

# **UNIVERSITY OF CALCUTTA**

## **SYLLABI**

**F  
O  
R**

### **THREE-YEAR HONOURS & GENERAL DEGREE COURSES OF STUDIES**



**ZOOLOGY  
2010**

**Syllabus for three years B.Sc.(Honours Course ) in Zoology,  
University of Calcutta, 2010**

---

**University of Calcutta  
Syllabus structure for B.Sc. (Hons) Zoology**

---

		Marks
<b>Part I</b>	<b>Paper-I</b>	
	Unit-1 ZHT 01. Animal diversity I: Non-chordate	50
	Unit-II ZHT 02. Cell Biology & Genetics	50
	<b>Paper-II</b>	
	Unit- I ZHT 03. Animal Physiology & Biochemistry	50
	Unit-II ZHP 04. Laboratory course I [Gr. A=25 + Gr. B =25)	50
		200
<b>Part II</b>	<b>Paper -III</b>	
	Unit I ZHT 05. Animal diversity II. Chordate	50
	Unit-II ZHT 06. Histology, Endocrinology & Reproductive Biology	50
	<b>Paper -IV</b>	
	Unit-I ZHT 07. Developmental Biology	50
	Unit-II ZHP 08. Laboratory course II [Gr. A=25 + Gr. B=25]	50
		200
<b>Part III</b>	<b>Paper -V</b>	
	Unit-I. ZHT -09. Microbiology, Parasitology & Immunology	50
	Unit- II ZHT -10. Molecular Biology and Biotechnology	50
	<b>Paper-VI</b>	
	Unit- I ZHT -11. Evolution, Systematics & Animal behavior	50
	Unit-II ZHT -12. Ecology and Environmental Biology	50
	<b>Paper -VII</b>	
	Unit I ZHT -13. Applied Zoology and Biostatistics	50
	Unit-II ZHP -14. Laboratory course-III	50
	<b>Paper-VIII</b>	
Unit-I ZHP -15. Laboratory Course- IV	50	
	Unit-II ZHP -16. Laboratory Course -V	50
		400
Total		800

**Detailed Syllabus**  
**Part –1**  
**Theory –150 and Practical –50**

**Paper I**

**Unit- 1. ZHT 01 Animal diversity I : Nonchordate**

**Full Marks 50**  
(Lectures 60)

1. Distinguishing characters & classification of Protozoa (up to Phyla) [Levine *et al*, 1980]  
Special Features a) **Morphology:** *Paramoecium sp.*  
b) **Movement:** i) Amoeboid movement in *Amoeba*, ii) Ciliary movement of *Paramoecium sp* and iii) flagellar movement in *Euglena*, c) **Reproduction:** *Paramoecium sp.* with special reference to conjugation
2. Distinguishing characters and classification of Phylum *Porifera* up to class  
Special feature : Canal system in *Porifera* and its evolutionary significance
3. Distinguishing characters and classification of Phylum *Cnidaria* up to class  
Special feature : i) Polymorphism in Siphonophores, ii) Coral reefs (types, theories on coral reef formation, distribution with reference to India and conservation)
4. Symmetry and Coelom- types with examples
5. Distinguishing characters and classification of Phylum *Platyhelminthes* up to class
6. Form and function and classification of Phyla Aschelminthes and Nematoda
7. Distinguishing characters and classification of Phylum *Annelida* up to class
8. Metamerism in Annelida
9. Distinguishing characters and classification of Phylum *Arthropoda* up to class  
Special feature: Respiration in *Arthropoda* (a) Terrestrial : *Periplanata*, scorpion, spider, b) Aquatic : Prawn, Kingcrab): Organ structures and mechanism
10. Distinguishing characters and classification of Phylum *Mollusca* up to class  
Special feature: Nervous system: Nervous system in gastropods and cephalopods (Types structures, organs and mechanism)
11. Distinguishing characters and classification of Phylum *Echinodermata* up to class  
Special feature: a) Water vascular system of *Asterias sp.*, b) Echinoderm larvae
12. Anatomical peculiarities of (a) *Limulus* (b) *Balanoglossus* and their phylogenetic position.

**N.B. Classification scheme other than Protozoa as per Ruppert and Barnes (1994) 6<sup>th</sup> Ed., Invertebrate Zoology.**

**Unit- II. ZHT 02. Cell Biology and Genetics**

**Full Marks 50**  
(Lectures- 60)

**Group- A: Cell Biology****20**

1. Microscopy: Principles of optical, Phase Contrast, and Electron microscopes
2. Cellular organelles and operating system for cells: Ultrastructure and functions of Plasma membrane, Mitochondria, Golgi apparatus and its network, ribosome, Endoplasmic reticulum and Lysosome.
3. Nucleic acids: Physio-chemical properties, structures types and functions of DNA and RNA

**Group- B Genetics****30**

4. Chromosome structure: nucleosomal organization, telomere, centromere, kinetochore, B chromosome, polytene chromosome, lampbrush chromosome.
5. Replication, transcription and translation in prokaryotes and eukaryotes.
6. C-value paradox, Genome concept and its organization,
7. Allele: a) types, b) multiple allele, (ABO blood group only)
6. Linkage and recombination, Holliday model, gene mapping in diploid (by three point crosses).
8. Sex determination and dosage compensation in *Drosophila* and man.
9. Genetic variation : Mutation types with example, chromosomal aberrations in number and structure, chromosomal basis of genetic disorder and diseases,- Down, Patau, Turner's and Klinefilter syndromes; induction of mutation by a) ionizing radiation and b) Chemical mutagens only.

