BHARATHIAR UNIVERSITY, COIMBATORE.

B.Sc. ZOOLOGY (School of Distance Education)

(for the candidates admitted from 2014-2015 onwards)

SCHEME OF EXAMINATIONS

Part	Subject	Title of the Subject	Examination	
			Duration in Hours	**Maximum Marks**
I YEAR				
Part I	Language	Language - I	3	100
Part II	Language	English - I	3	100
Part III	Core - I	Invertebrate Zoology	3	100
	Core Practical - I	Invertebrate Zoology	3	100
	Allied - I	Botany	3	100
II YEAR				
Part I	Language	Language - II	3	100
Part II	Language	English - II	3	100
Part III	Core - II	Vertebrate Zoology	3	100
	Core Practical - II	Vertebrate Zoology	3	100
	Allied - II	Chemistry	3	100
III YEAR				
Part III	Core - III	Cell Biology	3	100
	Core – IV	Genetics and Evolution	3	100
	Core – V	Developmental Biology and Immunology	3	100
	Core - VI	Animal Physiology	3	100
	Core - VII	Environmental Biology	3	100
	Core Practical - III	Cell Biology, Genetics, Evolution and Developmental Biology	3	100
	Core Practical -IV	Immunology, Animal Physiology and Environmental Biology	3	100
Total				**1700**

I Year

CORE - I

INVERTEBRATE ZOOLOGY

Objective

To understand the systemic and functional morphology of various groups of invertebrates. To study their economic importance, affinities and adaptations.

UNIT-I

Principles of Taxonomy - Binomial nomenclature - classification of the animal kingdom. **PROTOZOA**: General characters and classification up to class with examples. Type study plasmodium, parasitic protozoans (*Entamoeba, Trypansosoma* and *Leishmania*).

UNIT-II

PORIFERA: General characters and classification up to classes with examples. Type study Sycon, Canal system in sponges.
COELENTERATA: General characters and classification up to classes with examples. Type study – *Obelia* - Structure and life cycle, Polymorphism – Corals, coral reef formation and conservation

UNIT-III

HELMINTHES: General characters and classification up to classes with examples. Type study - *Taenia solium*. Nematode parasites and diseases - *Wuchereria bancrofti, Enterobius vermicularis, Ancylostoma duodenale*. Elementary idea of parasitic adaptations in helminthes

UNIT-IV

ANNELIDA: General characters and classification up to classes with examples. Type study - Earthworm, Trochophore larva, and its evolutionary significance.
ARTHROPODA: General characters and classification up to classes with examples. Type study - Prawn. *Peripatus* and its affinities.

UNIT-V

MOLLUSCA: General characters and classification up to classes with examples. Type study - Freshwater Mussel.
ECHINODERMATA: General characters and classification up to classes with examples. Type study – Starfish. Echinoderm larvae and their significance.

Reference Books

1. Ekambaranatha Ayyar.M. and T.N. Ananthakrishnan, 1992. Manual of Zoology Vol. 1 (Invertebrata), parts I and II.S. Viswanathan (Printers and Publishers) Pvt. Ltd; Madras.

2. Jordan, E.L. and P.S. Verma, 1993. Ivertebrate Zoology, 12th Edition. S. Chand and Co. Ltd, New Delhi.

3. Kotpal, R.L. 1988 - 1992 Protozoa, Porifera, Coelenterata, Helminthes, Arthropoda, Mollusca, Echinodermata. Rastogi Publications, Meerut.

4. Parker and Haswell, 1964. Text Book of Zoolgy. Vol I (Invertebrata). A.Z.T; B.S. Publishers and distributors, New Delhi.

5. L.A. Borradile and F.A. Pott. 1987. The Invertebrates. Cambridge University press.UK

6. Adam Sedgwick.1972. A student text book Zoology. Vol. I and II. Central book Depot. Allahabad.

7. P.S. Dhami and J.K. Dhami. 1980. Invertebrate Zoology. S. Chand and Co. New Delhi.

8. Hyman L.H. The Invertebrate Vol. I-VI. 1982, McGraw Hill Co New York.

9. Barrington, E.J.W. 1969. Invertebrate structure and function. ELBS Publication.

10. Barnes. 1973.Invertebrate Zoology. Toppan international Co.

****

CORE PRACTICAL – I – INVERTEBRATE ZOOLOGY

MAJOR PRACTICAL

CD/Model/Chart - Anatomical observation and comment. Cockroach - Digestive, reproductive and Nervous system.

