

Scheme:

Max Mark: 100

Min. Pass Marks: 36

Paper - I	3 Hrs duration	33 Marks
Paper - II	3 Hrs duration	33 Marks
Paper - III	3 Hrs duration	34 Marks
Practicals	4 Hrs duration	50 Marks

NOTE:

- There will be two parts of every theory question paper with a total duration of 3 hours. First part of question paper will comprise of question No. 1 containing 9(Paper I & II) or 10 (Paper III) very short answer (Maximum 25 Marks) type questions, each of 1 mark. This part is compulsory to attempt Question should be evenly distributed covering the entire syllabus. Second part of question paper will be of long answer type questions having three sections. There will be total 9 questions(Q No. 2 to 10) in this part i.e. three from each unit / section out of which candidate will be required to attempt any 4 questions selecting at least one question from each unit/section. Each question will carry 6 marks.
- The candidate has to answer all question in the main answer book only.

PAPER - I: Z-101**DIVERSITY OF ANIMAL AND EVOLUTION**

NOTE:

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- The candidate has to answer all question in the main answer book only.

Section - A**Diversity of Animals**

- Zoogeographical distribution: Principal zoogeographical regions of the world with special reference to their mammalian fauna.
- Diversity of fauna of India and the world.
- Adaptation of animal and their modes of life and the environment.
- Reason of depletion of biodiversity and conservative measures of biodiversity wherever required.
- Continental drift.

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2/11/22
C.D.M. DHIRENDRA DEWARSHIअकादमिक प्रभारी
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भरतपुर (राज.)2/11/22
Joshi. Raji

Section - B

SESSION-2022-23

Biosystematic and Taxonomy

1. General Principles of taxonomy, concept of five kingdom scheme, international code of nomenclature, (ICZN) cladistics, molecular taxonomy.
2. Concept of Protozoa and Metazoa, and levels of organisation.
3. Taxonomy and basis of classification of non-chordata and chordate: symmetry, coelom, segmentation and embryogeny.
4. Detailed classification of non-chordata and Chordata (up to sub ^{class} ~~orders~~ with examples).
5. Phylogeny of major invertebrate phyla (Sponges, Crustacea, Echinodermata & Hemichordata).

Section - C

Evolution

1. History of evolutionary thoughts (Lamarckism and Darwinism).
2. Natural selection, speciation.
3. Variation, isolation and adaptations.
4. Paleontology: Fossils, geological division of the Earth's crust, imperfection of the geological record.
5. Study of extinct forms: Dinosaurs, Archaeopteryx.

PAPER - II: Z-102

CELL BIOLOGY AND GENETICS**NOTE:**

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2. The candidate has to answer all questions in the main answer book only.

Section - A

Cell Biology

1. Introduction to cell; Morphology, size, shape, characteristics and structure of prokaryotic and eukaryotic animal cell; basis idea of virus and cell theory.
2. Cell membrane; Characteristics of cell membrane molecules, fluid-mosaic model of Singer and Nicholson, concept of unit membrane.
3. Cell membrane transport; Passive (diffusion and osmosis, facilitated, mediated) and active transport.
4. Cytoplasmic organelles:
 - (i) Structure and biogenesis of mitochondria; electron transport chain and generation of ATP molecules.
 - (ii) Structure and function of endoplasmic reticulum, ribosome (prokaryotic and eukaryotic) and Golgi complex.

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PAPER - III: Z-103
GAMETE AND DEVELOPMENTAL BIOLOGY

SESSION-2022-23

NOTE:

1. There will be two parts of this theory question paper with a total duration of 3 hours. First part of question paper will comprise of question No. 1 containing 9 very short Answer (Maximum 25 Marks) type questions, each of 1 mark. This part is compulsory to attempt. Question should be evenly distributed covering the entire syllabus. Second part of question paper will be of long answer type questions having three sections. There will be total 9 questions (Q No. 2 to 10) in this part i.e. three from each unit / section out of which candidate will be required to attempt any 4 questions selecting at least one question from each unit/section. Each question will carry 6 marks.
2. The candidate has to answer all questions in the main answer book only.

