.</li> <li>3. Describe normal Human karyotype</li> </ol>		
	<ol style="list-style-type: none"> <li>1. Normal human karyotype: Karyotype preparation &amp; banding techniques, band numbering scheme, human genome project.</li> <li>2. Chromosome nondisjunction               <ol style="list-style-type: none"> <li>i. Process of nondisjunction &amp; its genetic implications</li> <li>ii. Nondisjunction of autosomes: Trisomy 21 &amp; Trisomy 13</li> <li>iii. Non-disjunction of sex chromosomes: Turner’s &amp; Klinefelter’s syndromes, XYY males.</li> </ol> </li> <li>3. Other chromosomal anomalies: Deletions &amp; duplications with examples, microdeletion &amp; micro-duplication with examples, translocation- D-G translocation.</li> <li>4. Other abnormalities like Inversions, ring chromosomes,</li> </ol>	<p>3L</p> <p>3L</p> <p>3L</p> <p>3L</p>



	polyploidy.	
<b>References:</b> <ul style="list-style-type: none"><li>● Cell biology, Genetics, Molecular biology, evolution, and ecology- P. S. Verma and Dr. V K Agarwal, S. Chand Publications</li><li>● Principles of genetics - Eldon John Gardner, Michael Simmons and D Peter Snustad, Wiley India pvt Ltd</li></ul>		





**Question Paper Template**

**S. Y. B.Sc. Zoology SEMESTER IV**

**Core Course- II**

**COURSE TITLE: Homeostasis, Nutrition and Health, Human Genetic disorders**

**COURSE CODE: 22US4ZOCC2HNG**

**[CREDITS - 02]**

Module	Remembering/ Knowledge	Understanding	Applying	Analysing	Evaluating	Creating	Total marks
I	15	10	5	-	-	-	30
II	15	10	5	-	-	-	30
III	20	5	5	-	-	-	30
<b>Total marks per objective</b>	<b>50</b>	<b>25</b>	<b>15</b>	<b>-</b>	<b>-</b>	<b>-</b>	<b>90</b>
<b>% Weightage</b>	<b>55</b>	<b>28</b>	<b>17</b>	<b>-</b>	<b>-</b>	<b>-</b>	<b>100</b>

**S. Y. B.Sc. Zoology SEMESTER IV**

**Core course - III**

**COURSE TITLE: Parasitology - protozoan, helminth and arthropod; Wildlife Conservation and Zookeeping**

**COURSE CODE: 22US4ZOCC3PWZ**

**[CREDITS - 02]**

**Course Learning Outcomes**

After the successful completion of the Course, the learner will be able to:

1. Identify different helminth and arthropod parasites.
2. Diagnose, describe and differentiate between the diseases caused by helminth and arthropod parasites.
3. Elaborate the life cycle of helminth and arthropod parasites.
4. Explain the prophylaxis and treatment measures for helminth and arthropod parasites.
5. Summarize different types of crimes related to wildlife.
6. Recognize various components of the zoo.
7. Discuss the requirements of the animals and working of the zoo.
8. Design a model of a zoo.
9. Explain the concept of parasitology.
10. Recognize the difference between protozoan and helminth parasites.
11. Describe the morphology and life cycle of several protozoan parasites.
12. Discuss the mode of transmission, pathogenicity, symptoms, preventive measures and treatment for diseases caused by several protozoan parasites



Module 1	Introduction to Parasitology, study of Protozoan parasites	[12 L]
<p><b>Learning Objectives:</b></p> <p>This module is intended to</p> <ol style="list-style-type: none"> <li>1. Introduce the concept of parasitology.</li> <li>2. Explain the difference between protozoan and helminth parasites.</li> <li>3. Elaborate on morphological stages and life cycle of several protozoan parasites.</li> <li>4. Review on the host-parasite relationship.</li> <li>5. Summarize the mode of transmission, pathogenicity, symptoms, preventive measures and treatment for diseases caused by several protozoan parasites.</li> </ol>		
<p><b>Learning Outcomes:</b></p> <p>After the successful completion of the module, the learner will be able to</p> <ol style="list-style-type: none"> <li>1. Define and enlist various parasites and hosts.</li> <li>2. Distinguish between various types of parasites and hosts.</li> <li>3. Explain the host-parasite relationship.</li> <li>4. Classify several protozoan parasites with examples.</li> <li>5. Describe morphological stages of various protozoan parasites.</li> <li>6. Understand the life cycle of various protozoan parasites.</li> <li>7. Discuss the mode of transmission, pathogenicity, symptoms, preventive measures and treatment for diseases caused by several protozoan parasites.</li> </ol>		
	<ol style="list-style-type: none"> <li>1. Types of Parasites and Hosts: Parasites: Ectoparasite, Endoparasite, Monogenetic, Digenetic, Temporary, Permanent, Extracellular parasites, Intracellular, Facultative, Accidental. Types of Hosts: Definitive, Intermediate, paratenic, Reservoir. Host- parasite relationship.</li> <li>2. Study of Protozoan Parasites: Morphology, Mode of</li> </ol>	<p>6L</p> <p>6L</p>