MINOR PRACTICAL

Slides/Model/Chart – Identification (draw and label):

1. Cockroach: Mouth Parts.

2. Earthworm: Penial setae and body setae.

3. Honey bee, House fly, Mosquito - Mouth Parts.

4. Prawn - Appendages

SPOTTERS

1. **Study of the following specimens to bring out and their adaptations to their respective modes of life**.

   Entamoeba, Trypanosoma, Leishamania, Sycon, Taeniasolium, Ancylostoma duodenale, Enterobius vermicularis, Ascaris, Wuchereria bancrofti, Chaetopterus, Leech, Limulus, Any two Crustacean larvae and Starfish.

2. **Study of the following specimens to bring out their biological significance:**

   Obelia, Corals (Any 3), *Physalia, Porpita, Vellela*, Trochophore Larva, *Peripatus, Sacculina* On Crab, Sea Anemone on Hermit Crab, Pearl Oyster and Bipinnaria Larva.

3. **Study of the following to relate structure and function**:

   Sponge Spicules, *Obelia* ployp, *Taenia* Scolex, Prawn Appendages and Pedicellaria of Starfish.

4. Study of the following to draw labelled sketches:

   T.S. of the Earthworm, T.S. of Leech, Obelia Medusa and T.S. Through arm of Starfish.

REFERENCES:

1. A Manual of Practical Zoology (6^{th} Edition) by P.S. Verma and V.K. Aggarwal, 2003 – S. Chand Publication, New Delhi.

2. Invertebrate Zoology: A Laboratory Manual (5^{th} Edition) by Robert L. Wallace, Walter Kingsley Taylor and D. Elden Beck, 2004.

****

II Year

CORE - II

VERTEBRATE ZOOLOGY

OBJECTIVES:
To understand the systemic and functional morphology of various groups of chordates. To study their affinities and adaptations to different modes of life.

UNIT-I
1. Salient Features, General classification of Phylum Chordata upto orders.
2. Origin of Chordata.
3. Prochordata: General Characters with an examples for Hemichordata, Cephalochordata and Urochordata

UNIT-II
PISCES
1. General characters and classification up to orders.
2. Type study: Shark.
3. Parental care.

AMPHIBIA
1. General characters and classification up to orders.
2. Type study : Frog
3. Adaptive features of Anura, Urodela and Apoda.
4. Parental care in Amphibia

UNIT-III
REPTILIA
1. General characters and classification upto order level.
2. Type study- Calotes.
3. Poison apparatus and biting mechanism of poisonous snakes.
4. Identification of poisonous and non-poisonous snakes.

UNIT-IV
AVES
1. General characters and classification upto orders
2. Type study-Pigeon
3. Characters of Archaeopteryx and its evolutionary significance.
4. Flightless birds (Ratitae).
5. Flight adaptation.

UNIT-V
MAMMALIA
1. General characters and classification upto orders.
2. Type study-Rabbit.
3. Flying Mammals.
4. Dentition in mammals.
5. Aquatic mammals.

REFERENCES:

1. Ekambarantha Ayyar, M and T.N Ananthakrishnan 1992, A manual of Zoology Vol. II[Chordata]. S. Viswanaathan (Printers and Publishers] Pvt. Ltd., Madras.

2. Jordan E.L. and P.S. Verma 1995. Chordata Zoology and Elements of Animal Physiology. S. Chand and Co., New Delhi.

3. Kotpal R.L. 1992. Vertebrata, Rastogi Publications, Meerut

4. Nigam.H.C. 1983 Zoology of Chordates, Vishal publications, Jalandhar.

5. Waterman, Allyn J.et al.1971, Chordate Structure and Functions. Mac.Millan and Co., New York.

6. Jollie. M. 1968. Chordate Morphology. East west press Pvt. Ltd., New Delhi.

7. Hyman. L.H. 1972. Comparative Vertebrate Zoology. McGraw Hill Co., New York.

****

CORE PRACTICAL – II – VERTEBRATE ZOOLOGY

MAJOR PRACTICAL

CD/Model/Chart - Anatomical observation and comment. Frog - Digestive system, Urino genital system, Arterial and venous systems.