Section - A

Developmental Biology: Scope and Early Events

1. Historical review, type and scope of embryology.
2. Gametogenesis:
 - (i) Formation of ova and sperm.
 - (ii) Vitellogenesis.
3. Fertilisation: Activation of ovum, essence of activation: Changes in the organization of the egg cytoplasm.
4. Parthenogenesis.

Section - B

Developmental Biology Pattern and Processes

1. Cleavage: Definition, planes and patterns of cleavage among non chordates and chordates, significance of cleavage, blastulation and morulation.
2. Fate maps, morphogenetic cell movements, significance of gastrulation.
3. Embryonic induction, primary organizer, Differentiation and competence.
4. Development of chick up to 96 hours stage.
5. Embryonic adaptations:
 - (i) Extra embryonic membranes in chick, their development and functions.
 - (ii) Placentation in Mammals: Definition, types, classification on the basis of morphology and histology, functions of placenta.
 - (iii) Paedogenesis and neoteny.

Section - C

Dimensions in Developmental Biology

1. Regeneration.
2. Various type of stem cells and their applications.
3. Cloning of animals.
 - (i) Nuclear transfer technique.
 - (ii) Embryo transfer technique.
4. Teratogenesis (Genetic and induced).
5. Biology of aging.
6. Cell death.

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J. K. J.

21/11/22

21/11/22

Min. Marks: 18

4 Hrs. / Week

Max. Marks:50

I. Microscopic Techniques:

1. Organisation and working of Optical Microscope, Dissecting and Compound microscopes.
2. General methods of microscopic slide preparations; narcotization; fixing and preservation; washing; staining; destaining; dehydration; clearing and mounting; General idea of composition, preparation and use of:
 - (i) Fixatives: Formalin, Bouin's fluid.
 - (ii) Stains: Aceto-carmin, Aceto-orcin, Haematoxylin-Eosin, Giemsa.
 - (iii) Common reagents: Normal saline, Acid water, Acid alcohol and Mayer's albumin.
3. Collection and Culture Methods:
 - (i) Collection of Animals from their natural habitat during field trips such as Amoeba, Paramecium, Euglena, Planaria, Daphnia, Cyclops, etc.
 - (ii) Culture of Paramecium in the laboratory and study of its structure life - process and behavior in live state.
 - (iv) Vermicomposting (Theory and Practice).

II. Study of Microscopic Slides and Museum Specimens:

Protozoa: *Amoeba*, *Euglena*, *Trypanosoma*, *Giardia*, *Entamoeba*, *Elphidium* (*Polystomella*), *Foraminiferous shells*, *Monocystis*, *Plasmodium*, *Paramecium*, *Paramecium* showing binary fission and conjugation, *Opalina*, *Nyctotherus*, *Balantidium*, *Vorticella*.

Porifera: *Leucosolenia*, *Euplectella*, *Spongilla*, *T.S Sycon*, *Spicules*, *Spongin fibers*, *Gemmules*.

Coelenterata: *Millepora*, *Physalia*, *Velella*, *Aurelia*, *Alcyonium*, *Gorgonia*, *Pennatula*, *Sea anemone*, *Stone corals*, *Obelia colony and medusa*.

Ctenophora: Any Ctenophore.

Platyhelminthes: *Taenia*, *Planaria*, *Fasciola*, (W.M.) T.S. body of *Fasciola* through various regions. *Miracidium*, *Sporocyst*, *Redia*, *Cercaria* and *Metacercaria* Larvae of *Fasciola*, *Scotex*, T.S. mature proglottid of *Taenia*, *Cysticercus* larva.

Aschelminthes: *Ascaris*, *Wuchereria*, *Dracunculus*.

III. Biodiversity: Appliances used in Biodiversity study.

Nature trails, water sieving.

Discovery hunt in college campus/university campus/Forest reserves/sanctuaries/National Park.

Biodiversity survey:

Insect count on vegetation: Bird counts with general information on survey methods.