**Paper –II****Unit-I. ZHT 03. Animal Physiology & Biochemistry****(Full marks 50)****(Lecture-60)**

1. a) Elementary idea of structure of carbohydrate, protein and lipid.  
b) Process of Glycolysis, Glycogenesis, glycogenolysis, gluconeogenesis
2. Elementary idea of biological oxidation, oxidative phosphorylation and electron transport chain
3.  $\beta$  oxidation of fatty acids,
4. Protein metabolism with special reference to Deamination and Transamination.
5. Enzymes: (a) Classification b) Kinetics: Michelis-Menten concept, c) Factors affecting enzymetic actions
6. Structure & function of haemoglobin, transport of  $O_2$  and  $CO_2$  in mammals, Bohr and Haldane effect, Chloride shift.
7. Structure of mammalian nephron, physiology of urine formation, osmoregulators and osmoconformers
4. Physiology of excretion a) urea cycle, Nitrogenous wastes- Amonia, urea, uric acid, creatinine.
8. Propagation of nerve impulse through nerve fibres, synaptic and neuro-mascular

- junctions (origin, nature and mechanism).
9. Temperature regulation in human
  10. Physiology of vision in mammals
  11. Physiology of hearing in mammals

**Unit- II. ZHP 04. Laboratory courses**

**Full Marks- 50**

**Group-A**

**25**

**1. Major dissections**

**15x 1 =15**

- a) Cockroach : i) Salivary apparatus (with Hypopharynx), ii) Nervous system and iii) Male reproductive system
- b) *Pila sp* : i) Digestive and ii) Nervous system

**2. Minor dissections**

**5x1=5**

- (a) Digestive system of cockroach
- b) Female reproductive system of cockroach
- c) Mouth parts of cockroach
- d) Radula of *Pila sp*.
- e) Osphradium of *Pila sp*.

**3. Laboratory note book -**

**2**

**4. Viva voce -**

**3**

**Group-B.**

**25**

1. Study of meiosis from grasshopper (staining and identifications of different stages of meiotic division). 10
2. Colorimetric estimation (Lowry's method) of protein 5
3. Test of ammonia, uric acid and urea from test sample (Qualitative) 5
4. Laboratory note book 2
5. Viva voce 3

**Part –II**

**Theory –150 and Practical –50**

**Paper III**

**Unit- I. ZHT 05. Animal Biodiversity II : Chordate**

**Full Marks 50  
(Lectures –60)**

1. Classification of Phylum Chordata (a) Urochordata, Cephalochordata, Chondrichthyes, Osteichthyes, Aves and Mammalia (up to subclass) and Amphibia and Reptilia upto order (Classification as per J.Z. Young, Life of

- Vertebrates)
2. Structural organization (a) *Branchiostoma* sp. and b) *Ascidia* sp, c) *Petromyzon*
  3. Special feature :Retrogressive metamorphosis in *Ascidia* sp.
  4. a) Comparative gill morphology of *Chondrichthyes* & *Osteichthyes*, b) Accessory respiratory structure in fish.
  5. Paedomorphosis with special reference to Axolotl larva
  6. Distinguishing features : a) Non-poisonous and poisonous snakes, b) Ratites and Carinates, c) Cetacea and Sirenia d) Artiodactyla and Perissodactyla
  7. Principles of bird flight
  8. Bird migration,
  - 9 Comparative anatomy & structural organization of (a) heart and aortic arches in vertebrates, b) kidney in vertebrates
  10. Special topics : (a) Swim bladder in teleost, b) Poison apparatus and biting mechanism of snake, c) exoskeleton structures of birds and mammals, d) Dentition in Mammals e) ruminant stomach in mammals , f) Echolocation in bats, Cetaceans and Sirenia

**Unit. II. ZHT 06. Histology, Endocrinology & Reproductive Biology**

**(Full Marks 50)**

**(Lectures- 60)**

**Group A: Histology**

**15**

1. Histology of liver, Kidney, pituitary, thyroid, adrenal, pancreas, testis and ovary in mammals,
2. Corpora cardiaca, corpora allata and neurosecretory cells in insects (with special reference to metamorphosis in insects) .

**Group-B: Endocrinology & Reproductive Biology**

**35**

3. Classification of hormones and mechanism and effects of hormonal actions.
4. Hormonal regulation of physiological processes- (basic concepts and methods with special references to carbohydrate and calcium metabolism).
5. Biosynthesis and secretion of adrenal, pancreas (insulin), ovarian, testicular and thyroid hormones, factors influencing hormone secretions
6. a) Hormone assays- bioassays and RIA & ELISA  
b) Endocrine disorders with special reference to thyroid gland
7. Estrous cycle in rat and menstrual cycle of human
8. Hormonal regulation of gametogenesis in male and female of mammals

**Paper -IV**

**Unit- I. ZHT 07. Developmental Biology**

**Full Marks 50**

**(Lectures –60)**

1. Outline knowledge of gametogenesis, ultrastructure of sperm and ovum, egg types, egg membrane
2. Physical & molecular events of fertilization in sea urchin and mammals

3. Cleavage: types, role of yolk in cleavage
4. Embryonic stem cell (in brief), Potency
5. Formation of blastula in frog and chick
6. Fate map, morphogenetic movement & process of gastrulation in frog and chick
7. Role of organizers in development
8. Organogenesis: Development of brain and eye in chick
9. Formation and function of extra embryonic membranes in chick
10. Placenta a) types with examples, b) structure and function of placenta in human
11. Principles of collections and cryopreservation of gametes and embryos
12. *In vitro* fertilization and embryo transfer (in brief)

