PUNJABI UNIVERSITY, PATIALA 147002

(INDIA)

(Established under Punjab Act No. 35 of 1961)

Faculty of Life Sciences

Outline of Course and Syllabi

for

B.Sc. Zoology

Sessions: 2020-21, 2021-22 and 2022-23

SYLLABUS

B.Sc. (Zoology) Part-I (Semester-I and II)

(Session 2020-21, 2021-22 and 2022-23)

Semester-I

THEORY

	External Marks	Internal Assessment
Paper-I : Cell Biology	40	15 (Attendance: 3 + Assignment: 6 + House Test 6)
Paper-II : Non-chordates	40	15 (Attendance: 3 + Assignment: 6 + House Test 6)

PRACTICAL

Pertaining to Theory Paper-I and Theory Paper-II:	40

Total Marks (Semester-I)

Theory		80 Marks
Practical		40 Marks
Internal Assessment pertaining to Theory Paper I & II		30 Marks
Total	**:**	**150 Marks**

Semester-II

THEORY

	External Marks	Internal Assessment
Paper-III : Ecology	40	15 (Attendance: 3 + Assignment: 6 + House Test 6)
Paper-IV : Chordates	40	15 (Attendance: 3 + Assignment: 6 + House Test 6)

PRACTICAL

Pertaining to Theory Paper-III and Theory Paper-IV :	40

Total Marks (Semester-II)

Theory		80 Marks
Practical		40 Marks
Internal Assessment pertaining to Theory Paper III & IV		30 Marks
Total	**:**	**150 Marks**

Note:

1) The number of teaching hours per week will be three for each theory paper and three for each practical in every semester. In all, there will be 12 teaching hours per week covering both theory and practical requirements. (Six teaching hours for theory and Six teaching hours for practical per week)
2) There will be one Practical paper of 3 hours pertaining to the theory papers I & II in each semester. The timing of practical examination will be 9.00 am to 12.00 noon.

SEMESTER-I

PAPER-I: CELL BIOLOGY

Max. Marks: 55 ***Time Allowed: 3 hours***
Pass marks: 35% ***Lectures to be delivered: 45***
Theory-40 ***(Each of 45 minutes duration)***
Internal Assessment : 15

INSTRUCTIONS FOR PAPER SETTER

The question paper will consist of three sections A, B and C. Section A and B will have four questions from the respective sections of the syllabus and will carry 6 marks each. Section C will consist of 8 short-answer type questions which will cover the entire syllabus uniformly and will carry 16 marks in all.

INSTRUCTIONS FOR CANDIDATES

Candidates are required to attempt two questions from each section A and B and the entire section C, which is compulsory.

SECTION-A

1. Overview of Cells: Prokaryotic and Eukaryotic cells, Principle of light and electron microscope
2. Plasma Membrane: Various models of plasma membrane structures, Transport across membranes: Active and Passive transport, Facilitated transport, endocytosis, exocytosis
3. Cell-Cell Junction structures and functions: Tight junctions, Adhesive junctions, Gap junctions.
4. Structure and Functions: Endoplasmic Reticulum, Golgi Apparatus, Lysosomes, Ribosome; Vesicular transport from ER to Golgi Apparatus; Protein sorting and transport from Golgi Apparatus.

SECTION-B

5.Mitochondria: Structure, Semi-autonomous nature, Endosymbiotic hypothesis Mitochondrial Respiratory Chain, Chemi-Osmotic Hypothesis and ATP Synthase.
6. Cytoskeleton: Structure and Functions: Microtubules, Microfilaments and Intermediate filaments.
7. Nucleus: Structure of Nucleus: Nuclear envelope, Nuclear Pore Complex, Chromatin: Euchromatin and Hetrochromatin, Nucleolus.
8. Cell Division: Mitosis, Meiosis, Cell cycle and its regulation

Books Recommended:

1. De Robertis, EDP, Dc Robertis, E.M.F., *Cell Biology and Molecular Biology*, Eighth Edition. W.B. Saunders Co., Philadelphia, 1995.
2. Powar, C.B., *Cell Biology,* Himalaya Publishing House, Bombay, 1999.
3. Alberts, B Bray, D., Lewis, J., Raff, M., Roberts, K., Watson, J.D., *Molecular Biology of the Cell*, Gerland Publ. Inc., New York, 1998.