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- Preparation of fact sheet of common wild life found in your campus /area.
- IV. Fields visits/Excursion to wild life areas.**
 (i A candidate is expected to submit a written report of the visit. ii No protected animal be harmed in any way).
- V. Study of the following Through Permanent Slide Preparation:** Paramecium Euglena, Foraminiferous shells, Sponge spicules. Spongin fibres, Gemmule, Hydra, Obelia colony and Medusa; Parapodium of Neries and Heteronereis, Cyclops, Daphnia.
- VI. Exercise in Cell Biology:**
1. Squash preparation for the study of mitosis in onion root tip.
 2. Squash preparation for the study of meiosis in grasshopper or cockroach testis.
 3. Study of giant chromosomes in salivary glands of chironomous or Drosophila larva.
 4. Study of cell permeability using mammalian R.B.C.
 5. Permanent slides of mitosis and meiosis (all stages).
- VII. Exercise in Genetics:**
- A Study of Drosophila:**
1. Life cycle and an idea about its culture.
 2. Identification of male and female.
 3. Identification of wild and mutants (yellow body, ebony, vestigial wing and white eye).
 4. Study of permanent prepared slides: Sex comb and salivary gland chromosomes.
- VIII. Developmental Biology:**
1. **Study of development of frog/toad with the help of Chart/Slides/Models:**
 - (i) Eggs, cleavage, blastula, gastrula, neurula, tail-bud, hatching, mature tadpole larvae, metamorphic stages, toadlet/ froglet.
 - (ii) Histological slides: Cleavage, blastula, gastrula, neurula and tail-bud stage.
 2. **Study of development of chick with the help of whole mounts/Charts/Slides/Models.**
 - (i) 18 hrs, 21 hrs, 24 hrs, 33 hrs, 48 hrs, 72 hrs and 96 hrs of incubation.
 - (ii) Primitive streak stage in living embryo, if possible, after removal of the blastoderm from the egg.
 - (iii) Study of the embryo at various stages of incubation in vivo by making a window in the egg-shell.
 - (iv) Study of various foetal membranes in a 10-12 day old chick embryo.

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Scheme of Practical Examination and Distribution of Marks SESSION-2022-2

Time: 4 Hrs.

Min Pass Marks: 18

Max. Marks : 50

	Regular	Ex. /N.C. Student
1. Study of Biodiversity	06	4
2. Permanent Preparation	04	7
3. Cell Biology and Genetics	4+4	6+6
4. Developmental Biology	6	6
5. Identification and Comments on Spots (1 to 8)	16	16
6. Viva Voce	5	5
7. Class Record	5	-
	50	50

Notes:

1. With reference to study of museum specimens and developmental Biology, candidate must be well versed in the study of various systems with the help of chart/models/CD-ROMs, multimedia computer based simulations including computer assisted learning (CAL) and other softwares.
2. With reference to permanent preparations and microscopic slides, in case of non-availability, the exercise should be substituted with diagrams, photographs, models, charts etc.
3. Candidates must keep a records of all work done in the practical class and submit the same for the inspection of the time of the practical examination.
4. The candidates may be asked to write detailed methodology wherever necessary and separate marks may be allocated for the same.
5. Mounting material for permanent preparation would be as per the syllabus or as available through collection and culture methods.
6. It should be ensure that animal used in the practical exercises are not covered under the wild life act 1972 and amendments made subsequently.

Recommended Books;

1. Balinsky B. I. and Fabain BC Intoduction to Embryology. CENGAGE Learning 2012.
2. Barrington EJW: The Biology of Hemichordata and Protchordata. Oliver & Boyd. London 1965.
3. Berril N J: Development Biology. Tata McGraw Hill 1971.
4. Colbert EH: Evolution of the Vertibrates 2nd edition John Wiley & Sons, New York 1969.
5. Colbert EH, Morales M, Minkoff EC. Colberts Evolution of the Vertebrates: A History of the Backboned Animal Through Time 5th edition Wiley Liss 2001.
6. Costanzo LS: Physiology. 4th edition Saunders Inc 2009.
7. Davenport R: An outline of Animal Development Addison-Wesley Longman Inc 1979.