MINOR PRACTICAL

Slides/Model/Chart – Identification (draw and label): 1. Frog vertebrate: Brain and Hyoid apparatus. 2. Placoid Scales.

SPOTTERS

1. **Study of the following specimens to bring out and their adaptations to their respective modes of life**. *Balanoglossus*, *Ascidian*, *Ichthyophis*, *Draco*, *Phyrynosoma*, Sea snake and Bat.

2. **Study of the following specimens to bring out their biological significance**: *Amphioxus, Epiceratodus*, Shark, *Anabas, Hippocampus, Narcine, Echeneis*, *Arius*, Flying Fish Eel, *Amblystoma*, Axolotl Larva, Bufo, Hyla, Cobra, Krait, Ressel Viper, *Echies carinatus*, Turtle, Pigeon, Owl and King Fisher.
3. **Study of the following to relate structure and function**: Placoid Scale of Shark, Quill Feather of Pigeon.
4. **Study of the following to draw labelled sketches**: T.S. of *Amphioxus* through Pharynx.

5. **Osteology**:
   a. Study of the following skulls with reference to dentition –Dog, Rat, Rabbit and Man.
   b. Pectoral girdles of Frog, Calotes, Pigeon and Rabbit.
   c. Pelvic girdles of Frog, Calotes, Pigeon and Rabbit.
   d. Fore limbs of Frog, Calotes, Pigeon and Rabbit.
   e. Hind limbs of Frog, Calotes, Pigeon and Rabbit.
   f. Synsacrum.

REFERENCES:

1. GENERAL VERTEBRATE ZOOLOGY LAB MANUAL by BATEMAN, ISBN:9780536106247, Publisher: Pearson Custom Publishing.
2. A Text Book of Practical Zoology – Vertebrate by S.S. Lal, Oscar Publication, New Delhi.

****

III Year

Core Paper – III

CELL BIOLOGY

Objectives:

1. To learn the cytological techniques, the structure and functions of various cellular components.
2. To understand the integrated activity of the whole cell as in mitosis, meiosis and protein synthesis.
3. To understand the molecular basis of cell structure DNA structure and functions

UNIT-I

History of Cell Biology - Principles of light and electron microscopes. Cytological Techniques: cell fractionation, homogenization, centrifugation and isolation of Sub-cellular components. Biochemical Techniques: Chromatography - Electrophoresis and their Applications.

UNIT-II

Cell: Cell Theory, Ultrastructure of Animal cell - structure, composition and functions - cell components - Plasma Membrane - Endoplasmic reticulum, Ribosomes, Golgi Complex, Lysosmes, Centrioles and Mitochondria.

UNIT-III

Nucleus - Ultrastructure, Composition and Function - Nuclear Membrane, Nucleoplasm - Chromosomes DNA, RNA, Protein synthesis - Nucleolus - Cell Division and Cell cycle - Amitosis, Mitosis and Meiosis and their significance

UNIT-IV

Cell signalling: Cell Surface receptors - second messenger system MDPkinase pathways - Signalling from plasma membrane to nucleus.

UNIT-V

Semi conservative replication, mechanism and enzymology of DNA replication, Structure and functions of DNA and RNA (mRNA, tRNA and rRNA).

References :

1. Cohn, N.S., 1979, Elements of Cytology, Freeman Book Co., New Delhi
2. De Robertis, E.D.P. and E.M.F. De Robertis, 2008. Cell and Molecular Biology, 8th edition, International edition Informes Hongkong. 734p.
3. Gies, A.C., 2014. Cell Physiology, Saunders Co., Philadelphia, London, Toronto, 609p.
4. Powar, C.B., 2012. Essentials of Cytology, Himalaya Publishing House, Bombay, 368p.
5. Verma, P.S. and V.K. Agarwal, 2000. Cell and Molecular Biology, 8th edition, S. Chand & Co., New Delhi, 567p.
6. Rastogi. S.C. Cell and Molecular Biology, 2008. 2nd Edition, New Age International (p) Ltd., New Delhi.

