

**MARWARI COLLEGE, RANCHI**  
(AN AUTONOMOUS UNIT OF RANCHI UNIVERSITY FROM 2009)



**DEPARTMENT OF ZOOLOGY**

**COURSES OF STUDY FOR ZOOLOGY HONOURS**

**Number of Papers: 20**

**(14 Theory papers & 6 Practical Papers)**

**Full Marks: 1600**

**Theory: 1200, Practical: 400**

**Number of Semesters: 06**

**B. Sc. Hons. Part - I: 400 Marks**  
**(Theory: 300, Practical: 100)**

**B. Sc. Hons. Part - II: 400 Marks**  
**(Theory: 300, Practical: 100)**

**B. Sc. Hons. Part - III: 800 Marks**  
**(Theory: 600, Practical: 200)**

## Zoology Syllabus for Hons. Marwari College, Ranchi

### DISTRIBUTIONS OF MARKS IN ZOOLOGY HONS.

ACADEMIC YEAR	SEMESTER	THEORY PAPER	FULL MARKS			PASS MARKS	DURATION	PRACTICAL PAPER	FULL MARKS	PASS MARKS	DURATION
			MSE	ESE	TOTAL						
FIRST YEAR	I	1	25	50	75	34	2½ HRS.	3	50	23	4 HRS.
		2	25	50	75	34	2½ HRS.				
	II	4	25	50	75	34	2½ HRS.	6	50	23	4 HRS.
		5	25	50	75	34	2½ HRS.				

### DISTRIBUTIONS OF MARKS IN ZOOLOGY HONS.

ACADEMIC YEAR	SEMESTER	THEORY PAPER	FULL MARKS			PASS MARKS	DURATION	PRACTICAL PAPER	FULL MARKS	PASS MARKS	DURATION
			MSE	ESE	TOTAL						
SECOND YEAR	III	7	25	50	75	34	2½ HRS.	9	50	23	4 HRS.
		8	25	50	75	34	2½ HRS.				
	IV	10	25	50	75	34	2½ HRS.	12	50	23	4 HRS.
		11	25	50	75	34	2½ HRS.				

### DISTRIBUTIONS OF MARKS IN ZOOLOGY HONS.

ACADEMIC YEAR	SEMESTER	THEORY PAPER	FULL MARKS			PASS MARKS	DURATION	PRACTICAL PAPER	FULL MARKS	PASS MARKS	DURATION
			MSE	ESE	TOTAL						
THIRD YEAR	V	13	30	70	100	45	3 HRS.	16	100	45	6 HRS.
		14	30	70	100	45	3 HRS.				
		15	30	70	100	45	3 HRS.				
	VI	17	30	70	100	45	3 HRS.	20	100	45	6 HRS.
		18	30	70	100	45	3 HRS.				
		19	30	70	100	45	3 HRS.				

# ZOOLOGY

## B.Sc. Part – I

### Semester - I

#### Paper –1 (Animal Diversity – Non-chordates) (24 classes)

#### Instructions to Paper Setters

**Full Marks: 50**

Paper setters shall set questions in three groups.

- Group A :** Shall contain multiple choice questions, fill in the blanks and true / false type questions (**10 x 1 = 10**).
- Group B :** Shall contain concept based questions – Five questions of two marks each (**5 x 2 = 10**). Total eight question are to be given. Students have to answer any five question out of 8 questions.
- Group C :** Long answer questions – three questions of ten marks each (**3 x 10 = 30**). Total six questions are to be given. Students have to answer any 3 questions out of 6 questions.

**Full marks: 25 (MSE) + 50 (ESE) = 75**

**Pass Marks: 34**

1. Principles of classification, Salient features and classification of non-chordates up to orders. Structural organization in different classes of non-chordates. (2)
2. Protozoa: Study of locomotion, osmoregulation, nutrition and reproduction in Protozoa. (5)
3. Porifera and Coelenterata: Canal system in Porifera, corals and coral reefs, Polymorphism in Hydrozoa. (4)
4. Platyhelminthes and Nematelminthes: Reproduction and Parasitic adaptations in Helminthes. (2)
5. Annelida: Coelom and excretory system. (2)
6. Mollusca: Torsion and Detortion in Gastropoda. (1)
7. Onycophora: Affinities. (1)
8. Arthropoda: Larval forms in Crustacea, Vision in Arthropoda. (3)
9. Echinodermata: Water vascular system and Larval forms. (3)
10. Hemichordata: Balanoglossus (1)

#### Books Recommended

1. Barnes, R.D. Invertebrate Zoology SAUNDERS
2. Dalela, R.C. A Textbook of Invertebrate Zoology Jai Prakash Nath & Co.
3. Hyman, L.H. Invertebrates McGraw-Hills
4. Jordan & Verma Invertebrate Zoology S. Chand & Co. Ltd. New Delhi
5. Kotpal, R.L. Modern Text Book of Zoology INVERTEBRATES Rastogi Publications, Meerut

**ZOOLOGY**  
**B.Sc. Part – I**  
**Semester - I**  
**Paper –2 (Biochemistry) (24 classes)**  
**Instructions to Paper Setters**  
**Full Marks: 50**

Paper setters shall set questions in three groups.

- Group A :** Shall contain multiple choice questions, fill in the blanks and true / false type questions (**10 x 1 = 10**).
- Group B :** Shall contain concept based questions – Five questions of two marks each (**5 x 2 = 10**). Total eight question are to be given. Students have to answer any five question out of 8 questions.
- Group C :** Long answer questions – three questions of ten marks each (**3 x 10 = 30**). Total six questions are to be given. Students have to answer any 3 questions out of 6 questions.