**Unit- II. ZHP 08 Laboratory course**

**Full Marks – 50**

**Group-A.**

**Marks-25**

1. Major dissection 15x1=15
  - a) Lata : a) Afferent branchial arteries b) efferent branchial arteries, c) IXth and Xth cranial nerves (origin & distribution)
  - b) White rat : (a)Arterial system, (b) reproductive system, (c)IXth and Xth cranial nerves (origin & distribution)
2. Minor dissections : 5x1=5
  - a) Brain, (b) Pituitary gland of *Tilapia sp.* / *Oreochromis sp.* (as available)
  - c) Ctenoid scale of fin fish
  - d) Placoid scale of *Scoliodon sp.*
  - e) Hyoid apparatus of fowl
  - f) Pecten of fowl
3. Laboratory note book 2
4. Viva voce 3

**Group-B.**

**Full marks -25**

1. Tissue fixation, embedding, microtomy, staining and mounting of histological tissues (liver, pancreas, thyroid, kidney, ovary and testis) of white rat. 8
2. Identification of mammalian histological tissue sections : liver, pancreas, thyroid, kidney, ovary, testis, stomach and lung 2x4=8
4. Identification of whole mount embryo (24 hrs, 48 hrs, 72 hrs and 96 hrs) 4
5. Laboratory note book 2

**Part- III****Theory –250 and Practical –150****Paper V.****Unit-I. ZHT 09. Microbiology, Parasitology & Immunology Full Marks 50  
(Lectures-60)****Group-A. Microbiology 15**

1. Characterization and classification (on the basis of staining methods), and identification of microorganisms, Techniques of microorganism culture (sterilization reproduction and growth, maintenance and preservation of pure cultures), Control of microorganisms.
2. Microbes in relation to common diseases and control (Cholera, Amoebiosis and Shiegella).

**Group-B. Parasitology 20**

3. Animal association : symbiosis, commensalism, mutualism, parasitism and zoonosis
4. Life cycle, pathogenecity, clinical features and control of a) *Plasmodium sp.* b) *Entamoeba histolytica*, c) *Leishmania donovani* d) *Wuchereria bancrofti* e) *Fasciola sp.* f) *Ascaris sp.*
5. Vector biology : mosquito and ticks

**Group- C. Immunology 15**

6. Cells and organs of immune system; Innate and adaptive immunity
7. Antigens : characteristics, antigenic determinants, Antigen processing and presentation
8. Antibody: Structure, classes, binding site, polyclonal and monoclonal antibodies
9. Cytokines, adjuvants and complements
10. B cell generation, activation and differentiation, co-operation, macrophage
11. T cell maturation and activation.

**Unit-II. ZHT. 10. Molecular Biology and Biotechnology Full Marks 50  
(Lectures- 60)****Group- A: Molecular Biology 30**

1. Gene and cistron concept : One gene one polypeptide, (sickle cell anemia;



- Thalassemia)
2. Benzer's RII locus (idea of complementation and non-complementation)
  3. Split gene, RNA splicing and editing
  4. Genetics of cell cycle,
  5. Cancer: types, causes- genetic and others
  6. Regulation of gene expression : *lac* and *trp* operons, epigenetic regulation
  7. Elementary idea of Repetative DNA, Transposable genetic element, LINES, SINES, Alu
  8. Repair mechanism, direct reversal repair, Excision repair, Mismatch repair, Repair defects and human disease.

**Group- B Biotechnology**

**20**

9. Gene cloning techniques, cDNA library, PCR
10. DNA polymorphism mapping RFLP, RAPD, Elementary idea of VNTR & DNA fingerprinting.
11. Medical Biotechnology – Gene therapy (basic concept)
12. Forensic Biotechnology (basic concept)

**Paper VI**

**Unit- I. ZHT 11. Evolution, Systematics and Animal Behavior**

**(Full marks 50)**

**(Lectures –60)**

**Group-A Evolution & Systematics**

**35**

1. Geological time scale, naming of different era
2. Barriers and dispersals: types and their impact on animal distribution, Zoogeographical realms: Names, subdivisions, climatic features, Vertebrate fauna
3. Origin of life (Chemical)
4. Principle of adaptative radiation with special reference to marsupials
5. Adaptation biology- xeric adaptation in camel; Coloration and mimicry and their adaptive significance
6. Concept of evolution : Emergence of evolutionary thoughts
  - a) Variation and sources of variation in a population
  - b) Forces altering Hardy-Weinberg equilibrium, calculating allele & genotype Frequency (multiple alleles, sex linked excluded); (non-random mating, mutation, migration, genetic drift and natural selection), Founder effect and population bottleneck
  - c) Genetic diversity and phylogenetic analysis
7. Mechanism of fossilization, and importance of fossils and dating of fossils
8. Origin of birds and mammals
9. Taxonomy (micro & macro taxonomy), systematics, applications of systematics in biology, classification (Natural and cladistics only)
10. Biological species concept, subspecies other intraspecific categories.
11. Modes of speciation, sympatric, allopatric & parapatric processes
12. Type concept : names of Primary and Secondary types, their definitions and applications.

**Group-B Animal Behavior**

15

11. a) Instinctive and learning behaviour, (b) Fixed action pattern, (c) Communication in honeybees (dance Language and pheromone) (d) Elements of Sociobiology : Altruism and selfishness, (e) Social organization in termites (including Eusociality, castes in termites) (g) Circadian rhythm
12. Parental investment (fish only); role of male and female in parental investment, effect, cost and benefit of parental investment, parent-offspring conflict.

