

SCHEME OF STUDIES FOR BACHELOR OF SCIENCE (BSc)

**Subject Zoology
(Two Years Course; Annual System)
For Affiliated Colleges**

Subject Zoology		Marks
BSc Part I (3rd Year)		30-30-15=75
Theory		
Paper A	Invertebrate Zoology	30
Paper B	Cell Biology and Genetics	30
Practical	Invertebrate Zoology	15
	Cell Biology and Genetics	
BSc Part II (4th Year)		30-30-15=75
Theory		
Paper C	Comparative Anatomy	30
Paper D	Biology of Chordates	30
Practical	Comparative Anatomy	15
	Biology of Chordates	

COURSES FOR BSc Part I (3rd Year)

Paper A	Invertebrate Zoology	Theory
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Classification (upto order) of the phyla listed below and general organization (structure, function, Mode of life, reproduction and life cycles, adaptations, distribution and economic importance) of the following groups. Types wherever mentioned shall be used for understanding the structure-function problems in the group.

1. Protozoa: Type: *Paramecium caudatum* General organization of protozoa with emphasis on locomotion, nutrition, reproduction. Parasites of medical importance (*Plasmodium, Leishmania, Entamoeba, Giardia, Trichomonas*)
2. Porifera: type: *Scypha (Sycon)* General organization with emphasis on canal system, skeleton and reproduction.
3. Coelentrata: Type: *Obelia geniculata*. General organization of coelentrata with emphasis on polymorphism, corals and coral reefs.
4. Ctenophore: diagnostic features only.
5. Platyhelminthes: type: *Fasciola hepatica*. General organization with emphasis on parasitic adaptations. Life cycle variations. *Taenia saginata, T. solium*, helminth disease.
6. Aschelminthes: Type: *Ascaris lumbricoides*. Diagnostic features only. Nematodes of economic importance.
7. Annelid: Type: *Hirudinaria granulose*. General organization with emphasis on coelom, feeding, excretion, mode of life.
8. Minor phyla: diagnostic features only. Onychophora, Bryozoa, Brachiopoda, chaetognatha, Sipunculida, Entoprocta and Ectoprocta.

9. Arthropoda: Type: *Periplanata Americana*. *Orilosquilla nepa*. General organization of arthropods with emphasis on metamorphosis and ecdysis. Appendages, respiration, social insects. Economic importance of crustacean and insects. Mouth parts of different insects.
10. Mollusca: Type: *Anodonta*. *Spp perna viridis*. General organization of mollusca with emphasis on shell, locomotion, respiration, gill, torsion, detorsion, economic importance.
11. Echinodermata: Type: General organization with emphasis on skeleton, larval forms and phylogeny.

Text books (Latest Editions)

1. Hegner, R.W. and Engemann, J.G.(1981). *Invertebrate Zoology*, McMillon Co., New York.

Books Recommended

1. Ruppert, E.F and Barnes, R.D (1991). *Invertebrate Zoology*, (4th Edition), Saunder, Philidelphia.
2. Parker, T.J and Haswell, W.A (1972), *Textbook of Zoology (volume I)* McMillon Co., New York.
3. Barrington, E.I.W (1979) *Invertebrate structure and function*. The English language book, society London.
4. Borradaile. L.A, Potts, F.A, Eastham, L.E.S. Saunder, T.J and Kerkut, J.A,(1961), *The Invertebrata*, cambrige university press.
5. Bhatti, H.K and Hashmi, T.H (1972), *Invertebrate Zoology*, Caravan Book Corporation, Lahore.
6. Kent, G.C. and Miller, S. *Comparative anatomy of vertebrates*. 2001. New York: McGraw Hill.
7. Moore, J, *An Introduction to the Invertebrates*, 2nd edition.2008. Cambridge University Press

Paper A	Invertebrate Zoology	Practical (2 hours duration)
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1. Dissections: *Anodonta/Perna/unio*, *Hirudinaria granulose*. *Neries*, *Periplanata Americana/grasshopper*.
2. Museum study: examination of commen examples of phyla and their classification upto order witgh the help of given literature(Taxonomic Keys)
3. Examination of the following prepared slides:

Protozoa: *Euglena*, *Volvox*, *Trypanaosoma*, *Opadina*, *Entamoeba*, *Malarial parasites*, *Paramicium*, *Balantidium*, *Scentor*, *vortecili*.