PAPER-II : NON-CHORDATES

Max. Marks: 55 ***Time Allowed: 3 hours***
Pass marks: 35% ***Lectures to be delivered: 45***
Theory-40 ***(Each of 45 minutes duration)***
Internal Assessment : 15

INSTRUCTIONS FOR PAPER SETTER

The question paper will consist of three sections A, B and C. Section A and B will have four questions from the respective sections of the syllabus and will carry 6 marks each. Section C will consist of 8 short-answer type questions which will cover the entire syllabus uniformly and will carry 16 marks in all.

INSTRUCTIONS FOR CANDIDATES

Candidates are required to attempt two questions from each section A and B and the entire section C, which is compulsory.

SECTION-A

1. Protozoa

General characteristics, Locomotion in *Euglena*, *Paramecium* and *Amoeba*; Conjugation in *Paramecium*. Life cycle and pathogenicity of *Plasmodium vivax* and *Entamoeba histolytica.*

2. Porifera :

General characteristics, Canal system in sponges, Skeleton of sponges.

3. Coelenterata:

General characteristics,Polymorphism in *Obelia*; Corals and coral reef diversity, Conservation of coral and coral reefs.

4. Platyhelminthes:

General characteristics,Life cycle and pathogenicity and control measures of *Fasciola hepatica* and *Taenia solium.*

5. Aschelminthes:

General characteristics, Life cycle, and pathogenicity and control measures of *Ascaris lumbricoides* and *Wuchereria bancrofti,* Parasitic adaptations in helminthes.

6. Annelida:

General characteristics, Excretion in Annelida through nephridia; Metamerism in Annelida, Evolution of coelom.

SECTION-B

7. Arthropoda:

General characteristics,Respiration: Terrestrial respiration in *Periplaneta* – Structure of tracheal system and mechanism of respiration. Aquatic respiration in Prawn– structure and types of gills and mechanism of respiration.

Metamorphosis in Lepidopteran Insects; Social life in Termite and honeybee,

8. Onychophora

General characteristics and Evolutionary significance, affinities of *Peripatus.*

9. Mollusca:

General characteristics, Torsion in Gastropoda; definition of Torsion, effects of Torsion on body structure, detorsion, Feeding and respiration in *Pila globosa*.

10. Echinodermata:

General characteristics, Water vascular system in *Asterias*, Echinoderm larvae, affinities with chordates

11. Hemichordata

General characteristics, *Balanoglossus*; external characters and affinities.

Books Recommended:

1. Dhami P. S. & Dhami J. K., *Invertebrates,* R. Chand & Co., New Delhi, 2001.
2. Barnes, R.D., *Invertebrates Zoology,* W.B. Saunders Philadelphia, 1999.
3. E. L. Jordan and others: *Invertebrate Zoology,* 14th ed. Rep. 2002 ISBN: 81-219-0367X.
4. Ashok Sabharwal & S. K. Malhotra: *Modern Zoology,* Vol. I, Modern Publishers.
5. P. S. Verma & V. K. Aggarwal: *Environmental Biology,* 4th ed. Rep. 2003.

PRACTICAL PAPER (Pertaining to paper I & II)

Max. Marks: 40 *Time Allowed : 3 hours*

Pass marks : 35%

1. Classification upto orders with ecological notes and economic importance of the following:

A. Protozoa: (a) Slides: *Amoeba, Euglena, Trypansoma, Noctiluca, Eimeria, Monocystis, Paramecium (*Binary fission and conjugation), *Opalina, Vorticella, Balantidium, Nyctotherus* & *Polystomella.*

B. Porifera: Specimens: *Sycon, Grantia, Euplectella, Hyalonema, Spongilla* and *Euspongia.*

C. Coelenterata: (a) Specimens: *Porpita, Velella, Physalia, Aurelia, Rhizostoma, Metridium, Millipora, Alcyonium, Tubipora, Zoanthus, Madrepora, Favia, Fungia* and *Astrangia.*