**Unit- II. ZHT 12. Ecology and Environmental Biology****Full marks 50  
(Lectures –60)  
30****Group : A Ecology**

1. Components of ecosystems
2. Ecological factors a) Abiotic : temperature and light & their effects on organisms  
b) Biotic- Intraspecific & interspecific associations
3. Wetland ecosystem and its importance
4. Energy flow in the ecosystem
5. Population ecology: natality & mortality, growth forms, age pyramids  
dispersal, distribution types, regulation of population density
6. Community ecology: Characteristics, types, habitat & niche concept, Resource partitioning
7. Ecological succession and concept of climax
8. Concept of biodiversity : types of biodiversity, biodiversity and human welfare, mega diversity zones and biodiversity hot spots with special reference to India.

**Group- B. Environmental Biology****20**

10. Environmental degradation (natural and man made), Pollution: types, sources and effects of major pollutants of air, water, soil and noise, Control of pollution
11. Wildlife Protection (a brief idea): Schedule I of wildlife Protection Act, 1972 and the role of schedules in wildlife conservation. IUCN categories
12. Concept of Project Tiger and Tiger Project zones in West Bengal
13. Management of wildlife : (a) Conservation areas and their role in management of wild life (Biosphere reserves, National Parks, Sanctuaries, Protected areas etc.) b) Reduction of man-animal conflict by proper management
14. Biomonitoring of environment, environmental impact assessment
16. Concept of conservation, *in situ* and *ex-situ* methods

## Paper-VII

### Unit- I. ZHT-13 Applied Zoology and Biostatistics

Full marks 50  
(Lectures-60)

#### Group- A Applied Zoology

30

1. Aquaculture : resource in India, induced breeding and seed production of carps, Polyculture of fin fish and exotic fish (Methods, problem and precautions), fish byproducts, fish diseases-(pathogens, symptoms and control)
2. a) Fresh water and brackish water prawn culture in India and its prospects, b) Pearl culture and its prospects in India
3. Sericulture : Types of silk, species of silk moth (scientific names), Silkworms and their host plants, mulberry silk worm culture, agricultural aspects of mulberry plant cultivation, extraction and reeling of silk, natural enemies and diseases of silkworm and their control.
4. Apiculture : Species of honey bees in India, life history of *Apis cerana indica*, agriculture technique, bee products and their uses, natural enemies and diseases of honey bee and their control,
5. Lac culture: lac insect (Scientific name), composition of lac, strains of lac insect, cultivation of lac host plants (in brief) processing of lac and uses of lac
6. a) Biology and control of pests: Jute pest (*Apion sp.*), Vegetable pest (*Leucinodes orbonalis*), stored grain pest (*Sitophilus sp.*), rodent pest (*Bandicota sp.*), b) basic idea of pest control methods and IPM.
7. Environmental toxicology: LC50, LD50, acute and chronic toxicity,
8. Animal husbandry : a) Common dairy breeds (cow), techniques of dairy management (in brief),
9. Poultry breeds (fowl): a) Types of breeds, rearing methods, (b) Diseases – types pathogens, symptoms, and control measures

#### Group-B Biostatistics

20

9. Biostatistics - Mean, Mode, Median, Probability, Hypothesis testing (Chi-square, t-test), Correlation test

### Unit- II. ZHP 14 Laboratory Course

Full Marks 50

10x1=10

1. a). Study of gut contents of cockroach for protozoa (Fixation, staining & identification  
b). Collection of helminth, parasites from vertebrates (their fixation, staining and identifications) (Goat and fowl)
2. Identifications (systematic position and specimen characters only) and clinical importance : *Entamoeba*, *Giardia*, *Trypanosoma*, *Plasmodium vivax*, *Plasmodium falciparum*, *Leishmania*, *Ascaris* (male and female), *Wuchereria*

*bancrofti*. 2.5x4=10

- |  |   |
|--|---|
| 3. Gram staining of bacteria                 | 5 |
| 4. Determination of blood group (ABO and Rh) | 5 |
| 5. DNA isolation from goat liver cells       | 7 |
| 6. Pedigree analysis                         | 7 |
| 7. Laboratory note book                      | 3 |
| 8. Viva voce                                 | 3 |

### **Paper VIII**

#### **Unit –I.**

**50 marks**

- |  |        |
|--|--------|
| 1. a. Use of pH meter for estimation of pH in soil samples   |        |
| b. Use of pH meter for estimation of pH in water samples   |        |
| c. Study of micro arthropods of soil samples   | 4+4=8  |
| d. Study of aquatic micro arthropods   |        |
| 2. a) Determination of dissolved O <sub>2</sub> of water   | 1x 5=5 |
| b) Determination of dissolved free CO <sub>2</sub> of water  |        |
| 3. Chi-square test and t-test  | 10     |
| 4. Identification and economic importance of the following:<br>(Systematic position not required).   | 2 x4=8 |
| <i>Sitophilus sp., Apion sp., Leptocorisa sp. Scirpophaga ( Syn. Tryporyza) sp., Hispa sp, Leucinodes sp. Bandicota sp., silkworm life history stages, members of bee colony (Apis sp.), members of termite colony, lac insect, Culex Anopheles, Aedes, Penaeus spp., Macrobrachium sp., Labeo rohita, Labeo bata, Cirrhinus mrigala, Mugil parsia, Lates calcaifer.</i> |        |
| 5. Submission of field study report on ecosystem and its biodiversity assessment.<br>(Any suitable ecosystem)  | 8      |
| 6. Laboratory note book  | 3      |
| 7. Viva voce [on laboratory work = 4 and on field study = 4]   | 8      |

#### **Unit-II. ZHP-16 Laboratory course**

**50**

#### **Group-A**

**25**

- |  |        |
|--|--------|
| 1. Identification of larval forms (Specimen characters only)                                 | 2x2= 4 |
| <i>Ephyra, Nauplius, Zoea, Mysis, Megalopa, Glochidium, Trochophore, Veliger, Bipinnaria</i> |        |
| 2. Identifications (systematic position up to class and specimen characters only)            | 3x4=12 |