	<p>Infection, Lifecycle, Pathogenicity, Treatment, Control measures and Economics involved: <i>Entamoeba histolytica</i>, <i>Plasmodium vivax</i>, <i>Leishmania donovani</i> and <i>Giardia lamblia</i></p>	
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**References:**

- Parasitology by K. D. Chatterjee, Thirteenth Edition, CBS Publishers and Distributors Pvt Ltd.
- Medical Parasitology by D.R.Arora and Brij Bala Arora, Fifth Edition, CBS Publishers and Distributors Pvt Ltd.
- Paniker’s Textbook of Medical Parasitology, revised and edited by Soughata Ghosh, Foreword by Jagdish Chander, Eight Edition, Jaypee Brothers Medical Publishers (P) Ltd
- Textbook of Human Parasitology by Ramnik Sood, CBS Publishers and Distributors Pvt Ltd.

<b>Module 2</b>	<b>Study of Helminth and Arthropod Parasites</b>	<b>[12 L]</b>
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**Learning Objectives:**

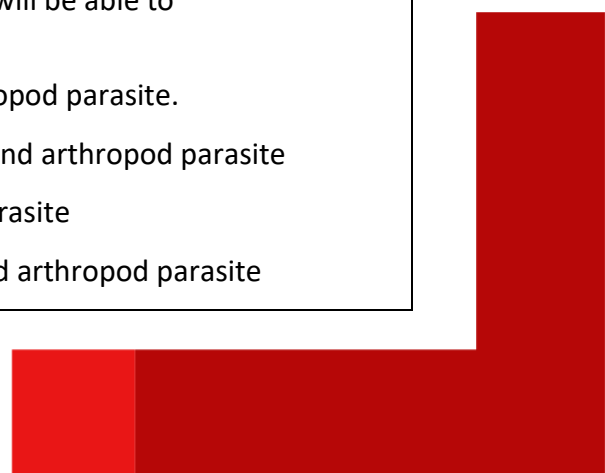
This module is intended to

1. Explain the adaptation of helminth and arthropod parasite
2. Explain the life history of helminth and arthropod parasites.
3. Identify helminth and arthropod parasites.
4. Educate then with the concept of helminth and arthropod parasitology

**Learning Outcomes:**

After the successful completion of the module, the learner will be able to

1. Discuss the mode of infection of helminth and arthropod parasite.
2. Discuss the treatment and prophylaxis of helminth and arthropod parasite
3. Describe the life cycle of helminth and arthropod parasite
4. Differentiate between different type of helminth and arthropod parasite





5. Identify helminth and arthropod parasite		
6. List morphological characteristics and adaptation of helminth and arthropod parasite		
	Morphology, Mode of Infection, Lifecycle, Pathogenicity, Treatment, Control measures and Economics involved:	6L
	a) Helminthes: <i>Taenia solium</i> , <i>Ascaris lumbricoides</i> , <i>Ancylostoma duodenale</i> , <i>Wuchereria bancrofti</i> .	6L
	b) Arthropod: Head louse, Bed bug, Tick and Mite	

**References:**

- Mueller, J. F. (1976). Parasitology, Protozoology and Helminthology
- Lilly, A. A., Mehlman, P. T., & Doran, D. (2002). Intestinal parasites in gorillas, chimpanzees, and humans at Mondika research site, Dzanga-Ndoki National Park, Central African Republic. *International Journal of Primatology*, 23(3), 555-573.
- Human Parasitology Book Fourth Edition 2012 Authors: Burton J. Bogitsh, Clint E. Carter and Thomas N. Oeltmann Gunn Gunn, A., & Pitt, S. J. (2012). *Parasitology: an integrated approach*. John Wiley & Sons.

<b>Module 3</b>	<b>Wildlife Reserves and Zoo Keeping</b>	<b>[12 L]</b>
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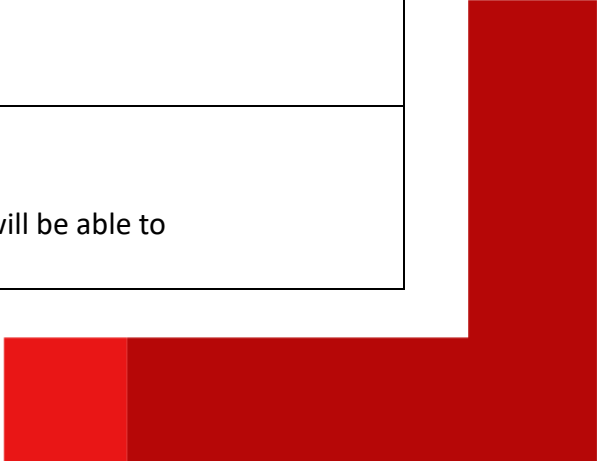
**Learning Objectives:**