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8. De Robertis EDP and De Robertis Jr EMF. Cell and Molecular Biology. 8th edition Lippincor Williams & Wilkins 2006.
9. Gasque: CD Manual of Laboratory, Experience Cell Biology Mc Graw-Hill Professional publishing 1989.
10. Gilbert SF and Singer SR: Development Biology, Sinauer Associates; 9th addition 2010.
11. Lodish H, berk A, Kaiser CA, Krieger M, Bertscher A, Ploegh H, Amon A, scott M P: Molecular Cell Biology 6th edition W.H. Freeman and Company, New Yark, 2008.
12. Lodish H. Berk A. Keiser CA, Kriser M, Bertscher
13. Lodish H, Berk A. Matsudaira, P, Kaiser CA, Krieger M, scott MP, Zipursky SL, Darnell J: Molecular Cell Biology . 5th addition W.H. freeman and Company. New York 2004.
14. Lodish H, Berk A, Zipursky SL, Matsudaira P, Baltimore D., Darnell J: Molecular Cell Biology 4th addition W.H. freeman and Company. New York 2000.
15. Morgan DD The Cell Cycle: Principal of Control, Sinauer/Panima Books 2007.
16. Petsko GA and Ringe D: Protein structure and function Sinauer/Panima Books 2004.
17. Rao KV Development Biology: A Modern synthesis. Oxford and IBH publishing 1994.
18. Rastogi VB Animal Distribution, Evolution and development Biology. Kedar Nath Ram Nath Educational Publisher.
19. Rastogi VB Evolutionary Biology Kedar Nath Ram Nath Educational Publisher.
20. Singh SP and Tomar BS: Cell Biology 10th edition Rastogi , Publication Meerut New Delhi. 1971
21. Snustad DP and Simmons MJ. Principle of genetics 4th eddition John Wile & Sons Inc. 2005.
22. Verma PS. A manual of Practical Zoology: invertebrates. S. Chand & Co Ltd New Delhi 1971.
23. Verma PS & Agrawal VK: Chordate Embryology: Development Biology. S. Chand & Com Ltd 2012.
24. Verma PS & Agrawal VK: Cell Biology, Genetic Molecular Biology. Evolution and Ecology. 14th addition S. Chand 2004.
25. Winchester AM: An introduction to genetics Barners & Noble. Canada, 2002.
26. Winchester AM: Genetics; A survey of principal of Heredity Oxford & IBH Publishing Co. 1967.
27. Winchester AM: Human Genetics: Ohio Charles E. Merrill Publishing Co. 1971.
28. Trigunayat, M.M & Kritika Trigunayat, A manual of practical Zoology, Part-I Scientific Publishers, Jodhpur.
29. एम.एम. त्रिगुणायत व कृतिका त्रिगुणायत, प्रायोगिक मैन्युअल भाग-1 साईंटिफिक पब्लिशर्स जोधपुर (राज.)

M.S.

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3. Zoology

B.Sc Part II (Second)
2022-23Scheme:
Max. Marks: 100

Min. Marks: 36

Paper I	: 3 Hrs duration	33 Marks
Paper II	: 3 Hrs duration	33 Marks
Paper III	: 3 Hrs duration	34 Marks
Practical	: 4 Hrs duration	50 Marks

NOTE:

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PAPER - I: Z-201

STRUCTURE AND FUNCTION OF INVERTEBRATE TYPES

NOTE

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Section-A

Structure and Function-I

Structural and functional organization of vital systems of non-choradates as exemplified by Amoeba, Paramecium, Euglena, Obelia, Sycon, Fasciola, Taenia, Nereis, Hirudinaria, Palaemon, Lamellidens, Pila and Aseterias.