*Elphidium, Scypha (Syn, Sycon), Neptune's cup, Aurelia, Pennatula, Sea anemone, Beroe, Madrepora, Nereis, Aphrodite, Squilla, Hippa, Eupagurus, King crab, Peripatus, Belostoma, Chiton, Patella, Aplysia, Mytilus, Sepia, Loligo, Asterias, Sea-urchin, Sea-lily, Balanoglossus.*

- |   |   |
|---|---|
| 3. Uses of stage and ocular micrometer for cellular study | 4 |
| 4. Laboratory note book -                                 | 3 |
| 5. Viva voce  | 2 |

### **Group- B.**

1. Identifications (systematic position up to sub-class and specimen characters only) (Any four) 2.5x 4=10  
*Branchiostoma, Ascidia, Petromyzon, Myxine, Torpedo, Sphyrna, Hippocampus, Ichthyophis, Tylotriton, Axolotl, Cryptobranchus, Hyla, Chameleon, Gekko, Vipera, Naja, Hydrophis.*
  
2. Identification of bones with reasons : 3 x3=9
  - a) Skull of Calotes, Snake, *Chelonia, Columba, Cavia,*
  - b) Vertebrae of *Columba & Cavia*
  - c) Appendicular bones of *Columba & Cavia*
  - d) Girdle bones of *Columba & Cavia*
  
3. Laboratory note book 3
4. Viva voce 3

### **Suggested readings with regard to B.Sc. ( Hons.) Course in Zoology**

#### **Animal Diversity –I : Non-chordate**

1. Text book of Zoology Vol-1 Invertebrates – Parker & Haswell (edited by Marshall & Williams) (ELBS & Macmillan)
2. Biology – Raven, Johnson, Losos, Mason and Singer (Tata MaGraw-Hill Edition)
3. Invertebrate Zoology- Ruppert and Barnes
4. Invertebrate structure and function – E. J. W. Barrington
5. Biology of nonchordates – H.C. Nigam
6. General Zoology -Villev, Walker and Bsarnes
7. Invertebrate Zoology -Meglitch and Schram
8. Invertebrate Zoology Jordon and Verma
9. The Invertebrates : Function and form : A laboratory guide – by I. W. Sherman and V. G. Sherman (Pearson)
10. Practical Zoology- Ghosh and Manna
11. Manual of Practical Zoology- A.K.Roy

### **Cell Biology & Genetics**

1. Principles of Genetics- R. H. Tamarin (Tata MaGraw-Hill Edition)
2. The World of Cell – W. M. Becker, L. J. Kleinsmith, J. Hardin (Pearson)
3. Genetics – S. Elrod and W. Stansfield (Tata MaGraw-Hill Edition)
4. Genetics - (Tata MaGraw-Hill Edition)
5. Concepts of Genetics- W. S. Klug and M. K. Cummings (Pearson)
6. Cell Biology- Cooper
7. Fundamental of Genetics- Russel

### **Animal Physiology & Biochemistry**

1. Modern Experimental Biochemistry- R. Boyer (Pearson)
2. Animal Nutrition – P. McDonald, R.A. Edwards, J.F.D. Greenhalgh and C. A. Morgan (Pearson)
3. Biochemistry- D. Das
4. Biochemistry- Lehninger
5. Animal Physiology – Prosser and Brown
6. Animal Physiology- Adaptation & Environment- Schmidt & Neilson
7. General Biochemistry- J. H. Weil
8. Essential of Animal Physiology- S. C. Rastogi
9. Biochemsitry- Mathews

### **Animal diversity II. Chordate**

1. Text book of Zoology Vol-II Vertebrates – Parker & Haswell (Edited by Marshall & Williams) ( ELBS & Macmillion)
2. Vertebrate life- Pough and McFerland
3. Life of Vertebrates . J. Z. Yong
4. Vertebrates : Comparative anatomy, function, Evolution- K. V. Kardong (Tata MaGraw-Hill Edition)
5. Comparative Anatomy of Vertebrates- G.C. Kent & R. Carr
6. The Vertebrate body- Romer & Parsons
7. Biology of Vertebrates- Walter & Sayles
8. Elements of Chordate Anatomy- Weichert
9. Analysis of Vertebrate Structure- Hildebrand

### **Histology, Endocrinology & Reproductive Biology**

1. Endocrinology- M. E. Hadley and J. E. Levine (Pearson)
2. General Endocrinology- Turner & Bagnara
3. Text book of Endocrinology- Gorman & Wilson

4. Essential Endocrinology- Charles, Book and Marshall
5. Endocrinology ( Vol. 1, 2, 3)- L. J. Degroot
6. Vertebrate Endocrinology- Norris
7. Histology- Ross and Reith
8. Histology and Histological techniques- Bankroft
9. Endocrinology and Reproductive Biology- K. V. Shastry

### **Developmental Biology**

1. Introduction of Embryology- Balinsky
2. Pattern's foundation of Embryology- (Tata MaGraw-Hill Edition)
3. Development Biology- Gilbert
4. Developmental Biology- Browder et al.
5. Principles of Developmental Biology – Wilt and Hake

### **Microbiology, Parasitology & Immunology**

1. Microbiology : an Introduction- G. J. Tortora, B. R. Funke and C. L. Case (Pearson )
2. Principles of Microbiology- Dr. Geeta Sumbali and Dr. R. S. Mehrotra. (Tata McGraw-Hill Edition)
3. Microbiology – M. J. Pelczar Jr., Chan E. C. S. and N.R. Krieg (Tata MaGraw-Hill Edition)
4. An Introduction to Parasitology- J. D. Smyth
5. General Parasitology- Cheng
6. Foundation of Parasitology- Schmidt & Roberts
7. The elements of Immunology- F. H. Khan (Pearson)
8. Immunology – G. Pinchuk (Tata MaGraw-Hill Edition)
9. Immunology- J. Kuby
10. Immunology-A. K. Chakraborty
11. Principles of Cellular and Molecular immunology – J, M. Austyn et al.
12. Parasitism- The diversity and ecology of animal parasites- A. Bush, J. Fernandez, G. Esh and J. Richard seed
13. Zoonoses: Infectious diseases Transmissible from animal to human- K. W. Appeal et al.