**Full marks: 25 (MSE) + 50 (ESE) = 75**

**Pass Marks: 34**

1. Structure and classification of Proteins and Amino acids. (5)
2. Structure and classification of Carbohydrates. (4)
3. Structure and classification of Lipids. (3)
4. Metabolism of carbohydrates: Glycolysis, Glycogenesis, Gluconeogenesis, Krebs cycle, Electron transport chain. (8)
5. Discovery, Structure and Function of Vitamins. (2)
6. Enzymes: Nature and Classification. (2)

**Books Recommended**

1. Ayodhya Prasad      Scientific Refresher Course in Zoology Paper – V Biochemistry,  
Physiology & Endocrinology      Scientific Book Company  
Patna
2. Cantrow      Biochemistry
3. Conn & Stumpf      Outlines of Biochemistry      (Wiely)
4. Lehninger      Biochemistry      Kalyani Publishers      New Delhi
5. Srivastava, H.S.      Elements of Biochemistry      Rastogi Publications, Meerut

## B.Sc. Part – I

### Semester - I

#### Paper –3 (Practicals) (20 classes)

**Full marks: 50**

**Time: 4 Hrs.**

**Pass Marks: 23**

1. **Dissection (major). Any one of the following may be set. (10 marks)**
  - a) Earthworm: Alimentary canal, nervous system, reproductive system.
  - b) Prawn: Digestive and nervous system
  - c) Pila: Nervous system
2. **Temporary mounting / minor dissection: (6 marks)**  
Nerve ring and ovary of earthworm, Mouthparts of cockroach; statocyst of prawn; radula, osphradium and ctenidium of Pila.
3. **Biochemistry: (6 marks)**
  - a) Extraction of starch from potato and its test.
  - b) Extraction of Proteins from milk and its test.
  - c) Extraction of Lipids from mustard and its test.
4. **Identification: (16 marks)**  
Invertebrate slides: (4 x 2 marks) = 8 marks
  - a) Paramecium, Amoeba, Euglena, Vorticella, LS/TS of Sycon, Sponge spicules, Hydra (WM/TS), Obelia colony, Scyphistoma, Sea anemone (TS), slides of Fasciola, Taenia and Ascaris, TS of earthworm through different regions.
  - b) Museum specimens: (4 x 2 marks) = 8 marks  
Aurelia, Sea anemone, Gorgonia, Ascaris (male and female), Spiders, Chiton, Pila, Aplysia, Unio, Mytilus, Octopus, Nautilus, Sea star, Sea urchin, Sea-cucumber and Antedon.
5. **Practical record (6 marks)**
6. **Viva voce (6 marks)**

**B.Sc. Part – I**  
**Semester - II**  
**Paper – 4 (Cell Biology) (25 classes)**  
**Instructions to Paper Setters**  
**Full Marks: 50**

Paper setters shall set questions in three groups.

- Group A :** Shall contain multiple choice questions, fill in the blanks and true / false type questions (**10 x 1 = 10**).
- Group B :** Shall contain concept based questions – Five questions of two marks each (**5 x 2 = 10**). Total eight question are to be given. Students have to answer any five question out of 8 questions.
- Group C :** Long answer questions – three questions of ten marks each (**3 x 10 = 30**). Total six questions are to be given. Students have to answer any 3 questions out of 6 questions.

**Full marks: 25 (MSE) + 50 (ESE) = 75**

**Pass Marks: 34**

- |  |      |
|--|------|
| 1. Cell theory   | (1)  |
| 2. Cell cycle  | (1)  |
| 3. Structure of Prokaryotic and Eukaryotic cells.  | (2)  |
| 4. Different types of microscopes  | (2)  |
| 5. Structure and function of the following Cell Organelles: Plasma membrane, Golgi complex, Endoplasmic reticulum, Mitochondria, Lysosome, Ribosome and Nucleus. | (10) |
| 6. Chromosome: Structure (chromatin fibres, solenoid model), Types   | (4)  |
| 7. Cytoskeleton  | (1)  |
| 8. Cell junctions, cell adhesion & extra-cellular matrix.  | (2)  |
| 9. Biology of cancer (elementary idea).  | (2)  |

**Books Recommended**

- |                              |   |
|------------------------------|---|
| 1. Agarwal, V.K.             | Cell Biology S. Chand & Co Ltd. New Delhi   |
| 2. Ayodhya Prasad            | Scientific Refresher Course in Zoology Paper – VI <u>Cell Biology</u> , Genetics & Economic Zoology Scientific Book Company Patna |
| 3. Cooper                    | Cell Biology  |
| 4. Dalela & Verma            | A Textbook of Cytology Jaiprakash Nath & Co Meerut  |
| 5. De Robertis & De Robertis | Cell & Molecular Biology B.I. Waverly   |
| 6. Gasque                    | Manual of Laboratory Experiments in Cell Biology (Brown)  |
| 7. Geise                     | Cell Physiology   |
| 8. Gupta, P.K.               | Cytology Genetics & Evolution Rastogi Publications New Delhi  |
| 9. Prescott, D.M.            | Reproduction in Eukaryotic Cells Academic Press Pvt. Ltd. New Delhi   |
| 10. Rastogi, S.C.            | Cell & Molecular Biology New Age International P Ltd. New Delhi   |
| 11. Singh & Tomar            | Cell Biology Rastogi Publications Meerut  |