- Locomotion: Pseudopodial (*Amoeba*), ciliary (*Paramecium*), flagellar (*Euglena*), parapodial (*Nereis*), pedal-muscular foot (*Pila*) and tube-feet (*Asterias*).
- Skeleton: Endoskeleton (spicules of *Sycon*); exoskeleton, chitinous (*Palaemon*), calcareous (*Corals*, *Pila*, *Lamellidens* and *Asterias*), siliceous (*Radiolaria*).
- Nervous System: Sensory and nerve cells (*Obelia*); brain ring and longitudinal nerves (*Fasciola* and *Taenia*); brain and ventral nerve cord (*Nereis* and *Palaemon*); nervous system of *Pila* and *Lamellidens*.
- Sense-organs: Statocyst and ospharidium (*Lamellidens* and *Pila*), compound eye (*Palaemon*) and simple eye (*Nereis*, *Pila*); tactile and olfactory organs (*Palaemon*); nuchal organs (*Nereis*).

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Dr Dharendra
Devastha

Section - B

Structure and Function - II

1. Food feeding, digestive structures and digestion: Autotrophic (Euglena) : heterotrophic through food vacuole (Paramecium) and in hydroid and medusoid zooids (Obelia) : Parasitic (Fasciola, Taenia, Hirudinaria): Predatory (Nereis, Palaemon, Asterias) : filter-feeding (Lamellidens)
2. Respiration: Aquatic general body surface (Euglena), Nereis, Hirudinaria): dermal bronchial (Asterias) parapodia (Nereis), gills (Palaemon, Lemellidens, Pila): aerial: pulmonary sac (pila), trachea (insect); anaerobic (fasciola, Taenia).
3. Excretion: General body surface (protozoa, Sycon, Obelia): Protonephridial system and flame cells (Fasciola, Taenia); nephridia (Nereis, Hirudinaria); malpighian tubules (insect); organ of Bojanus (Lamellidens, Pila).
4. Circulation: Cyclosis (Euglena, Paramecium); diffusion (Sycon, Obedia, Fasciola, Taenia); open circulatory system (Hirudinaria, Palaemon, Lamellidens, Pila, Asterias); closed circulatory system (Nereis).
5. Reproduction: Asexual (paramecium, Euglena, Sycon); alternation of generation (obelia); sexual (Fasciola, Taenia, Nereis, Lamellidens, Pila, Hirudinaria, Asterias).

Section- C

Invertebrate Adaptations

1. Salient features of Hemichordata.
2. Evolution of canal system of sponges.
3. Parasitic adaptations in Helminthes.
4. Social organization in termites and honey bees.
5. Direct and indirect development in insects.
6. Water vascular system of starfish.
7. Crustacean larvae.
8. Parasitism in Crustacea.

PAPER - II: Z-202

ANIMAL PHYSIOLOGY AND BIOCHEMISTRY

NOTE:

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Section-A

Animal Physiology with special reference to mammals

1. Osmoregulation in mammals.
2. Physiology of digestion: Various types of digestive enzymes and their digestive action in the alimentary canal.
3. Physiology of blood circulation: Composition and functions of blood; mechanism of blood clotting; heart beat; cardiac cycle; blood pressure; body temperature regulation.
4. Physiology of respiration: Mechanism of breathing; exchange of gases: transportation of oxygen and carbon dioxide in blood; regulation of respiration.
5. Physiology of excretion: Kinds of nitrogenous excretory end products (ammonotelic, uricotelic and ureotelic); role of liver in the formation of these end products. Functional

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architecture of mammalian kidney tubule and formation of urine; hormonal regulation of water and electrolyte balance (Homeostasis).

Section - B

Regulatory aspects of Animal Physiology

1. Physiology of nerve impulse and reflex action: functional architecture of a neuron, origin and propagation of nerve impulse, synaptic transmission, reflex arc.
2. Physiology of muscle contraction: Functional architecture of skeletal muscles; chemical and biophysical events during contraction and relation of muscle fibers.
3. Types of endocrine glands, their secretions and function Pituitary, adrenal, thyroid, islets of Langerhan's, testis and ovary.
4. Physiology of Reproduction: Hormonal control of male and female reproduction, implantation, parturition and lactation in mammals. Menopause in human.
5. Preliminary idea of neurosecretion. hypothalamic Control of pituitary function.