The module is intended to

1. Educate stakeholders about a science of keeping animals - zoo keeping
2. Educate stakeholders about crime against wildlife
3. Expose stakeholders to the specific sanctuaries in India

**Learning Outcomes:**

After the successful completion of the module, the learner will be able to





1. Develop knowledge about zoo keeping.
2. Evaluate a zoo
3. Create a basic master plan of a zoo/animal enclosure
4. Apply knowledge of animal crimes to educate others.
5. List biodiverse sanctuaries in India

1.	Wildlife and conservation  1.1 India biodiversity: rare and endangered animals of India:  1.2 wildlife conservation projects; important national parks, and sanctuaries.  1.3 Wildlife crime	5L
2	Zoo keeping  2.1 Zoo – definition, etymology, history, Different types of zoos.  2.2 Zoo design: Basic personnel requirement of zoo – managerial, commercial, scientific, staff requirement – zoo keeper, volunteer, scientist, veterinary doctors, managers, clerks, clean up team, security.  2.3 Significance of zoos – recreation, awareness, education, conservation, rehabilitation (man eater, rescued animals etc.)  2.4 Central Zoo Authority of India, World zoos, Indian zoos	7L

**References:**

- Zoo animals by Hossey, Melfi and Pankhurst. Oxford University Press. Second Edition. 2009. ISBN 978-0-19-969352-8
- [www.cza.gov.in](http://www.cza.gov.in)
- IUCN website
- CITES website
- Ministry of Environment and Climate Change, Government of India website





**Question Paper Template**

**S. Y. B.Sc. Zoology SEMESTER IV**

**Core Course- III**

**COURSE TITLE: Parasitology - protozoan, helminth and arthropod; Wildlife Conservation and Zookeeping**

**COURSE CODE: 22US4ZOCC3PWZ**

**[CREDITS - 02]**

Module	Remembering/ Knowledge	Understanding	Applying	Analysing	Evaluating	Creating	Total marks
I	15	20	5	-	-	-	30
II	15	10	5	-	-	-	30
III	20	5	5	-	-	-	30
<b>Total marks per objective</b>	<b>50</b>	<b>25</b>	<b>15</b>	<b>-</b>	<b>-</b>	<b>-</b>	<b>90</b>
<b>% Weightage</b>	<b>55</b>	<b>28</b>	<b>17</b>	<b>-</b>	<b>-</b>	<b>-</b>	<b>100</b>



**S. Y. B.Sc. Zoology**

**Practical Semester IV**

**Course I: 22US4ZOCCP**

**Title of Experiment**

1. Ecology:
  - a) Estimation of free carbon dioxide in water.
  - b) Estimation of DO of water.
  - c) Estimation of Salinity of water
  - d) Determination of total Hardness of water
  - e) Determination of pH of soil and texture of soil (coarse and fine)
2. Study related to Population Dynamics.
3. Ethology-
  - a) Mimicry, Instinct, Imprinting, Displacement Activities in animals, Ritualization
  - b) Communication in Animals: Chemical Signals, Light Signals, Language development in Bees
4. Study of slides of following human tissues - blood smear, bone, cartilage, skin, artery and vein.
5. Mounting of Nerve fiber, muscle fiber from cockroach



**Practical Semester IV**

**Course II: 22US4ZOCCP**

**Title of Experiment**

1. Extraction and detection of casein from milk.
2. Detection of glucose by GOD/POD method.
3. Colorimetric estimation of protein from two different varieties of hen's egg (Biuret or Folin Lowry method).
4. Estimation of Cholesterol by  $FeCl_3$  Method.
5. Estimation of Triglyceride by phosphovanillin method.
6. Study of Normal human karyotype.
7. Identification of abnormal human karyotypes - Down's Syndrome, Klinefelter's Syndrome, Turner's Syndrome, Edward's Syndrome, Patau's Syndrome.
8. Identification related to fitness and addiction.
9. Project on health awareness- Survey.
10. Demonstration based on Third law of thermodynamics with respect to Homeostasis



**Practical Semester IV**

**Course III: 22US4ZOCCP**

**Title of Experiment**

1. Study of Protozoan parasites: Identification of Entamoeba histolytica, Plasmodium vivax, Leishmania, Giardia.
2. Study of Helminth Parasites: Identification of Taenia, Ancylostoma, Ascaris, Wuchereria and Dracunculus Parasitic adaptation in Liver fluke, Pinworm, Guinea worm
3. Study of ectoparasites- Head louse, Bed bug, Tick, Mite
4. Wildlife conservation - Plotting the location of National parks and Sanctuaries on Map of India and enlist the major fauna.
5. Identify the endangered species of animal and give the reasons for decline
6. Basic designing of a zoo (based on species of animals, their numbers and gender)
7. Economics of zoo– Prepare plan as per number of visitors, daily expenses, salaries, entry fee or entire budget.
8. Visit to a Zoo and preparation of report