**B.Sc. Part – I**  
**Semester - II**  
**Paper – 5 (Mol. Biology & Immunology) (19 classes)**  
**Instructions to Paper Setters**  
**Full Marks: 50**

Paper setters shall set questions in three groups

- Group A :** Shall contain multiple choice questions, fill in the blanks and true / false type questions (**10 x 1 = 10**).
- Group B :** Shall contain concept based questions – Five questions of two marks each (**5 x 2 = 10**). Total eight question are to be given. Students have to answer any five question out of 8 questions.
- Group C :** Long answer questions – three questions of ten marks each (**3 x 10 = 30**). Total six questions are to be given. Students have to answer any 3 questions out of 6 questions.

**Full marks: 25 (MSE) + 50 (ESE) = 75**

**Pass Marks: 34**

1. Nucleotides and nucleic acids, Structural properties and functions of DNA & RNA (4)
2. Genes: Nature of genetic material. (1)
3. Organization of DNA: Viral, bacterial and eukaryotic; split genes and transposons. (3)
4. DNA replication: General principles, enzymes and inhibitors (3)
5. DNA repair mechanisms. (1)
6. Protein biosynthesis in Prokaryotes (Basic details): Central dogma, transcription and translation. (2)
7. Regulation of gene expression: (General idea): Lac operon and tryptophan operon. (2)
8. Concept of immune system. (3)

**Books Recommended**

1. Agarwal, V.K. Molecular Biology S. Chand & Co Ltd. New Delhi
2. Glick Molecular Biotechnology
3. Gupta, P.K. Molecular Biology Rastogi Publications New Delhi
4. Kuby Immunology Freeman
5. Meyers, R.A. Molecular Biology & Biotechnology
6. Old & Primrose Principles of gene manipulation
7. Powar & Dagniwala General Microbiology
8. Rastogi, S.C. Cell & Molecular Biology New Age International P Ltd. New Delhi
9. Roitt Essentials of immunology ELBS
10. Watson, J.D. Molecular Biology of the Genes (Cummings)

**B.Sc. Part – I****Semester - II****Paper – 6 (Practicals) (12 classes)****Full marks: 50****Time: 4 Hrs.****Pass Marks: 23****1. Cell Biology:****(12 marks)**

- a) Squash preparation: Stages of mitosis in onion root tip.
- b) Barr body from buccal epithelium of female human.
- c) Acetocarmine preparation of the giant chromosomes from salivary glands of Chironomus or Drosophila larva.
- d) Stages of meiosis in testis of grasshopper/ anthers of onion

**2. Chromatography & Microtomy:****(8 marks)**

- a) Paper Chromatography
- b) Block preparation and section cutting

**3. Identification: Slides of mitosis, meiosis and giant chromosomes****(12 marks)****4. Practical record****(10 marks)****5. Viva voce****(8 marks)**



**ZOOLOGY**  
**B.Sc. Part – II**  
**Semester - III**  
**Paper – 7 (Animal diversity – Chordates) (24 classes)**  
**Instructions to Paper Setters**  
**Full Marks: 50**

Paper setters shall set questions in three groups

- Group A :** Shall contain multiple choice questions, fill in the blanks and true / false type questions (10 x 1 = 10).
- Group B :** Shall contain concept based questions – Five questions of two marks each (5 x 2 = 10). Total eight question are to be given. Students have to answer any five question out of 8 questions.
- Group C :** Long answer questions – three questions of ten marks each (3 x 10 = 30). Total six questions are to be given. Students have to answer any 3 questions out of 6 questions.

**Full marks: 25 (MSE) + 50 (ESE) = 75**

**Pass Marks: 34**

1. Origin and general characters of chordates. (2)
2. Protochordates: Structural organization of Urochordates and Cephalochordates & classification. (2)
3. Fishes: Classification (up to classes of living fishes) and Accessory respiratory organs. (2)
4. Amphibians: Origin of land vertebrates, Classification up to orders. (3)
5. Reptiles: Classification of living reptiles up to orders, biting and feeding mechanism of snakes. (2)
6. Bird: Origin of birds, Migration of birds, Flight adaptation. (5)
7. Ratitae: Distribution and classification. (1)
8. Mammals: Classification and general characters (2)
9. Comparative anatomy of systems (kidney, heart, aortic arches) in vertebrates. (5)

**Books Recommended**

- |    |                    |  |                                   |
|----|--------------------|--|-----------------------------------|
| 1. | Alexander, R.M.    | The Chordates                                | Cambridge University Press        |
| 2. | Kotpal, R.L.       | Textbook of Zoology<br>Ltd. New Delhi        | VERTEBRATES Rastogi Publications, |
| 3. | Manieth, A.R.      | The Chordates                                | Cambridge University Press        |
| 4. | Nigam, H.C.        | Biology of Chordates                         | Vishal Publishing Co. Jalandhar.  |
| 5. | Pough.....         |  |                                   |
| 6. | S.K. Kulashreshtha | Comparative Anatomy of Vertebrates<br>Meerut | Anmol Publications Pvt.           |
| 7. | Waterman, A.J.     | Chordata: Structure & Function               | (Macmillan)                       |
| 8. | Young, J.Z.        | Life of Vertebrates                          | Cambridge University Press        |

**ZOOLOGY**  
**B.Sc. Part – II**  
**Semester - III**  
**Paper – 8 (Physiology) (24 classes)**  
**Instructions to Paper Setters**  
**Full Marks: 50**

Paper setters shall set questions in three groups

- Group A :** Shall contain multiple choice questions, fill in the blanks and true / false type questions (10 x 1 = 10).
- Group B :** Shall contain concept based questions – Five questions of two marks each (5 x 2 = 10). Total eight question are to be given. Students have to answer any five question out of 8 questions.
- Group C :** Long answer questions – three questions of ten marks each (3 x 10 = 30). Total six questions are to be given. Students have to answer any 3 questions out of 6 questions.