Section-C

Biochemistry

1. Carbohydrates: Structure, function and significant): oxidation of glucose through glycolysis, Kreb's cycle and oxidative phosphorylation; elementary knowledge of interconversion of glycogen and glucose in liver; role of insulin and glucagon.
2. Proteins : Structure, function and significance, essential and non-essential amino acids, transformation of amino acids: deamination, transamination, decarboxylation. Synthesis of protein and urea, fate of ammonia (Ornithine cycle), fate of carbon skeleton.
3. Enzymes: Types and mechanism of action.
4. Lipids: Structure, function and significance; Beta.oxidative pathway of fatty acids; brief account of biosynthesis of triglycerides, Cholesterol and its metabolism.
5. Catabolism and biosynthesis of nucleotides.
6. Mineral metabolism: Iodine, iron, calcium and zinc.

Paper - III: Z-203

Immunology, Microbiology & Biotechnology

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Section - A

Immunology

1. Immunology: Definition, types of immunity: innate and acquired; humoral and cell mediated. Organs of immune system.
2. Antigen and antibody: Antigenicity of molecules, happens, antibody types.
3. Antigen-Antibody reactions; Precipitation reaction, agglutination reaction, neutralizing reaction, complement and lytic reactions and phagocytosis.
4. Immunity Regulating Cells: Macrophages, lymphocytes (B and T-Types) T-helper cells, T-Killer cells, plasma cells and memory cells.

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5. Mechanism of humoral or antibody mediated immunity and cell mediated immunity.
6. MHC: Structure and function of class I, II and III MHC molecules, regulation of MHC expression.

Section- B

Microbiology

1. Brief introduction to the History of Microbiology: Work of Anatomy Van Leeuwenhoek, theory of spontaneous generation, germ theory of fermentation and disease: Works of Louis Pasteur, John Tyndall, Robert Koch and Edward Jenner.
2. The Prokaryota (Bacteria) : Structural organization:
 - (i) Size, shapes and patterns of arrangement
 - (ii) Structural organization: Slime layer (capsule), cell envelopes: cytoplasmic membrane (inner membrane). Cell wall (outer membrane) of Gram-negative and Gram-positive bacteria; Mesosomes; cytoplasmic organization; cell projections: flagella and cilia.
3. Genetic material of Bacteria: chromosome, replication of bacterial DNA.
4. Reproduction in Bacteria: Asexual reproduction, binary fission, budding, endospore formation, exospores and cyst formation; sexual reproduction, conjugation.
5. Microbial Nutrition: Culture of bacteria
 - a. Carbon and energy source
 - b. Nitrogen and minerals
 - c. Organic growth factors
 - d. Environmental factors: temperature and pH
6. Bacteria of Medical Importance:
 - (i) Gram-Positive
 - a. Cocci: *Staphylococci*, *Streptococci*
 - b. Bacilli: *Diphtheria*, *Tetanus*.
 - (ii) Gram-Negative
 - a. Cocci: *Gonorrhoea Meningitis*
 - b. Bacilli: *Diarrhoea*
 - (iii) Mycobacteria: *Tuberculosis*, *Leprosy*
7. AIDS and hepatitis. The causative agents, transmission, pathogenicity, laboratory diagnosis, treatment and prevention (elementary idea only).

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Handwritten signatures and dates: 23.12.17, 21/11/22, 21/11/22

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Section - C

Biotechnology

1. Definition, history, scope and application of biotechnology, major areas of biotechnology (microbial, plant and animal biotechnology).
2. Vectors for gene transfer.
3. Basic concepts of animal cell, tissue, organ and embryo culture.
4. Protoplast fusion in prokaryotes and eukaryotes.
5. Recombinant DNA technology; hybridomas and their applications, PCR, DNA finger printing, DNA foot printing, RFLP, RAPD & AFLP, Human genome project, Genomics & Proteomics (Brief idea only).
6. Monoclonal antibodies and their applications.
7. Genetic engineering (outline idea only); Applications of genetic engineering, hazards and regulations.
8. Transgenic animals, their uses.
9. Brief account of cloning: its advantages and disadvantages.
10. Biotechnology in medicine (outline idea only), antibiotics, vaccines, enzymes, vitamins, hormones, artificial blood.
11. Environmental Biotechnology (outline idea only): Metal and petroleum recovery, pest control, waste water treatment.
12. Food, drink and dairy biotechnology (outline idea only): Fermented food production; dairy products, wine, beer, vinegar and food preservation.