### **Molecular Biology and Biotechnology**

1. Molecular and cell biology – W. D. Stansfield, J. S. colome and R. J. Cano. (Tata MaGraw-Hill Edition)
2. Bioinformatics - (Tata MaGraw-Hill Edition)
3. Introduction to Biotechnology- W. J. thieman and M.A. Palladino. (Pearson)
4. Molecular Biology of the gene – J. D. Watson et al. (Pearson)
5. Advanced Molecular Biology- Twyman
6. Genes IX – B. Lewin
7. Molecular Biology and Biotechnology- R. A. Meyers

## **Evolution, Systematics and Animal Behaviour**

1. Principles of Systematic zoology- Mayr & Ashlock
2. Evolutionary Biology- futuyama
3. Evolution-Strickberger
4. An introduction to Animal Behaviour- Manning & Dawkins
5. Animal Behaviour- Drickamar & Vessey
6. Evolution of the Vertebrates- Colbert
7. Vertebrate Paleontology- Benton
8. Vertebrate Paleontology- Romer
9. Principles of Animal Taxonomy- Simpson
10. Zoogeography- Darlington
11. Evolution- Dobzhansky, Ayala, Stebbins, Valentine
12. Understanding Evolution- Hanson

## **Ecology and Environmental Biology**

1. Elements of Ecology- by T. H. Smith and R. L. Smith. (Pearson)
2. Microbial Ecology : Fundamentals and Applications – R. M. Atlas and R. Bartha (Pearson)
3. Environmental Science- G. Tyler Miller
4. Essentials of Ecology – C. townsand, J. L. Harper, M. Bagon
5. Conservation Biology- Hunter
6. Fundamentals of Ecology- E. P. Odum
7. Basic Ecology- E. P. Odum
8. Ecology: Principles and Applications- Chapman & Reiss
9. Environmental Biology- Park
10. Biodiversity- Wilson
11. Wildlife of India- Majupuria
12. Endangered animals of India- A. K. Mukherjee
13. Ecology- Riclefs and Miller
14. Threatend Mammals of India- G. K. Shah & S. Majumdar

## **Applied Zoology and Biostatistics**

1. Pest Control- H. F. Vasn Emden
2. Applied Entomology- P. G. Fenemore, A Prakash
3. Freshwater Aquaculture- Santhanam *et al.*
4. Aquaculture- T. V. R. Pilley
5. Animal Husbandary- G. C. Banerjee
6. Sericulture & Silk Industry- D. C. Sarkar
7. Lac Culture- N. Ghorai
8. Bee keeping in India- ICAR
9. Economic Zoology- Shukla U[adhyay
10. Livestock & Poultry Production- Singh and Moore
11. Insect Pest of crop- S. Pradhan



12. Biostatistics: Principles and Practice – B. Antonisamy, S. Christopher, and P. P. Samuel (Tata McGraw-Hill Edition)

## Syllabus for three years B.Sc.(General Course), Zoology, University of Calcutta, 2010

University of Calcutta  
Syllabus structure for B.Sc. (General) Zoology

Part -I	Paper –I	Marks
	Gr. A Non-Chordate	35
	Gr. B. Cell Biology and Genetics, Molecular Biology	35
	Gr. C. Developmental Biology	30
		-----
		100
<hr/>		
Part-II	Paper II	
	Gr. A. Chordate	35
	Gr. B. Ecology, Animal Behavior, Biodiversity and Wildlife	35
	Gr. C Histology, Endocrinology, Animal Physiology & Biochemistry	30
		-----
		100
	Paper III Laboratory Course (all Groups)	100
<hr/>		
Part -III	Paper IV	
	Gr. A .Applied Zoology	30
	Gr. B. Evolutionary Biology	20
	Gr. C. Parasitology & Immunology	20
	Gr. D Laboratory course	30
		-----
		100
<hr/>		
	Total.	400

## Zoology General

### Part –I : (100 Marks)

#### Paper I: Theory (Full Marks –100)

##### Group-A: Course No ZG-01 :Functional Anatomy of Non-Chordates

(Full marks –35)

(Lectures : 35)

1. Classification with distinctive features and suitable examples of sub-kingdom Protozoa (upto Phylum) ( Levine *et al*, 1980) and Phylum Porifera, Cnidaria, Platyhelminthis, Annelida, Arthropoda, Mollusca and Echinodermata (up to Class)
2. General structure & function of the following with reference to the specimens mentioned:
  - I) Locomotion (a) Microfibrils (*Amoeba*), (b) Flagella (*Euglena*), (c) Cilia (*Paramecium*)
  - II) Feeding & digestion (a) Microphagy (*Amoeba*), Macrophagy (*Periplaneta*)
  - III) Respiration (a) Respiratory pigments (Hemoglobin & hemocyanin, (b) Ctenidium & pulmonary sac (Pila), gills, Trachea and booklung (prawn, cockroach, scorpion )
  - IV) Excretion (a) Flame cells (Taenia), b) Nephridia (Earthworm), Malpighian tubules (Cockroach), Green gland (Prawn)
  - V) Circulation (a) Open circulation (Cockroach, (b) Closed circulation (Earth worm)
  - VI) Neural Integration : Integration –simple & complex nerve nets, (b) Nervous system, (Cockroach, Apple snail)
  - VII) Reproduction : a) Fission (*Amoeba*) (b) Budding (*Hydra*) (c) Conjugation (*Paramecium*), (d) Sexual (Cockroach), (e) Metagenesis in *Obelia* (in Brief)

N.B. Scheme of classification other than Protozoa as per Ruppert and Barnes

(1994), 6<sup>th</sup> Ed., Invertebrate Zoology.

