To
The Registrar,
MJP Rohilkhand University,
Bareilly

Sub: Syllabus for B.Sc. (Honours) Zoology

Dear Sir,
Please find enclosed herewith the Syllabus for B.Sc. (Honours) Zoology for necessary action at your end.

Thanking you,

Yours sincerely,

(D.K. Gupta)
Convener
Board of Studies (Zoology)
# Syllabus for three years B.Sc. (Honours Course) in Zoology,
MJP Rohilkhand University, 2015

**Part I: Total Marks 200**
(Theory 150 marks and Practical 50 marks)

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<th>Year</th>
<th>Papers</th>
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<td>Unit-I ZHT01. Animal diversity I: Non-chordate</td>
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<td>Unit-II ZHT04. Laboratory course I</td>
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**Part II: Total Marks 200**
(Theory 150 marks and Practical 50 marks)

|      | **Paper-III A**                                                       |       |
|      | Unit I ZHT201. Animal diversity II. Chordate                          | 50    |
|      | **Paper-III B**                                                       |       |
|      | Unit-II ZHT06. Animal Physiology, Biochemistry and Immunology         | 50    |
|      | **Paper-IV A**                                                        |       |
|      | Unit-I ZHT02. Developmental Biology                                    | 50    |
|      | **Paper-IV B**                                                        |       |
|      | Unit-II ZHT04. Laboratory course II                                    | 50    |

**Part III: Total Marks 400**
(Theory 250 marks, practical 100 marks & Dissertation 50)

|      | **Paper-V A**                                                         |       |
|      | Unit-I ZHT201. Histology, Endocrinology & Reproductive Biology        | 50    |
|      | **Paper-V B**                                                         |       |
|      | Unit-II ZHT202. Molecular Biology and Biotechnology                   | 50    |
|      | **Paper-VI A**                                                        |       |
|      | Unit-I ZHT03. Evolution, Systematics & Animal behaviour               | 50    |
|      | **Paper-VI B**                                                        |       |
|      | Unit-II ZHT04. Ecology and Environmental Biology                      | 50    |
|      | **Paper-VII A**                                                       |       |
|      | Unit-I ZHT205. Applied Zoology and Biostatistics                      | 50    |
|      | **Paper VIII B**                                                      |       |
|      | Unit-II ZHT206. Laboratory course-III                                 | 50    |
|      | **Paper VIII A**                                                      |       |
|      | Unit-I ZHT207. Laboratory course-IV                                   | 50    |
|      | **Paper IX**                                                          |       |
|      | ZHT208. Project & Dissertation                                         | 50    |
Detailed Syllabus
Part - I
Theory - 150 and Practical - 50

Paper I A

Max. Marks 50
Lectures 60

Unit- I. ZHT101 Animal diversity I: Nonchordates

Paper Code: ZHT-101

1. Distinguishing characters & classification of Protozoa (up to class) [Levine et al, 1980]
   Special Features a) Morphology: *Paramaecium* sp. b) Movement: i) Amoeboid movement in *Amoeba*, ii) Ciliary movement of *Paramaecium* sp and iii) flagellar movement in *Euglena*, c) Reproduction: *Paramaecium* 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) 6th Ed., Invertebrate Zoology.

Paper I B

Max. Marks 50
Lectures 60

Unit- II. ZHT102. Cell Biology and Genetics

Paper Code: ZHT-102

Group- A: Cell Biology

3. Nucleic acids: Physio-chemical properties, structures types and functions of DNA and RNA

4. Cell cycle and cell division

Group- B Genetics

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

Paper-II A

Max. Marks 50

Unit- I ZHT|03. Microbiology and Parasitology

Group- A. Microbiology

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, Amoebiasis and Shigellosis).