****

Core Paper – IV

GENETICS AND EVOLUTION

UNIT-I

Introduction to Genetics – Basis of Mendelian inheritance and Mendelian laws – Interaction of Genes – Complementary Factors, Inhibitory and Lethal Factors – Multiple Alleles – Blood Groups and their Inheritance in Human.

UNIT-II

Linkage and Crossing Over – *Drosophila*: Morgan's Experiments – Cytological Evidence for Crossing Over. Sex determination and sex Linkage in *Drosophila* and Man.

UNIT-III

Non-Disjunction and Gynandromorphs – Cytoplasmic Inheritance – Maternal Effect on *Limnaea* (shell coiling), Fine structure of Gene – Cistron – Recon, Muton – Gene Regulation – Operon concept – Lac Operon

UNIT-IV

Mutation – Chromosomal Aberrations – examples from Human – Applied Genetics – Animal Breeding – Heterosis, Inbreeding, Outbreeding, Outcrossing, Hybrid Vigour – Population Genetics, Hardy Weinberg Law – Gene Frequency, Factors Affecting Gene Frequency.

UNIT-V:

Theories of Lamarck, Darwin and Devries – Modern concept of natural selection – Variation – isolation – speciation – living fossils – Evolution of man - biological and cultural. Distribution of animals – Zoogeographical realms.

REFERENCES:

1. Verma, P.S. and V.K. Agarwal, 2013. Genetics, 8th edition, S. Chand & Co, New Delhi.
2. Gunther S. Stent, 1986. Molecular Genetics. Macmillan Publishing Co Inc. 773 pp.
3. Higgins II, Best GJ and Jones J, 1996. Biotechnology – Principles and application Black Well Scientific Publication Oxford London.
4. Gupta P.K., 2010. Elements of Biotechnology [2001] Rastogi Publications, Meerut.
5. Dubey, 2006. Text book of Biotechnology S. Chand & Co. New Delhi.
6. Gardener, 1991. Principles of genetics. 8th edition. John Wiley & Sons Inc. New York. Chichester, Brisbane, Toronto, Singapore.
7. Monroe. W. Strick Berger 2004 Genetics. Printice Hall of India New Delhi

****

Core Paper - V

DEVELOPMENTAL BIOLOGY AND IMMUNOLOGY

UNIT-I

Spermatogenesis and Oogenesis - Comparative study of Invertebrate, Vertebrate sperms and eggs, polarity and symmetry of eggs – Fertilization: Mechanism, physiology and theories – parthenogenesis - Artificial parthenogenesis and its significance.

UNIT-II

Cleavage - Factors influencing cleavage-Fate map - Blastulation and Gastrulation; General principles - physiology and comparative study in Amphioxus, Frog and Chick - Experimental works of Speerman and Mangold - Development of brain and eye in Frog - Regeneration in Invertebrates.

UNIT-III

Embryonic adaptations: Embryonic membranes and their functions in chick - placentation in mammals. Puberty - Menstrual cycle - contraception-family welfare - Reproductive technology: Artificial cycle - insemination - IVF - Embryo-transfer - Test tube babies - Bioethics.

UNIT-IV

Basics of Immunology – Antigen - antibody reaction. Types of immunity - Hypersensitivity and graft rejection - Lymphoid organs, cells of immune system and their role in immune response.

UNIT-V

Immunoglobulin: types, structure, physico-chemical and biological properties - Immunoprophylaxis - Immunization schedule for children. Immuno deficiency - AIDS, Immunotechniques.