##### Group –B: Course No ZG-02:Cell Biology, Genetics and Molecular Biology

(Full marks –35)

(Lectures : 35)

1. Ultrastructure & function of plasma membrane, GERL system, ribosome, lysosome

2. Chromosome structure, nucleosome concept
3. Cell cycle, oncogene & cancer (basic idea)
4. Physio chemical properties, types, structures (in brief) and functions of DNA and RNA.
5. Nucleic acids as genetic material,
6. Mechanisms of replication, transcription and translation in *E. coli*
7. Modes of inheritance of autosomal and sex linked genes in man (Thalassemia & Haemophilia, colour blindness)
8. Linkage and recombination,
9. Chromosomal aberrations-in number and structures, point mutation, Down syndrome & Klinefelter syndrome
10. Sex determination in *Drosophila* and man
11. Basic concept of genetic engineering & gene cloning, and gene manipulation

**Group-C. Course No. ZG-03. Developmental Biology**

**(Full Marks –30)**

**(Lecture: 30)**

1. Spermatogenesis and Oogenesis
2. Fertilization in sea urchin
3. Types of eggs & cleavages; process of cleavage in frog and chick
4. Gastrulation in frog and chick
5. Extra-embryonic membranes in chick
6. Placenta types and function
7. Organizer concept
8. Concept of Protostomia & Deuterostomia with reference to metazoan origin

**Part –II**

**Paper II Theory (Full Marks –100)**

**Group A : Course No.ZG-04: Functional Anatomy of Chordates**

**(Full Marks –35)**

**(Lectures : 35 )**

1. Classification of Phylum Chordata with distinctive features and suitable examples –upto living subclass (Amphibia, Reptilia and Mammalia); upto subclass (Fishes and Aves) (Scheme of classification as per J.Z. Young 1980, Life of vertebrates)
2. Functional anatomy in relation to respiration (*Bufo*); Circulation (*Columba*)
3. Structure & function of the followings :
  - i) Integument-general structure & function; integumentary derivatives (scales in fishes, horny scales & plates in reptiles; feathers of Columba ; hair of mammals, Camel ).
  - ii) Pharynx (Branchiostoma); stomach (*Columba & Bos*)

- iii) Respiratory structures and Respiration : Gill (Fish), accessory respiratory organs (Fish); lung (*Columba* and *Cavia*), Air sac – *Columba*
- iv) Circulatory structure and circulation: Single circuit heart (fish); double circuit heart (Amphibia and Mammals)
- v) Excretory system-pro, meso and meta-nephric kidneys;
- vi) Nervous system- Brain in *Cavia*,
- vii) Origin and distribution of cranial nerves (in *Cavia*).

**Group B. Course No ZG-05 Ecology, Animal Behavior, Biodiversity and Wildlife**

**(Full Marks 35)  
(Lectures 35)**

1. Ecology & Ecosystem-definition, components, energy flow, food chain, food web, ecological pyramids
2. Population- definition and growth
3. Community- definition and types
4. Basic concept of Biodiversity, Biodiversity hotspots.
5. Pollution- air, water and noise (Sources of pollutants, effects on human life and control measures)
6. Honey bee- Hive, castes and their roles
7. Conservation of wild life- purpose & methods, concept of Biosphere Reserve, importance & strategies of wildlife conservation; conservation act and application. National park & Wildlife Sanctuary, Animal cruelty and prevention act.
8. Scheduled I of wild life protection Act, 1972 and importance of schedules in conservation.
9. Basic idea of ecotoxicology and xenobiotics, concept of EIA.

**Gr.C Course No ZG-06: Histology, Endocrinology, Animal Physiology & Biochemistry,**

**(Full marks- 30) ( Lectures : 30)**

1. General characters of hormones : Histology of pituitary, thyroid and pancreas, Naming and function of hormones secreted from Pituitary, Thyroid and Pancreas
2. Insects endocrine glands (in brief)
3. Composition of vertebrate blood; clotting & coagulation; ABO blood group & Rh factor
4. Enzyme- classification & characteristics; mechanism of enzyme action; effects on enzymetic action (pH and temperature)
5. Classification of carbohydrate, protein and lipid; concept of glycolysis, neoglucogenesis (aerobic, anaerobic & fermentation)

6. Physiology of nerve impulse & synaptic transmission (in brief)
7. Osmoconformers and Osmoregulators; Osmoregulation in fishes

**Paper III. Laboratory Course No. ZG 07**

(5 hrs)

(Full marks 100)

1. Dissection (two major dissections – one invertebrate and one vertebrate)

(15+15=30)

- i) Apple snail : Digestive and nervous systems
- ii) Cockroach: digestive, nervous and female reproductive system
- iii) Lata : afferent and efferent, brain, cranial nerves (IX<sup>th</sup> and X<sup>th</sup> origin and distribution).