Group-B. Parasitology

3. Animal association : symbiosis, commensalism, mutualism, parasitism and zoonosis
4. Life cycle, pathogenicity, 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

Paper-II B

Max. Marks- 50

Unit-II ZHP 04. Laboratory course 1

Group-A

1. Major dissections
   10x 1 =10
   (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
   4x1=4
   (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. Identifications (systematic position up to class and specimen characters only) $3 \times 2 = 6$
   Elphidium, Scypha (Syn, Sycon), Neptune’s cup, Aurelia, Pennatula, Sea anemone, Beroe,
   Madrepora, Nereis, Aphrodite, Squilla, Hippa, Eupagurus, King crab, Peripatus, Belostoma,
4. Laboratory note book
5. Viva voce

Group-B
1. Study of meiosis from grasshopper (staining and identifications of different stages of meiotic division). 3
2. Study of gut contents of cockroach for protozoa (Fixation, staining & identification) 5
3. Collection of helminth, parasites from goat and fowl (their fixation, staining and identification). 5
4. Systematic position, specimen characters and clinical importance of: Entamoeba, Giardia,
   Trypanosoma, Plasmodium vivax, Plasmodium falciparum, Leishmania, Ascaris (male and female),
   Wuchereria bancrofti. 4
5. Gram staining of bacteria
6. Laboratory note book
7. Viva Voce
Detailed Syllabus
Part II
Theory -150 and Practical -50

Paper III A
Unit-I ZHT 05. Animal Biodiversity II: Chordate

Max. 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.
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.

Paper-III B
Unit-II ZHT 06. Animal Physiology, Biochemistry and Immunology

Max. Marks 50
Lectures -60

1. Elementary idea of structure of carbohydrate, protein and lipid. 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: Michelin-Menten concept, c) Factors affecting enzymatic actions
7. Structure of mammalian nephron, physiology of urine formation, osmoregulators and osmoconformers.
8. Physiology of excretion a) urea cycle, Nitrogenous wastes- Ammonia, urea, uric acid, creatinine.
9. Propagation of nerve impulse through nerve fibres, synaptic and neuro-muscular junctions (origin, nature and mechanism).
11. Physiology of vision in mammals
12. Physiology of hearing in mammals
13. Cells and organs of immune system; Innate and adaptive immunity
14. Antigens: characteristics, antigenic determinants, Antigen processing and presentation
15. Antibody: Structure, classes, binding site, polyclonal and monoclonal antibodies
16. Cytokines, adjuvants and complements
17. B cell generation, activation and differentiation, co-operation, macrophage
18. T cell maturation and activation.

**Paper-IV A**

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

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)

**Paper-IV B**

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

**Group-A. Marks-25**

1. Major dissection  
   a) *Scoliodon*: 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:  
   a) Brain, (b) Pituitary gland of fish  
   c) Ctenoid scale of 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

Max. Marks 50  
Lectures –60

15x1=15  
5x1=5
1. Identifications (systematic position up to sub-class and specimen characters only) 
   (Any three) 
   \[ 2 \times 3 = 6 \] 
   Branchiostoma, Ascidia, Petromyzon, Myxine, Torpedo, Sphyrna, Hippocampus, Ichthyophis, 
   Tylototriton, Axolotl, Cryptobranchus, Hyla, Chameleon, Gekko, Vipera, Naja, Hydrophis

2. Identification of bones with reasons: 
   \[ 2 \times 2 = 4 \]
   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

2. Colorimetric estimation (Lowry's method) of protein 

3. Test of ammonia, uric acid and urea from test sample (Qualitative) 

4. Determination of blood group (ABO and Rh) 

5. Identification of whole mount embryo (24 hrs, 48 hrs, 72 hrs and 96 hrs) 

6. Laboratory note book 

7. Viva voce
### Detailed Syllabus

**Part –III**

**Total Marks 400**

(Theory 250 marks, Practical 100 Marks & Dissertation 50)

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<td><strong>Unit-I. ZHT –09. Histology, Endocrinology &amp; Reproductive Biology</strong></td>
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**Group A: Histology**

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**

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

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<th>Paper- V B</th>
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<td><strong>Unit-II ZHT 10. Molecular Biology and Biotechnology</strong></td>
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**Group- A: Molecular Biology**