(b) Slides: *Hydra (*W.M.), *Hydra* with buds, *Obelia (*colony and medusa), *Sertularia, Plumularia, Tubularia, Bougainvillea* and *Aurelia.*

D. Platyhelminthes: (a) Specimens: Dugesia, Fasciola, *Taenia* and *Echinococcus.*

(b) Slides: Miracidium, Sporocyst, Redia, Cercaria of *Fasciola,* Scolex and Proglottids of *Taenia (*mature and gravid)

E. Aschelminthes : *Ascaris (*male and female*), Trichinella* and *Ancylostoma.*

F. Annelida : Specimens: *Pheretima, Nereis, Heteronereis, Polynoe, Eunice, Aphrodite, Chaetopterus, Arenicola, Tubifex* and *Pontobdella.*

G. Arthropoda : *Peripatus, Palaemon* (Prawn), *Lobster,* Cancer (Crab), *Sacculina, Eupagurus (*Hermit crab), *Lepas, Balanus, Cyclops, Daphnia, Lepisma, Periplaneta (*Cockroach), *Schistocerca* (Locust), *Poecilocerus* (Ak grasshopper), *Gryllus,* (Cricket), *Mantis* (Praying mantis), *Cicada, Forficula* (Earwig), Dragonfly, termite queen, bug, moth, beetle, *Polistes* (Wasp), *Apis* (Honey bee), *Bombyx*, *Pediculus* (Body louse), Millipede and Centipede, *Palamnaeus* (Scorpion*), Aranea* (Spider), and *Limulus* (King crab).

H. Mollusca : *Anodonta, Mytilus, Ostrea, Cardium, Pholas, Solen* (Razor fish), *Pecten, Haliotis, Patella, Aplysia, Doris, Limax, Loligo, Sepia, Octopus, Nautilus* shell (Complete and T.S.), *Chiton* and *Dentalium.*

I. Echinodermata: *Asterias, Echinus, Ophiothrix* and *Antedon.*

J. Hemichordata: *Balanoglossus.*

2. Study of the following permanent stained preparations:

A. L.S. and T.S. *Sycon,* Gemmules, Spicules and Spongin fibres of a sponge.

B. T.S. *Pheretima* septal nephridia,

3. Preparation of the following slides:

Preparation of permanent whole mount stained in borax carmine : *Hydra, Obelia, Sertularia, Plumularia* and *Bougainvillea.*

4. Cell Biology:

A. Study of permanent slides of Mitosis and Meiosis.

B. Identification of ultrastructure of different cell organelles from electron micrographs.

C. To study Principle of the Light and Electron microscope.

D. Preparation of temporary stained mount to show the presence of Barr body in human female cheek cells.

INSTRUCTIONS FOR PRACTICAL PAPER

Max. Marks: 40 *Time Allowed: 3 hours*

Pass Marks: 35%

1.	5 Museum specimens/slides from Protozoa to Hemichordata for identification, classification and short morphological note.	15
2.	Identification of 2 permanent stained slides of mitosis/meiosis.	6
3.	Identification of cell organelle form electron micrograph.	4
4.	To write principle of light and electron microscope/temporary stained mount to show the presence of Barr body.	5
5.	Viva-Voce	5
6.	Practical note book	5

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SEMESTER-II

PAPER-III: ECOLOGY

Max. Marks: 55
Pass marks: 35%
Theory-40
Internal Assessment : 15

Time Allowed: 3 hours
Lectures to be delivered: 45
(Each of 45 minutes duration)

INSTRUCTIONS FOR PAPER SETTER

The question paper will consist of three sections A, B and C. Section A and B will have four questions from the respective sections of the syllabus and will carry 6 marks each. Section C will consist of 8 short-answer type questions which will cover the entire syllabus uniformly and will carry 16 marks in all.

INSTRUCTIONS FOR CANDIDATES

Candidates are required to attempt two questions from each section A and B and the entire section C, which is compulsory.