REFERENCES:

1. Balinsky, B.I.,1981. Introduction to embryology Saundeers, Philadelphia.
2. Berril & Corp, 1983. Developmental Biology. Mc Graw Hill Book Company, New York.
3. M.S. Jayaraj, 1987. An Introduction to Embryology, Veer Bala Rastogi Publication, New Delhi.
4. Verma, P.S., V.K. Agarwal and Tyagi, 1995. Chordate embryology. S. Chand & Co., New Delhi.
5. Majumdar, N.N. 1990. Text book of Vertebrate embryology. Tata McGraw-Hill publishing company Ltd., New Delhi.
6. McEwen, R.S., 1969. Vertebrate Embryology. Oxford and IBH publishing co., New Delhi
7. Jain, P.C 1998, Elements of Developmental Biology. Vishal Publication, New Delhi.
8. Dubey, R.C., 2014. Text book of Biotechnology. S. Chand and Co., New Delhi.
9. Roitt.I.M., 2000. Essential Immunology, Blackwell scientific Publishers.
10. Paul, W.E.M. 1989, Fundamental Immunology, Raven press, New York.
11. Kuby. J., 2008. Immunology. W.H. Free man and Co. New York.
12. Roitt. I,Brostoff, J. and Male. D., 2002. Immunology, Mosby, New York.
13. Richard, A. Golds, Thomas I, Kindt & Barbara. A. Osborne, 2000. Kuby Immunology, Freeman and Co. New York.

****

Core Paper - VI

ANIMAL PHYSIOLOGY

Objectives:

To study the basic principles of animal physiology, chemical and physical properties of living matter. To understand the physiology of various organs and organ systems.

UNIT-I

Nutrition-Food requirements - Carbohydrates, Proteins, Fats, Minerals and Vitamins. Digestive - enzymes and their role in digestion – Metabolism - metabolic pathways with reference to carbohydrates

UNIT-II

Respiration - Respiratory pigments and functions. Transport of gases (CO_2+$O_{2)}$ - Respiratory quotient. Circulation: Types, Composition, Properties and Functions of blood - Human - cardiac cycle-cardiac rhythm.

UNIT-III

Excretion - kinds of excretory products - mechanism of urine formation in mammals - hormonal regulation of Excretion. Regulatory mechanisms - Osmoconformers - Osmoregulator - Muscles - Types of muscles - Muscle proteins - mechanism of muscles contraction.

UNIT-IV

Nervous tissue - Neuron - Structure, types of neurons. Nerve Impulse - Synapse - Synaptic transmission of impulses - Neuro-transmitters. Receptors - Photoreceptor - mammalian eye - structure of retina - visual pigments - Physiology of vision - Phonoreceptors - Mammalian ear- Physiology of organ of Corti.

UNIT-V

Endocrine glands - structure, secretions and functions of Endocrine glands of vertebrates- pituitary, Hypothalamus, thyroids, parathyroid, Adrenal, Thymus, Islets of Langherhans, Sex organs - Hormones of insects and crustaceans.

REFERENCES:

1. Sambasivaiah, Kamalakara Rao and Augustine Chellappa, 1990. A Text book of Animal Physiology and Ecology, S. Chand & co., Ltd., New Delhi - 110 055.
2. Parameswaran, Anantakrishnan and Ananthasubramananiam, 1975. Outlines of Animal Physiology, S. Viswanathan [Printers & Publishers] Pvt. Ltd.,
3. William S. Hoar, 2004. General and Comparative Physiology, Prentice Hall of India Pvt. Ltd., New Delhi - 110 001.
4. Wood, D.W., 1983. Principles of Animal Physiology 3rd Ed.,
5. Prosser, C.L. Brown 1985. Comparative Animal Physiology, Satish Book Enterprise, Agra - 282 003.

****

Core Paper - VII

ENVIRONMENTAL BIOLOGY

Objectives:
To realize the importance of inter relationship between every organism and environment. To study the impact of eco factors on the morphology and distribution of organisms.

UNIT-I
Scope – concept - Branches in ecology - Autoecology, Synecology, Micro and macro environment - Types of media and substratum and their influences on animals - Biosphere - Hydrosphere - Lithosphere - Atmosphere.

UNIT-II
Water: Properties, Forms of water, Soft and hard water. Air composition - Properties. Substratum: Soil: types - soil formation, soil group of India, soil profile. **Temperature**: Distribution of temperature, Thermal stratification - Temperature as a Limiting Factor, Thermal Adaptations. Light as a limiting factor. Leibig's law Minimum – Shelford's law of Tolerance.

UNIT-III
Bio-geo chemical cycles: Gaseous cycle and Sedimentary cycle (Phosphates and Sulphur). Intra specific and inter specific animal association with abiotic factors.