2. Mounting and preparation : (Two) (6+6=12)

- i) Mouth parts of cockroach
- ii) Radula of Pila
- iii) Osphradium of Pila
- iv) Placoid scale of *Scoliodon* sp, and Ctenoid scale of fin fish

(8)

3. (i) Blood film of rat
- ii) Haemolymph of cockroach (Leishman/Giemsa stain)
- iii) Gut contents of cockroach for protozoa (Fixation, staining and identification)
- iv) Whole mount of aquatic and soil micro-arthropods
- v) Epithelial cells from buccal smears

- ii) Identification with reasons : one from bones, one from histological slides, two from non-chordates and two from chordate specimens; systematic position upto taxon as mentioned in the theory.

25 marks

- a. Bones: Skull, vertebrae, limb and girdle bones of *Columba* & *Cavia*
- b. Histological slides : Sections of mammalian liver, pancreas, testis, ovary, kidney, thyroid.
- c. Non-chordate specimens : *Plasmodium vivax*, *Paramoecium*, *Scypha*, *Obelia*, *Sea-anaemone*, *Ascaris*, *Hirudinaria*, *Scorpion*, *Bombyx mori*, *Lamellidens*, *Achatina*, *Loligo*, *Starfish*, *Balanoglossus*.
- d. Chordate specimens : *Branchiostoma*, *Petromyzon*, *Scoliodon*, *Lates*, *Rhacophorous*, *Axolotl* larva, *Tylototriton*, *Gekko*; *Hemidactylus*, *Turtle*, *Naja*, *Chiroptera*

5. Report on field study tours: 10 marks

- Zoological importance : Zoological garden and Museum,
5. Viva –voce 10
  6. Laboratory Note Book 5

### **Part III**

**Full marks –100**

**Paper IV Group A. Course No ZG-8 : Applied Zoology**

**(Full Marks 30)**

**(Class 30)**

1. Sericulture : characteristics of sericulture industry and its scope; types of silk moths/ worms, (scientific names), host plants and improvement and their variety. Life history and rearing of *Bombyx mori*, harvesting & processing of cocoon, reeling and extraction of silk, pest on mulberry plants and diseases of worms of *Bombyx mori* and control measures. Research & development of sericulture in India.
2. Aquaculture : Principles, definition and scope. Fisheries resources of India (inland & off-shore) and their important ichthyofauna. Exotic fishes- their merits and demerits. Fish breeding and their application. Basic principles of different aquaculture system (Polyculture and integrated farming); marine pearl culture, culture of prawn and shrimps.
3. Pest and Management : a) Definition and types of pests with examples. Life history, behaviour, ecology, damage and control of the following pests : i) Paddy *Scirpophaga* (Syn. *Tryporyza*) *incertulas*, ii) Stores grain-*Sitophilus oryzae*, iii) Termite, iv) Mammalian pest (*Bandicota bengalensis*).  
b) Integrated Pest Management
4. Apiculture : Development of Apiary in India. Types of honey bees, modern methods of apiary management, products and its uses. Problems and prospects.
5. Lac culture : Lac insect (Scientific name). Composition of Lac. Strains of lac insects, cultivation of lac, lac host plants (name only), Processing of lac and uses.
6. Poultry : Duck and fowl - Types of breeds, rearing and disease management.

**Gr. B. Course No ZG-09 Parasitology & Immunology**

**(Full Marks: 20)**

**(Lectures-20)**

1. Parasitism (definition and types) and other interspecific (symbiosis, commensalism and mutualism) interactions.
2. Life history, Pathogenecity and clinical features of (a) *Entamoeba histolytica*, (ii) *Plasmodium vivax*, iii) *P. falciparum*, iv) *Ascaris*, v) *Fasciola hepatica*.
3. Outline structure and classification of immunoglobulin, antigen-antibody reaction, basic principle of vaccination

**Group –C. Course No ZG-10 Evolutionary Biology**

**(Full marks : 20)**

**(Lectures-20)**

1. Definition of systematics & taxonomy
2. Species as a unit of evolution (definition and types: biological, sibling and polytypic species)
3. Chemical basis of origin of life
4. Hardy-Weinberg equilibrium in relation to natural selection- a brief idea.
5. Anatomical and Physiological adaptations : Aquatic, Desert and Volant animals.
6. Zoogeographical realms & their subdivisions with characteristic fauna.

**Group –D. Laboratory course. Course No.ZG-11**

**(Full marks –30)**

1. Experimental works :
  - a. Estimation of dissolved O<sub>2</sub> content of water 8  
**or**  
Estimation of dissolved free CO<sub>2</sub> content of water
  - b. Pedigree analysis : sex linked recessive, autosomal recessive and dominant 4
  - c. Determinant of ABO blood group & Rh factor in man 4  
**or**  
Measurement of water pH and handling of pH meter
2. Field training : (Submission of report on field study tour at **any two** places from following: (4+4=8)
  - i) Estuarine bheri/ freshwater fish farm
  - ii) Poultry farm
  - iii) Apiary
  - iv) Sericulture center
  - v) Place of wild life interest (Sanctuary, National Park, Biosphere Reserve etc.)
  - vi) Agriculture farms for pest study & idea of IPM practices
  - vii) Species diversity studies in local area.
3. Identification: (Write specimen characters and applied importance) **any three**  
3x2=6  
*Microfilaria* of *Wuchereria bancrofti*, *Taenia solium*, *Scirpophaga* (*Syn. Tryporyza*) *incertulas*, *Sitophilus oryzae*, , *Leptocorisa*, *Epilachna*, *Coccinella*, *Lepisma*, Termite, *Bandicota bengalensis*, *Labeo rohita*, *L. bata*, *Catla catla*, *Cirrhinus mrigala*, *Hypophthalmichthyes molitrix*, *Cyprinus carpio*, *Ctenopharyngodon idellus*, *Tenuialosa* (*Hilsa*) *ilisha*, *Penaeus sp*, *Macrobrachium rosenbergi*.