 - a. Porifera: Spicules of sponges, section of sycon.
 - b. Coelentrata: Section of Hydra, Medusa of obelia.
 - c. Platyhelminthes: Section and whole mount of a Turbellarium(planaria); atrematode(*Fasciola hepatica*) and proglotid and scolex of a cestode(taenia)
 - d. Aschelminthes: T.S. of *Ascaris*, whole mounts of *Ancylostoma*.
 - e. Annelid: T.S.Neries. T.s of *hirudo*.
 - f. Arthropoda: whole mount of rat flea, lice, calamus/cyclopes, *Dephnia*, Crustacean larvae, mouth parts of mosquito and a butterfly.
 - g. Echinodermata: T.S.of a Starfish, Larvae of Echinodermata.

4. Microscopic preparations, study and demonstration; Leucosolenia. Obelia, Medusa, mature segment of a cestode, parapodium of aneries, Mouth parts of Periplanata and Musca, plankton.
5. Viva Voce: each student should be orally examined from all the major conceptual sections of the subjects. Equal number of questions should be asked from each student.
6. Practical Note book: student must maintain complete record of all the experiments done in the laboratory, duly checked and evaluated by the teacher.

Paper B	Cell Biology and Genetics	Theory
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Cell biology: Natural history of cell, small molecules of living machines, Nucleic acid and proteins. Enzymes, catalysis, metabolic pathways, Michondrion and Nucleus and the storage and formation and transmission of information. Ribosome and conversion of chemical energy into work, membrane system, Genetics: chromosome duplication and division. Duplication of genetic material and it's replication, Segregation of genes, Independent assortment, Linkage and recombination of genes, crossing over, Cytoplasm inheridity, Mutation, Genes action and synthesis of proteins. Genetic units of recombination, Mutation and function.

Books Recommended

1. Cell structure and function by Lowey and sickvits National Hock Foundation of Pakistan.1972.
2. Genetics by R.P. Levins. Reprinted by National Book Foundation.1976
3. Pollard T .D, Earnshaw W. C. Cell Biology. 2007. Saunders
4. Snustad, D.P. and Simmons, M.J. PRINCIPLES OF GENETICS. 3rd Edition, 2003. Johan Wiley and Sons Ins. New York, USA
5. Bittar. E. Molecular and Cellular Genetics. 2009. Elsevier Science

Paper B	Cell Biology and Genetics	Practical (2 hours duration)
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- a. Microscopic study and preprations
Study of live protozoa from laboratory culture.
Leucosolenia: Obelia, Medusa, Marginal lappets of jelly fish, mature segment of cestode, Nephridium of leach, parapodium of neries, mouth parts of cockroach, house fly, mosquito and butterfly.
- b. Preparation and study of meiosis in grasshopper.
Demonstration of RNA and DNA in Protozoa and blood cells. Chemical tests for the identification of carbohydrates, lipids and proteins.
Preparation and study of chrosomes from Drosophila and chironomid larvae

COURSES FOR BSc Part II (4th Year)

Paper C	Comparative Anatomy	Theory
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Origin of Chordates, comparative anatomy and function of integumentary, skeleton, Muscular, digestive, circulatory, respiratory, excretory, nervous (including sense organs), hormonal and reproductive system of chordates.

Books Recommended (Latest edition)

1. Kent, G.C 1996. Comparative anatomy of the vertebrates. Wm.C Brown Publisher.
2. Bhatti, H.K and Hashmi, T.H (1972), Invertebrate Zoology, Caravan Book Corporation, Lahore.
3. Romer, A.S. 1986the vertebrate body. W.B. Saunders Company Philidelphia.
4. Young, J.Z. 1991. The life of vertebrates. Oxford University Press. London.
5. Marshal, A.J. (Park, T.J. and Haswell, W.A.), 1972. A text book of zoology, volume II: vertebrata. McMillon Co., New York.
6. Randall, D., Burggren, W., French, K. and Fernald, R. ECKERT ANIMAL PHYSIOLOGY: MECHANISMS AND ADAPTATIONS, 5th Edition. 2002. W.H. Freeman and Company, New York
7. David R, Warren B, Eckert Animal Physiology: Mechanisms and Adaptations 4ed. 2009. W.H. Freeman and Company
8. Kent, G.C. and Miller, S. COMPARATIVE ANATOMY OF VERTEBRATES. 2001.New York: McGraw Hill