**Full marks: 25 (MSE) + 50 (ESE) = 75**

**Pass Marks: 34**

1. Blood: Composition (corpuscles and plasma) and Functions of blood and lymph, Blood groups, Blood coagulation, Structure and Function of Haemoglobin, Haemopoiesis. (10)
2. Respiration: Mechanism and Control of breathing, transport and exchange of O<sub>2</sub> and CO<sub>2</sub> (4)
3. Digestion and absorption of dietary components. (4)
4. Structure and function of the kidney, Physiology of urine formation. (4)
5. Physiology of nerve conduction. (2)

**Books Recommended:**

1. Bell, Davidson & Smith      Physiology      ELBS
2. Berry, A.K.                      Animal Physiology      Emkay Publications Delhi, Bumbai, Kolkata
3. Chatterjee, C.C.                  Physiology
4. Eckert, R.                          Animal Physiology      (Freeman)
5. Ganong                              Review of Medical Physiology      (Lange)
6. Goel & Sastri                      Animal Physiology      Rastogi Publications, Meerut
7. Gupta, P.K.                        Animal Physiology
8. Guyton & Hall                      Medical Physiology      Saundars New Delhi
9. Siddiqi, A.K.                      Experimental Physiology      Oxford & IBH Publishing Co ND,
10. Singh & Kumar                    Animal Physiology & Biochemistry      Vishal Publishing Co Jalandhar
11. Thakur & Puranik                  Mammalian Physiology      S. Chand & Co. Ltd. New Delhi

**B.Sc. Part – II**  
**Semester - III**  
**Paper –9 (Practicals) (14 classes)**

**Full marks: 50**

**Time: 4 Hrs.**

**Pass Marks: 23**

**1. Major dissection**

**(12 marks)**

- a) Scoliodon: Afferent and efferent branchial vessels, and Cranial nerves Vth, VIth, IXth and Xth.
- b) Frog: cranial and spinal nerves
- c) Columba / Fowl: flight muscles and air sacs (demonstration)
- d) Rat / squirrel: neck nerves

**2. Minor dissection/ temporary mounting**

**(8 marks)**

Placoid scales & ampullae of Lorenzini of Scoliodon, scales of bony fishes, pecten & down feathers of bird.

**3. Identification:**

**(16 marks)**

- a) Histological slides (vertebrates) (2 x 2 marks)
- b) Museum specimens (2 x 2 marks)
- c) Bones: vertebra (2 x 2 marks), limb bones and girdles (4 x 1 marks)

**4. Practical record**

**(8 marks)**

**5. Viva**

**(6 marks)**

**B.Sc. Part – II**  
**Semester - IV**  
**Paper – 10 (Endocrinology) (24 classes)**  
**Instructions to Paper Setters**  
**Full Marks: 50**

**Paper setters shall set questions in three groups.**

- Group A :** Shall contain multiple choice questions, fill in the blanks and true / false type questions (**10 x 1 = 10**).
- Group B :** Shall contain concept based questions – Five questions of two marks each (**5 x 2 = 10**). Total eight question are to be given. Students have to answer any five question out of 8 questions.
- Group C :** Long answer questions – three questions of ten marks each (**3 x 10 = 30**). Total six questions are to be given. Students have to answer any 3 questions out of 6 questions.

**Full marks: 25 (MSE) + 50 (ESE) = 75**

**Pass Marks: 34**

- |   |             |
|---|-------------|
| 1. Concept of endocrinology   | <b>(1)</b>  |
| 2. Histology and secretions of various endocrine glands: Pituitary, Thyroid, Parathyroid, Thymus, Pineal, Adrenal, Islets of Langerhans and Gonads. | <b>(14)</b> |
| 3. Biosynthesis of thyroid hormones and their physiology  | <b>(1)</b>  |
| 4. Endocrine disorders: Brief description of goiter formation, Addison's disease, Cushing's disease, diabetes, osteoporosis etc,                    | <b>(4)</b>  |

**Books Recommended:**

- |                     |  |                                  |
|---------------------|--|----------------------------------|
| 1. Ayodhya Prasad   | Scientific Refresher Course in Zoology Paper – V Biochemistry, Physiology & <u>Endocrinology</u> | Scientific Book Company<br>Patna |
| 2. Chapman          | Endocrinology  |                                  |
| 3. Hadley           | Endocrinology  |                                  |
| 4. Nalbandov        | Reproductive Physiology  |                                  |
| 5. Noris            | Vertebrate Endocrinology_  |                                  |
| 6. Turner & Bagnara | General Endocrinology  | (Saunders)                       |
| 7. Wigglesworth     | Insect Physiology  |                                  |

**B.Sc. Part – II**  
**Semester - IV**  
**Paper – 11 (Reproductive Biology) (20 classes)**  
**Instructions to Paper Setters**  
**Full Marks: 50**

**Paper setters shall set questions in three groups**

- Group A :** Shall contain multiple choice questions, fill in the blanks and true / false type questions (**10 x 1 = 10**).
- Group B :** Shall contain concept based questions – Five questions of two marks each (**5 x 2 = 10**). Total eight question are to be given. Students have to answer any five question out of 8 questions.
- Group C :** Long answer questions – three questions of ten marks each (**3 x 10 = 30**). Total six questions are to be given. Students have to answer any 3 questions out of 6 questions.