SECTION-A

1. Ecological Hierarchy, Sub divisions of ecology, Relation and scope of Ecology.

2. Environmental Factors: Liebig's law of minimum, Shelford's law of tolerance , Concept of limiting factors , Physical factors of the environment and their effect on animals Topography, light , temperature , water, Humidity.

3. Population: Characteristics–Size & density, Natality, Mortality, Dispersion, Age structure. Biotic potential and Environment resistance, r and K strategies

4. Population Dynamics & Regulation: Population Growth curves (I and J) , Survivorship curves, Population cycles - Density dependent and Density independent, Regulation of population.

SECTION-B

5. Biotic Community:General Characteristics, Food chain (Linear and Y-shaped), Food web, Flow of Energy, Ecological Pyramids, Productivity. Niche: Niche Concept, Types of Niche–Spatial, Trophic , Multidimensional; Gause's Principle, Lotka-Volterra equation for competition, Ecotone and edge effect

6. Biotic Interactions: Intra specific interactions and Inter specific interactions(Antagonism : Competition, Predation, Parasitism, Ammensalism; Beneficial : Commensalism , Proto cooperation, Mutualism).

7. Wild life: Importance, need of conservation, conservation strategies, projects for endangered species, project tiger, crocodile breeding project, Gir lion sanctuary project, vulture breeding project.

Books Recommended

1. Kormondy E. J., *Concepts of Ecology,* Englewood Cliffs, N.J. Prentice Hall Inc., 1975.
2. Kreb C. J., *Ecology,* Harper & Row, New York, 1982.
3. E.P. Odum, *Fundamentals of Ecology,* W.B. Saunders Co., Philadelphia, 1995.
4. Dhami P. S. & Dhami J. K., *Invertebrates,* R. Chand & Co., New Delhi, 2001.
5. Barnes, R.D., *Invertebrates Zoology,* W.B. Saunders Philadelphia, 1999.
6. Cooper, G.M., Hausman, R.E. (2009) The Cell: A molecular approach. ASM Press and Sinauer Associates (Fifth Edition).
7. Karp, G. (2010). Cell and Molecular Biology: Concepts and Experiments (Sixth Edition) John Wiley & Sons Inc.

PAPER-IV : CHORDATES

Max. Marks: 55 ***Time Allowed: 3 hours***
Pass marks: 35% ***Lectures to be delivered: 45***
Theory-40 ***(Each of 45 minutes duration)***
Internal Assessment : 15

INSTRUCTIONS FOR PAPER SETTER

The question paper will consist of three sections A, B and C. Section A and B will have four questions from the respective sections of the syllabus and will carry 6 marks each. Section C will consist of 8 short-answer type questions (8 to 10 lines) which will cover the entire syllabus uniformly and will carry 16 marks in all.

INSTRUCTIONS FOR CANDIDATES

Candidates are required to attempt two questions from each section A and B and the entire section C, which is compulsory.

SECTION-A

1. Brief classification of Chordata, Chordate characters, Origin of Chordata

2. Protochordata: General characteristics, affinities of Hemichordata, Urochordata and Cephalochordata; Study of larval forms in protochordates; Retrogressive metamorphosis in Urochordata
3. Advanced features of vertebrates over Protochordata
4. Agnatha: General characteristics, External features of *Petromyzon*.
5. Pisces: General characteristics and outline classification (up to order), General characteristics of Chondrichthyes and Osteichthyes, Scales and fins in fishes. Parental care in fishes, Migration, Swim bladder, Osmoregulation in fishes, Economic importance of fishes
6. Origin of Tetrapoda (Evolution of terrestrial ectotherms)
Amphibia: General character, Neoteny and Paedogenesis, Parental care in Amphibia.