Paper C	Comparative Anatomy	Practical (2 hours duration)
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1. Dissections: scolidon, uromastrix, Rabbit/pigeon (all systems to be done in detail)
2. Skeleton (detailed account)
 - a. Skulls:Fish(Labeo spp), frog(Rana tigrina),Lizard(Veramus monitor), Chicken(Gallus domesticus), Rabbit(Oryctolagus cuniculus).
 - b. Vertebrae: Labeo spp), frog(Rana tigrina), a snake, Gallus domesticus, Oryctolagus cuniculus.
 - c. Appendicular skeleton: Labeo spp, Rana tigrina, Veramus monitor, Gallus domesticus, Oryctolagus cuniculus.
 - d. Exoskeleton: scales of fishes, reptiles, birds and mammals. Feathers of birds, Shell of chelonian. Hair and their modification. Claws, nails and hooves, horns antlers and spines etc.
3. Museum study: identification of common vertebrates and lower chordates.
4. Examination of following prepared slides: whole mount of Amphioxus. T.S of Amphioxus through different regions. Pharynx of an Ascidian, section of skin of a fish, afrog and a rabbit. Section of mammalian liver, Kidney, Spleen, Thyroid gland, testes, ovary, heart muscles, pancreas, nerve cord, lung, intestine etc. whole mouint and histological sections of different developmental stages of of chick.

Paper D	Biology of Chordates, Embryology and Ecology	Theory
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a) Biology of chordates:

Classification of chordates (upto order), natural history (mode of life; aquatic, cursorial, fussorial, arboreal and aerial); Animal migration, Parental care, breeding habits, biting mechanism in snakes.

Distribution of various groups of chordates. brief account of Dinosaurs and Archeopterix.

- b) Embryology; early development of vertebrates, Egg types, Cleavage, blastula formation, gastrulation and germ layer formation, embryonic membranes and pacentation.
- c) Ecology: introduction of ecology, ecosystem and its components, aquatic and terrestrial as examples of ecosystem, diversity and ability in an ecosystem, energy flow within ecosystem, food chains and tropic levels. Biogeochemical cycles (A brief description of S, N, P and CO₂ cycles) Leibigs law of minimum and limiting factor concept. Pollution problems and their management, wild life and conservation, important reptiles, birds and mammals in Pakistan.

Books Recommended (Latest edition)

1. Kent, G.C 1996. Comparative anatomy of the vertebrates. Wm.C Brown Publisher.
2. Bhatti, H.K and Hashmi, T.H (1972), Invertebrate Zoology, Caravan Book Corporation, Lahore.
3. Romer, A.S. 1986the vertebrate body. W.B. Saunders Company Philidelphia.
4. Young, J.Z. 1991. The life of vertebrates. Oxford University Press. London.
5. Marshal, A.J. (Park, T.J. and Haswell, W.A.), 1972. A text book of zoology, volume II: vertebrata. McMillon Co., New York.
6. Weirhert, C.K., 1958. Anatomy of chordates. McGraw Hill Book Company, London.
7. Kent, G.C. and Miller, S. COMPARATIVE ANATOMY OF VERTEBRATES. 2001. New York: McGraw Hill
8. Attenborough. D. The Life of Mammals [BBC Series].2008. BBC Warner
9. Hickman, C.P., Roberts, L.S. and Larson, integrated principles of zoology,11thEdition (International), 2004. Singapore: McGraw Hill
- Roots.C. Flightless Birds (Greenwood Guides to the Animal World).2006.

Paper D	Biology of Chordates, Embryology and Ecology	Practical (2 hours duration)
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- a) Dissection; Pigeon and Uromastrix
- b) Demonstiation of brain, heart and eye of sheep
- c) Skeleton: detailed account of Labeo, varanus and rabbit, girdles of tortoise and pigeon, horse and cow, skull of dog.
- d) Different types of scales of fishes. Different types of feathers of birds, shell of a tortoise, epidermal scales of crocodiles, modification of hair, hornes, scales and spines, nails, hooves, antlers(demonstration from museum specimen only).
- e) Demonstration of the following prepared slides: Amphioxis(whole mount of T,S through different regions, pharynx of scolidon, section of skin of fishes, amphibians and mammals, different types of features. Development of amphioxus, frog and chick. Demonstration of chick embryo.
- f) Study of the histological prepared slides of the following:
Section of liver, kidney, spleen, thyroid gland, testis, ovary, hair, muscles, pancreas, nerve cord, lung, intestine, stomach of vertebrates.
- g) General survey of chordates from the museum specimen.