**Full marks: 25 (MSE)+50(ESE)=75**

**Pass Marks:34**

- |  |     |
|--|-----|
| 1. Gametogenesis: Spermatogenesis & Oogenesis  | (3) |
| 2. Reproductive cycles in mammals (Estrous & Menstrual) and their Hormonal Regulation. | (7) |
| 3. Fertilization in vitro and in vivo.   | (2) |
| 4. Implantation & Parturition  | (3) |
| 5. Embryo-transfer technology.   | (1) |
| 6. Accessory sex organs and their dependence on steroid hormones.                      | (2) |
| 7. Contraception methods   | (2) |

**Books Recommended:**

- |                   |   |                                  |
|-------------------|---|----------------------------------|
| 1. Ayodhya Prasad | Scientific Refresher Course in Zoology Paper – V Biochemistry, Physiology & Endocrinology | Scientific Book Company<br>Patna |
| 2. Guyton & Hall  | Medical Physiology  | Saunders New Delhi               |
| 3. Nalbandov      | Reproductive Physiology   |                                  |
| 4. Saidapur, K.   | Reproductive Cycles   |                                  |

**B.Sc. Part – II****Semester - IV****Paper –12 (Practicals) (6 classes)****Full marks: 50****Time: 4 Hrs.****Pass Marks: 23****1. Dissection:****(12 marks)**

Rat / squirrel: Reproductive system and endocrine glands.

**2. Comment upon adaptation:** Serial homology, homology and analogy, Mouth parts of insects, adaptive modifications in the feet and beak of birds **(8 marks)****3. Identification of Endocrine slides of:** (8 x 2) = **(16 marks)**

Pituitary, adrenal, thyroid, thymus, testis, ovary, pancreas etc.

**4. Practical record****(8 marks)****5. Viva****(6 marks)**

**ZOOLOGY**  
**B.Sc. Part – III**  
**Semester – V**

**Paper – 13 (Zoogeography, Evolution & Behaviour) (24 classes)**

**Full Marks: 70**

**Paper setters shall set questions in three groups.**

**Group A :** Shall contain multiple choice questions, fill in the blanks and true / false type questions (10 x 1 = 10).

**Group B :** Shall contain concept based questions – Three questions of five marks each (5 x 3 = 15). Total six question are to be given. Students have to answer any 3 question out of 6 questions.

**Group C :** Long answer questions – three questions of fifteen marks each (3 x 15 = 45). Total six questions are to be given. Students have to answer any 3 questions out of 6 questions.

**Full marks: 30 (MSE) + 70 (ESE) = 100**

**Pass Marks: 45**

- |  |     |
|--|-----|
| 1. Origin of life on earth   | (1) |
| 2. Zoogeographical realms and characteristic fauna of Oriental & Australian region                                   | (3) |
| 3. Concept of species and speciation: Variations, Mutations, Recombination, Polyploidy, Isolation, Natural selection | (3) |
| 4. Genetic drift, Hardy-Weinberg law   | (1) |
| 5. Macro and Microevolution,   | (2) |
| 6. Evolution of Man  | (2) |
| 7. Introduction to Ethology: Innate & Learned Behavior   | (3) |
| 8. Parental care in fishes and amphibians.   | (2) |
| 9. Parasitism, symbiosis and commensalisms.  | (3) |
| 10. Mimicry (Brief account).   | (1) |
| 11. Social organization in honeybees & termites.   | (2) |

**Books Recommended**

- |                      |   |                                  |
|----------------------|---|----------------------------------|
| 1. Ayodhya Prasad    | Scientific Refresher Course in Zoology Paper – VII <u>Evolution</u> ,<br><u>Palaeontology &amp; Zoogeography</u> & Embryology | Scientific Book<br>Company Patna |
| 2. Hoshang & Singh   | Animal Behaviour  | S. Chand & Co. Ltd. New Delhi    |
| 3. Manning & Dawkins | Animal Behaviour  | Cambridge Low Price Edition      |
| 4. Moody             | Introduction to Evolution   |                                  |
| 5. Rina Mathur       | Animal Behaviour  | Rastogi Publications, Meerut     |
| 6. Savage            | Evolution (Holt, Reinhart and Winston)  |                                  |

**ZOOLOGY**  
**B.Sc. Part – III**  
**Semester – V**  
**Paper – 14 (Environmental Biology) (24 classes)**  
**Full Marks: 70**

Paper setters shall set questions in three groups.

- Group A :** Shall contain multiple choice questions, fill in the blanks and true / false type questions (10 x 1 = 10).
- Group B :** Shall contain concept based questions – Three questions of five marks each (5 x 3 = 15). Total six question are to be given. Students have to answer any 3 question out of 6 questions.
- Group C :** Long answer questions – three questions of fifteen marks each (3 x 15 = 45). Total six questions are to be given. Students have to answer any 3 questions out of 6 questions.