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, gene battery model
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 Repetitive DNA, Transposable genetic element, LINES, SINES, Alu
9. Genome and human genome project

**Group- B Biotechnology**

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)
Group-A Evolution & Systematics
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 adaptive 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
13. 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

Paper-VI B
Unit-II ZHT 12. Ecology and Environmental Biology

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**

10. Environmental degradation (natural and man made), Pollution: types, sources and effects of major pollutants of air, water, soil and noise, Control of pollution


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

15. Concept of conservation, in situ and ex-situ methods

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**Paper –VII A**

**Unit I ZHT 13. Applied Zoology and Biostatistics**

**Max. Marks** 50

**Lectures** 60

**Group- A Applied Zoology**

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

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

Paper VII B

Unit-II ZHP 14. Laboratory course-III
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)  
   10x1=10.
2. Comments on instruments  
   a. Micrometry  
   b. PCR  
   c. Electrophoresis  
   d. Rotary microtome  
   2.5x4=10
3. Determination of blood group (ABO and Rh)  
4. DNA isolation from goat liver cells  
5. Pedigree Analysis  
6. Laboratory Note Book  
7. Viva Voce

Paper VIII A

Unit-I ZHP 15. Laboratory course-IV
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  
   d. Study of aquatic micro arthropods  
   4+4=8
2. a) Determination of dissolved O\textsubscript{2} of water  
   b) Determination of dissolved free CO\textsubscript{2} of water  
   1x5=5
3. Chi-square test and t-test  
   10
4. Identification and economic importance of the following:  
   (Systematic position not required).  
5. Submission of field study report on ecosystem and its biodiversity assessment. (Any suitable ecosystem)  
   8
6. Laboratory note book  
   3
7. Viva voce [on laboratory work = 4 and on field study = 4]  
   8
Suggested readings with regard to B.Sc. (Hons.) Course in Zoology

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

3. Invertebrate Zoology- Ruppert and Barnes
4. Invertebrate structure and function – E. J. W. Barrington
5. Biology of nonchrodates – H.C. Nigam
6. General Zoology -Villee, Walker and Bsarnes
7. Invertebrate Zoology -Meglitch and Schram
8. Invertebrate Zoology Jordan and Verma
10. Practical Zoology- Ghosh and Manna

**Cell Biology & Genetics**

2. The World of Cell – W. M. Becker, L. J. Kleinsmith, J. Hardin (Pearson)
6. Cell Biology- Cooper
7. Fundamental of Genetics- Russel
Animal Physiology & Biochemistry

1. Modern Experimental Biochemistry- R. Boyer (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. Biochemistry- Mathews

Animal diversity II. Chordate

2. Vertebrate life- Pough and McFerland
3. Life of Vertebrates . J. Z. Yong
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
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
3. Development Biology- Gilbert
4. Developmental Biology- Browder et al.
5. Principles of Developmental Biology – Wilt and Hake
**Microbiology, Parasitology & Immunology**

2. Principles of Microbiology - Dr. Geeta Sumbali and Dr. R. S. Mehrotra (Tata McGraw-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)
9. Immunology - J. Kuby
10. Immunology - A. K. Chakraborty

**Molecular Biology and Biotechnology**

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- Drickamár & Vessey
6. Evolution of the Vertebrates - Colbert
7. Vertebrate Paleontology - Benton
8. Vertebrate Paleontology - Romer
10. Zoogeography- Darlington
11. Evolution- Dobzhansky, Ayala, Stebbins, Valentine
12. Understanding Evolution- Hanson
Ecology and Environmental Biology

3. Environmental Science- G. Tyler Miller
5. Conservation Biology- Hunter
7. Basic Ecology- E. P. Odum
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

Applied Zoology and Biostatistics

1. Pest Control- H. F. Vasn Emden
3. Freshwater Aquaculture- Santhanam et al.
4. Aquaculture- T. V. R. Pilley
5. Animal Husbandry- 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 Upadhyay
10. Livestock & Poultry Production- Singh and Moore
11. Insect Pest of crop- S. Pradhan