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Syllabus: B.Sc. Part - II (Pass Course)

Zoology Practical

~~(2016-2017)~~

Min. Marks: 18

4 Hrs./ Week

Max. Marks: 50

I. Study of Museum Specimens:

Annelida	: Nereis, Heteronereis, Aphrodite, Chaetopterus, Arenicola, Glossiphonia, Pontobdella, Polygordins.
Onychophora	: Peripatus
Arthropoda	: <i>Limulus</i> , Spider, Scorpion, Centipede, Millipede, Lepas, Balanus, Squilla, Eupagurus, Crab, <i>Mantis</i> , Honey-bee, (queen, king, worker) Locust, Silkworm Moth, Beetle, White grub.
Mollusca	: Chiton, Aplysia, Cypraea, Mytilus, Pearl Oyster, Dentalium, Loligo, Nautilus.
Echinodermata	: Pentaceros, Echinus, Ophiothrix, Cucumaria, Antedon.
Hemichordata	: Balanoglossus

II. Study of Microscopic Slides:

Annelida	: T.S. body of Nereis through various regions.
Arthropoda	: V.S. of integument (cuticle): Pediculus, Bedbug, Termite and its castes, Cyclops, Daphnia, crustacean larvae (Nauplius, Zoea, Mysis, Megalopa). Statocyst of prawn.
Mollusca	: V.S.Shell. T.S gill of pila: Glochidium larva

III. Study of the Following Through Permanent Slide Preparation:

- Trachea, Mosquito larva, Lice, Termites.
- Differential staining and identification of various types of blood cells. \ 01

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IV. Anatomy:

SESSION-2022-23

Prawn/Squilla

:Study of External features, appendages, alimentary canal and nervous system; Hastate Plate

Cockroach/Grasshopper

: Study of External features, Appendages, Alimentary canal, Nervous system and Mouthparts.

V. Microbiology Immunology and Biotechnology:

1. Preparation and use of culture media for microbes.
2. Study of microbes in food materials like curd, etc (Lactobacillus Aspergillums, Mucor, Penicillium).
3. Educational tour to any Microbiology Laboratory, Dairy, Food processing factory and Distillery for first hand study. Collection of material may also be encouraged wherever possible. Candidates are expected to submit a detailed report of such visit.
4. Antigen-antibody reactions-precipitation, agglutination
5. A brief practical idea of fermentation of food, food preservation.

VI. Animal Physiology:

1. Counting of red and white blood cells in the given blood sample.
2. Estimation of hemoglobin in the given blood sample.
3. Estimation of haematocrit value (PCV) in the given blood sample.
4. Demonstration of enzyme activity (catalase) in liver.
5. Study of salivary digestion of starch and the effect of heat and alcohol on salivary digestion of starch.
6. Study of histological structure of major endocrine glands of mammals.
7. Demonstration of blind spot in Human-eye.

VII. Biochemistry:

1. Detection of protein, carbohydrate and lipid in the animal tissue/food samples.
2. Identification of different kinds of mono-di-and polysaccharides in the given food samples
3. Circular paper chromatography of dyes/amino acids.

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B.Sc. Part - II
Scheme of Practical Examination Distribution of Marks

Time: 4 Hrs.