**Full marks: 30 (MSE) + 70 (ESE) = 100**

**Pass Marks: 45**

1. Aim and scope of Ecology (1)
2. Concept and types of Ecosystem (2)
3. Energy flow in Ecosystems, Food chain, Food web and Tropic levels (5)
4. Principles of Adaptation to External factors, (e.g.: Light, Temperature and Carbon dioxide), Concept of limiting factors (2)
5. Populations: Characteristics, growth and its analysis, regulation of densities. (2)
6. Communities and development: Ecological succession, niche concept, major biomes (tropical, temperate, alpine, tundra, desert, grassland). (4)
7. Biogeochemical cycles (types, water cycle, carbon cycle) (4)
8. Conservation of natural resources, wild life management (4)

**Books Recommended**

1. Chapman & Reiss Ecology Cambridge Low Price Edition
2. Dash, M.C. Fundamentals of Ecology Tata McGraw-Hill New Delhi
3. Kendeigh, S.C. Ecology with special reference to man Prentice – Hall
4. Kormondy, E.J. Concepts of Ecology Prentice – Hall
5. Mukharjee, B. Fundamentals of Environmental Biology Silver Line
6. Mukherjee, B. Environmental Management Vikas
7. Odum, E.P. Fundamentals of Ecology Saundars Publications ND, Patna
8. Recklefs, R.E. Ecology Freeman
9. Sharma, P.D. Ecology & Environment Rastogi Publications, Meerut
10. Sharma, P.D. Environmental Biology & Toxicology Rastogi Publications, Meerut
11. Singh, H.R. Environmental Biology S. Chand & Co. Ltd. New Delhi
12. Verma & Sharma Ecology & Anmal Behaviour Jaiprakash Nath & Co. Meerut



**ZOOLOGY**  
**B.Sc. Part – III**  
**Semester – V**  
**Paper – 15 (Toxicology) (24 classes)**  
**Full Marks: 70**

Paper setters shall set questions in three groups.

- Group A :** Shall contain multiple choice questions, fill in the blanks and true / false type questions (10 x 1 = 10).
- Group B :** Shall contain concept based questions – Three questions of five marks each (5 x 3 = 15). Total six question are to be given. Students have to answer any 3 question out of 6 questions.
- Group C :** Long answer questions – three questions of fifteen marks each (3 x 15 = 45). Total six questions are to be given. Students have to answer any 3 questions out of 6 questions.

**Full marks: 30 (MSE) + 70 (ESE) = 100**

**Pass Marks: 45**

- |   |     |
|---|-----|
| 1. Environmental pollution: Air, Water and Soil; Control strategies   | (6) |
| 2. Environmental toxicology: Introduction, Definition, Classification, Toxic agents (Food additives, Pesticides, Metals, Solvents, Radiation, Carcinogens and Poisons), Xenobiotics | (8) |
| 3. Statistical methods in toxicology, Applications of toxicology (assessment of LC 50, LT 50)   | (2) |
| 4. Anthropogenic activity and Environment   | (2) |
| 5. Environmental policy & laws  | (3) |
| 6. Environmental Impact assessment  | (3) |

**Books Recommended**

1. Pandey, Shukla & Trivedi      Fundamentals of Toxicology New central Book Agency (P) Ltd. Kolkata, Banglore & Mumbai.
2. Sharma, P.D.                      Environmental Biology & Toxicology Rastogi Publications, Meerut

**B.Sc. Part – III**  
**Semester – V**  
**Paper –16 (Practicals) (12 classes)**

**Full marks: 100**

**Time: 6 Hrs.**

**Pass Marks: 45**

- 1. Environmental biology: (24 marks)**
  - a) Determination of oxygen in a water sample (Winkler's Method).
  - b) Determination of pH of a water or soil sample using a pH meter / pH paper
  - c) Qualitative analysis of plankton.
- 2. Haematology: (16 marks)**
  - a) Determination of blood groups.
  - b) Measurement of ESR, Haemoglobin, RBC, WBC, clotting and bleeding time.
  - c) Preparation of blood film & identification of blood cells
- 3. Identification: (32 marks)**

Plankton net, sechi disk, plankton counter, quadrat, haemometer, haemocytometer, pH meter, ESR instrument.
- 4. Practical record (16 marks)**
- 5. Viva (12 marks)**

**B.Sc. Part – III**  
**Semester - VI**  
**Paper – 17 (Genetics) (26 classes)**  
**Full Marks: 70**

**Paper setters shall set questions in three groups.**

- Group A :** Shall contain multiple choice questions, fill in the blanks and true / false type questions (**10 x 1 = 10**).
- Group B :** Shall contain concept based questions – Three questions of five marks each (**5 x 3 = 15**). Total six question are to be given. Students have to answer any 3 question out of 6 questions.
- Group C :** Long answer questions – three questions of fifteen marks each (**3 x 15 = 45**). Total six questions are to be given. Students have to answer any 3 questions out of 6 questions.