UNIT-IV
Population Ecology: Definition - characteristics – Natality, mortality, age distribution, population growth forms, population fluctuation. Community – ecological succession. Conservation - wild life management: preservation – sanctuaries, national parks. Natural resources management: renewable and non-renewable

UNIT-V
Environmental degradation - deforestation, urbanization, population explosion and other environmental hazards - depleting natural resources and relationship between poverty and environmental degradation. Environmental ethics and laws - Role of Governmental agencies for environmental monitoring.

REFERENCES:
1. Kotpal, R.L. and N.P. Bali, 1986. Concepts of Ecology, Vishal Publications, New Delhi.
2. Rastogi V.B. and M.S. Jayaraji, 1988-1989. Animal Ecology and Distribution of animals, Kedar Nath, Ram Nath Meerut.
3. Clark, G.L. 1954, Elements of Eology, John Wiley & Sons Inc., New York, London.
4. Ananthakrishnn, T.N. and S. Viswanthan, Principles of Animal Ecology.
5. Eugene P. Odum, 1971. Fundamentals of Ecology, Saunders International Student Edition, W.B. Saunders Company, Philadelphia London, Toronto.
6. Verma, P.S and Agarwal 1986, Environmental Biology, S. Chand & Co Ltd.,
7. Richard, Manual of Wild life Conservation.
8. Veer Bala Rastogi, 2004. Organic Evolution, Publications Meerut.

****

CORE PRACTICAL - III

CELL BIOLOGY, GENETICS, EVOLUTION AND DEVELOPMENT BIOLOGY

CELL BIOLOGY

1. Use of Microscope, Camera Lucida, Stage and Ocular Micrometers
2. Mounting of Buccal epithelium.
3. Mitosis in onion root tip squash.

GENETICS

1. Observation of common mutants of *Drosophila*.
2. Human blood grouping.

EVOLUTION

1. Calculating gene frequencies and genotype frequencies in the light of Hardy-Weinberg Law in human/other populations.
2. Calculation of frequencies of recessive and dominant genes in a population.
3. Calculation of Hetrozygotes and Homozygotes in a population.
4. Study of Evidences:
   i) Analogous and Homologous organs.
   ii) Connecting links (*Peripatus*, *Archaeopteryx* and *Limulus*).
   iii) Embryological evidences.
5. Study of Adaptation:
   i) Aquatic ii) Terrestrial iii) Aerial/Volant iv) Curssorial v) Desert.

DEVELOPMENT BIOLOGY

Study of the following prepared slides/museum specimens

1. Sections of Testis and Ovary (Mammalian)

2. Slides of Mammalian sperm and ovum.

3. Study of Egg types.

4. Study of cleavage stages – Blastula and gastrula of frog.

5. Slides of different stages of chick embryo-18 Hours (Primitive streak stage), 24 hours, 48 hours, 72 hours and 96 hours.

6. Placenta of Sheep, Pig and Man

****

CORE PRACTICAL - IV

IMMUNOLOGY, ANIMAL PHYSIOLOGY AND ENVIRONMENTAL BIOLOGY

IMMUNOLOGY

1. Study of Widal test – Qualitative and quantitative.
2. **Study of prepared slides of histology**:

   a) Thymus b) Spleen c) Bone marrow d) Lymph node.

ANIMAL PHYSIOLOGY

1. Study of human salivary amylase in relation to pH and Temperature.
2. Estimation of Oxygen consumption in a fish with reference to body weight.
3. Detection of nitrogenous waste products in fish tank water. Bird excreta and mammalian Urine.
4. Blood Smear Preparation - Differential count of W.B.C.
5. Total count of RBC and WBC using Haemocytometer.
6. Estimation of haemoglobin by Sahli's method.
7. **Study of prepared slides of histology**:

   Columnar Epithelium, Ciliated Epithelium, Glandular Epithelium, Cardiac muscle, Striated Muscle, Non striated muscle, Neuron, Male germ cell and Female germ cell

ENVIRONMENTAL BIOLOGY

1. Estimation of Dissolved oxygen, Salinity and CO_2 in water samples.
2. Plankton study - Fresh water.
3. Study of natural ecosystem and field report.

****