SECTION-B

7. Higher Chordata: Salient features, of various Higher chordate groups as covered under respective taxonomic groups.
8. Reptilia: A brief knowledge of extinct reptiles. Poisonous and non- poisonous snakes. Poison apparatus of snake. Snake venom and anti-venom. Evolution and Adaptive radiation in reptiles.
9. Aves: General characteristics, Origin and Ancestry of birds, Archaeopteryx-a connecting link, Flightless birds and their distribution. Principles and aerodynamics of flight, Flight adaptations in birds, Perching mechanism, Bird migration.
10. Mammalia: General characters, Origin and ancestry, affinities of Prototheria. Adaptive radiation, Dentition in mammals.

Books Recommended

1. Young, J. Z. (2004). The Life of Vertebrates. III Edition. Oxford university press.
2. Pough H. Vertebrate life, VIII Edition, Pearson International.
3. Darlington P.J. The Geographical Distribution of Animals, R.E. Krieger Pub. Co.
4. Hall B.K. and Hallgrimsson B. (2008). Strickberger's Evolution. IV Edition. Jones and Bartlett Publishers Inc.

PRACTICAL PAPER (Pertaining to paper III & IV)

Max. Marks: 40 *Time Allowed: 3 hours*
Pass Marks: 35%

I. Classification up to orders, excepting Pisces and Aves where classification up to subclasses only is required, habits, habitats, external characters and economic importance (if any) of the following animals:

1. Urochordata : *Herdmania,Doliolum*, *Salpa* and *Oikopleura*.
2. Cephalochordata: *Amphioxus.*
3. Cyclostomata: *Petromyzon*, *Myxine*
4. Chondrichthyes :*Zygaena* (Hammer headed shark), *Pristis* (saw fish), *Narcine* (Electric ray), *Trygon*, *Rhinobatus* and *Chimaera* (Rabbit fish).
5. Actinopterygii :*Polypterus, Acipenser, Lepidosteus, Muraena, Mystus, Catla, Hippocampus, Syngnathus, Exocoetus, Anabas, Tetradon, Echeneis* and *Solea*.
6. Dipneusti (Dipnoi) :*Protopterus* (African lung fish).
7. Amphibia :*Uraeotyphlus, Necturus, Amphiuma, Amblystoma* and its Axolotl Larva,*Salamandra, Hyla and Rhacophorus*.
8. Reptilia :*Hemidactylus, Calotes, Draco, Varanus, Phrynosoma, Chamaeleon, Typhlops, Python, Eryx, Naja, Hydrus, Viper, Crocodilus, Gavialis, Chelone* (Turtle) and *Testudo* (Tortoise).
9. Aves :*Ardea, Anas, Milvus, Pavo, Tyto, Alcedo, Eudynamis* and *Casuarius*.
10. Mammalia :*Ornithorhynchus, Echidna, Macropus, Loris, Macaca, Manis, Hystrix, Funambulus, Herpestes* and *Pteropus*.

II. Study of following prepared slides : T.S. *Amphioxus* through various regions. Spicules, pharynx of *Herdmania* and pharynx of *Amphioxus*, Scales of fishes

III. Study of Types of beaks and claws of birds

IV. Use of key for Identification of poisonous and non-poisonous snakes

V. Preparation of Charts for Origin and Ancestry of Chordates and its various classes

VI. Study of an aquatic ecosystem: Measurement of temperature, turbidity, and pH.

VII. To study species composition, dominant species and population ratio using coloured beads

VIII. Plotting of survivorship curves from the hypothetical data.

IX. Study of morphological adaptations.

XI. Report on a visit to National Park/Biodiversity Park/Wild life sanctuary / Zoological garden.

INSTRUCTIONS FOR PRACTICAL PAPER

Max. Marks: 40 Time Allowed: 3 hours
Pass Marks: 35%

1. Museum Specimens/slides from Phylum Urochordata, Cephalochordata, Chondrichthyes, Actinopterygii, Dipnusti(Dipnoi), Amphibia, Reptilia, Aves,Mammalia. for identification, classification and morphological note.	10
2. To identify and write a note on beak / Claw of the given bird	2
3. To identify the poisonous/ non poisonous snake by key	2
4. Identification of morphological adaptation	4
5. Ecology experiment (out of VI-VIII)	10
5. Excursion note	4
6. Viva-voce	4
7. Practical note-book and charts	4