**Full marks: 30 (MSE) + 70 (ESE) = 100**

**Pass Marks: 45**

1. Mendelian inheritance pattern and Laws of heredity. (2)
2. Co-dominance and incomplete dominance. (2)
3. Linkage and linkage maps. (3)
4. Varieties of Gene expression: Multiple alleles, Lethal genes, Pleiotropic genes, Gene interactions, Epistasis. (5)
5. Sex chromosome systems and sex linkage. (3)
6. Non-chromosomal inheritance. (2)
7. Mutations and Chromosomal Aberrations. (4)
8. Human genetics: Chromosomal and Single Gene Disorders (autosomal and sex), Genetic Counseling. (4)
9. Gene mapping. (1)

**Books Recommended**

1. Agarwal, V.K. Genetics S. Chand & Co. Ltd. New Delhi
2. Ayodyhya Prasad Scientific Refresher Course in Zoology Paper – VI Cell Biology, Genetics & Economic Zoology Scientific Book Company Patna
3. Dalela Genetics
4. Farnsworth Genetics (Harper & Row)
5. Gupta, P.K. Genetics Rastogi Publications, Meerut
6. Strickberger Genetics McMilan
7. Verma & Agarwal Genetics S. Chand & Co. Ltd. New Delhi

## B.Sc. Part – III Semester - VI

### Paper – 18 (Developmental Biology & Economic Zoology) (24 classes)

**Full Marks: 70**

**Paper setters shall set questions in three groups.**

- Group A :** Shall contain multiple choice questions, fill in the blanks and true / false type questions (**10 x 1 = 10**).
- Group B :** Shall contain concept based questions – Three questions of five marks each (**5 x 3 = 15**). Total six question are to be given. Students have to answer any 3 question out of 6 questions.
- Group C :** Long answer questions – three questions of fifteen marks each (**3 x 15 = 45**). Total six questions are to be given. Students have to answer any 3 questions out of 6 questions.

**Full marks: 30 (MSE) + 70 (ESE) = 100**

**Pass Marks: 45**

- |  |     |
|--|-----|
| 1. Vitellogenesis, Egg membranes.  | (2) |
| 2. Ultra-structure of sperm & egg.   | (2) |
| 3. Parthenogenesis.  | (2) |
| 4. Types of Animal eggs: Patterns of cleavage, Gastrulation, Fate maps and Cell lineage. | (6) |
| 5. Extra-embryonic membranes, Types and physiology of placenta.                          | (4) |
| 6. Organizer concept, induction.   | (2) |
| 7. Ageing, Cloning, Transgenic organisms   | (2) |
| 8. Aquaculture, Sericulture, Lac Culture & Apiculture                                    | (6) |

### Books Recommended

- |                               |                                  |  |
|-------------------------------|----------------------------------|--|
| 1. Balinsky                   | Introduction to Embryology       | CBS Publishers                         |
| 2. Berril, N.J.               | Developmental Biology            | TMH New Delhi                          |
| 3. Bradley M. Patten          | Early Embryology of the chick    | TMH Mumbai, ND                         |
| 4. Dalela & Verma             | Chordate Embryology              | Jaiprakash Nath & Co. Meerut           |
| 5. Davenport                  | An Outline of Animal Development | (Addison-Werley)                       |
| 6. Grant                      | Biology of Developmental Systems |  |
| 7. Jawed & Sinha              | A handbook of Economic Zoology   | S. Cand & Co. Ltd.<br>New Delhi        |
| 8. Rao, K.V.                  | Developmental Biology            | Oxford – IBH                           |
| 9. Sandhu, Srivastava & Arora | Embryology                       | Anmol Publications Pvt. Ltd. New Delhi |
| 10. Sastry & Shukla           | Developmental Biology            | Rastogi Publications, Meerut           |
| 11. Shukla & Upadhyay         | Economic Zoology                 | Rastogi Publications New Delhi         |
| 12. Subramanyam               | Developmental Biology (Narosa)   |  |

**B.Sc. Part – III**  
**Semester - VI**  
**Paper – 19 (Applied Zoology) (24 classes)**  
**Full Marks: 70**

**Paper setters shall set questions in three groups.**

- Group A :** Shall contain multiple choice questions, fill in the blanks and true / false type questions (**10 x 1 = 10**).
- Group B :** Shall contain concept based questions – Three questions of five marks each (**5 x 3 = 15**). Total six question are to be given. Students have to answer any 3 question out of 6 questions.
- Group C :** Long answer questions – three questions of fifteen marks each (**3 x 15 = 45**). Total six questions are to be given. Students have to answer any 3 questions out of 6 questions.

**Full marks: 30 (MSE) + 70 (ESE) = 100**

**Pass Marks: 45**

Any of the following suggested applied topics should be taken: (**only Medical Zoology**)

- a) ~~Bioinformatics.~~
- b) ~~Reproductive technologies.~~
- c) ~~Aquaculture. (Sericulture & Lac culture)~~
- d) **Medical Zoology.**
- e) ~~Biotechnology.~~

**(a) Bioinformatics**

1. ~~Historical perspectives on computers and their applications to biology.~~
2. ~~Operating systems: DOS, WINDOWS, UNIX.~~
3. ~~Introduction to programming.~~
4. ~~The internet and the biologist.~~
5. ~~Data bases and information retrieval.~~
6. ~~Sequence analysis: Basic concepts and operational aspects~~
7. ~~Phylogenetic analysis.~~
8. ~~Predictive methods based on sequence data.~~
9. ~~Genome information.~~
10. ~~Programming using C, C data types, C assignment statements.~~
11. ~~One dimensional arrays.~~
12. ~~Strings and C string libraries.~~
13. ~~Structures and Unions.~~

**(b) Reproductive Technologies**

1. Gamete technology: Gametogenesis in Economically Important invertebrates and vertebrates. Collection and crytopreservation of gametes and embryos.
2. Sperm function, Tests and Semen analysis. In vitro fertilization and Embryo Transfer
3. Immunocontraception, Vaccines.
4. Hormone assays: Bioassay and Immunoassay, RIA and ELISA, Immunodiagonostics for Pregnancy, Cancer and Reproductive Tract Infections.
5. Embryosexing: Methods and Principles.
6. Animal house-design, Breeding and Maintenance of animals, Production of transgenic animals
7. Embryocloning and cloning of animals by nuclear transfer.

**(c) Aquaculture**

1. World Aquaculture-role, Importance, Status, Production trend, Important species, Current concepts of culturable Fin fishes and Shell fishes.

2. Micronutrients.
3. World fishes: Production, Utilization and Demand.
4. Marine fisheries of India, Pelagic and Demersal, Fishery resource & Their exploitation, Area, Seasons, Production, Efforts, Utilization, Demand and Potential, Resources
5. Estuarine and Brackish water fishes of India: Characteristic species and their exploitation.
6. Freshwater fishes of India: River systems, Reservoir, Pond, Tank fisheries, captive, and culture fisheries, Cold water fisheries.
7. Fishing craft and Gear.
8. Finfishes, Crustaceans, Mollusks and their culture.
9. Sea weed culture.
10. Fish Seed production: Seed resources and its Assessment, Collection, Hatchery production.
11. Field culture: Ponds, Running water Recycled water, Cage culture, Pen culture, Sea ranching and Artificial recruitment., Culture site, its requirement, Nursery and Growout pond: Preparation, Management, Fertilization, Stocking, Feeding, Monitoring and Management, Poly culture farm construction.
12. Culture Technology: Biotechnology using chromosomal and Gene manipulation, Transgenic fish, Supermales, Artificial Insemination, Cryopreservation of Gametes and embryos, Economics, of production.

#### (d) Medical Zoology

1. Brief introduction to Pathogenic microbes: Viruses, Rickettsiae, Spirochaetes and Bacteria.
2. Brief account of the life history, Mode of infection and Pathogenicity of the following pathogens with reference to man, prophylaxis and treatment:
  - a) Pathogenic Protozoans: *Entamoeba*, *Trypanosoma*, *Leishmania*, *Giardia*, *Trichomonas* and *Plasmodium*.
  - b) Pathogenic Helminthes: *Schistosoma*, *Ancylostoma* and *Wuchereria*.
4. Brief account of Arthropods as direct agents of disease or discomfort; Accidental injury to sense organs; Blood loss; Entomophobia; Dermatitis; Myiasis; Allergy and Venoms.
5. Arthropods as vectors of Human diseases: Malaria, Yellow fever, Filariasis and Plague. Distribution biology and control of the above mentioned vectors.
6. Histopathological changes in organ in relation to diseases such as Liver Cirrhosis, Nephrosis, Tumors and Cancer.
7. Epidemic diseases such as: typhoid, cholera, small pox; their occurrence and eradication programs.
8. Elementary idea of drug therapy and drug resistance.
9. Brief introduction to human defense mechanism.

#### Books Recommended

1. Cheng, T.C.                      General Parasitology
2. Kettle, D.S.                    Medical Veterinary Entomology      International

#### (e) Biotechnology

1. Basic concepts in Genetic Engineering.
2. Enzymology of Genetic Engineering: Restriction enzymes, DNA ligase, Polymerase etc,
3. Cloning vehicles: Plasmids, Cosmids, Lambda phage, Charon phage, Shuttle vectors etc.
4. Introduction of cloned genes into the host cells: Transformation, Transduction, Particle gun, Electrophoration, Liposome mediated Cultivation etc.
5. Analysis and expression of cloned genes in host cells:

Restriction enzyme analysis, Southern blotting, Northern blotting, In situ hybridization, DNA sequencing, DNA fingerprinting, DNA probes, Antisense RNA, Expression of cloned genes.

6. Introductory idea about Gene Libraries.
7. Transferring genes into animal Oocytes, Eggs, Embryos, and specific animal tissues.
8. Application and Impact of DNA technology.
9. Ethical issues and Safety Regulations.

**B.Sc. Part – III**  
**Semester - VI**  
**Paper –20 (Practicals) (10 classes)**

**Full marks: 100**

**Time: 6 Hrs.**

**Pass Marks: 45**

**1. Slide preparation of chick embryo of different hours**

**(24 marks)**

**2. Projects:**

**(16 marks)**

- a) Field work to understand basic Ecological Principles.
- b) Analysis of producers and consumers in a field community.
- c) Estimation of productivity in a pond ecosystem.
- d) Estimation of population density using the quadrant method.
- e) Construction of a familial pedigree for a particular trait with the help of a questionnaire.
- f) Observation of *Drosophila* (wild and mutants).
- g) Observation of live gametes under microscope.
- h) Observation of development of the fertilized egg of frog.
- i) Preparation of a program for use in biological informatics.

**3. Identification:**

**(32 marks)**

a) Frog embryology:

**(6 x 2 = 12)**

Fertilized egg, morula stage, blastula stage, gastrula stage & tadpole stage.

b) Chick embryology:

**(6 x 2 = 12)**

Different hours stages.

c) Study of various equipments related to the above course:

**(4 x 2 = 8)**

incubator, pH meter, water bath, chromatograph, dark and light bottles, plankton net, counting cell.

**4. Practical record**

**(16 marks)**

**5. Viva**

**(12 marks)**