Min. Pass Marks : 18

Max. Marks: 50

	Regular	Ex./N.C. Students
1. Anatomy (any system)	3	3
2. Permanent Preparation Exercise in	4	6
3. Microbiology/ Immunology /Biotechnology	5	6
4. Exercise in Animal Physiology	6	7
5. Exercise in Biochemistry	6	7
6. Identification and comments on Spots (1 to 8)	16	16
7. Viva voce	5	5
8. Class Record	5	-
	50	50


Notes:

1. With reference to Anatomy, study of prescribed types (charts/models) candidates must be well versed in the study of various systems. CD ROMs multimedia computer based simulations including computer assisted learning (CAL) and other soft wares may be used.
2. With reference to permanent preparations and microscopic slides, the exercise should be substituted with diagrams, photographs, models, charts, etc.
3. Candidates must keep a record of all work done in the practical class and submit the same for inspection at the time of the practical examination.
4. The candidates may be asked to write detailed methodology wherever necessary and separate marks may be allocated for the same.
5. Mounting material for permanent preparations would be as per the syllabus or as available through collection and culture methods.
6. It should be ensured that animals used in the practical exercises are not covered under the wild life act 1972 and amendments made subsequently or Necessary permission from chief wildlife warden be sought.

Recommended Books:

1. Barnes R. D: Invertebrate Zoology. W. B. Saunders, 1969.
2. Barrington EJW: Invertebrate Structure and Function. 2nd edition John Wiley & Sons, Inc., 1978.
3. Barrington EJW: The Biology of Hemichordata and Protochordata. Oliver & Boyd, London 1965.
4. Barrett KE, Barman SM, Boctano, S and Brooks HL. Ganongs: Review of Medical Physiology. 24th edition Me Graw Hill Education India Pvt. Ltd., 2012.
5. Berril NJ: The Tunicates. The Roy Society, London.
6. Brusca RG and Brusca GJ: Invertebrates. 2nd edition Sinauer/Panama Books, 2003.
7. Cooper GM and Hausman RE: The Cell: A Molecular Approach. 6th edition ASM Press Washington, DCI Sinauer/Panama Books, 2013.
8. Conn EE, Stumpf PK, Bruening G, Doi, RH: Outline of Biochemistry. 5th edition. John Wiley & Sons, 1987.
9. De Robertis EDP' and De Robertis Jr EMF: Cell and Molecular Biology. 8th edition Lippincot Williams & Wilkins, 2006.
10. David R, Burggren Wand French K: Eckert Animal Physiology. 5th edition W H


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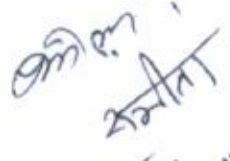
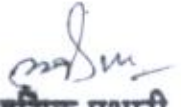
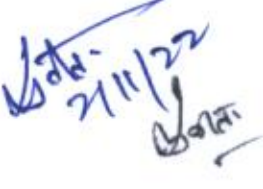



- Freeman & Company, New York, 2001.
11. Eckert R, Randall D. J. Burggen W, French K: Eckert Animal Physiology and Burggren WW & Co. Ltd., 1997.
 12. Fox SI: Human Physiology. 8th edition McGraw Hill Education 2003.
 13. Gardner EL, Simmons MJ and Snustad DP: Principles of Genetics 8th edition John Wiley & Sons, Inc., 2006.
 14. Giese A. C: Cell Physiology. 4th Edition, Saunders, 1973.
 15. Glick BR., Paeternak II: Molecular Biotechnology, 4th edition ASM Press, 2010.
 16. Goldsby RA, Kindt TJ and Osborne BA: Kuby Immunology. WH Freeman and Co., New York, 2002.
 17. Grant: Biology of Developmental System
 18. Gupta PK. Genetics: Classical to Modern. Rastogi Publications, 2007.
 19. Hall JE: Guyton and Hall Textbook of Medical Physiology. 12th edition Saunders Publications, 2010.
 20. Hill RW, Wyse GA, Anderson M: Animal Physiology. 3rd edition Sinauer Associates Inc. USA, 2012.
 21. Hyman LH: The Invertebrates, Vol. 6, Mc Graw Hill.
 22. Jordan EL and Verma PS: Invertebrate Zoology. S. Chand & Company Ltd., 2012.
 23. Karp G: Cell & Molecular Biology: Concepts and Experiments. 7th edition John Wiley & Sons, Inc., 2013.
 24. Kotpal RL: Modern Text Book of Zoology: Invertebrates, Rastogi Publications, 2012.
 25. Lal SS: Practical Zoology Invertebrate. 11th revised edition Rastogi Publications, 2014.
 26. Lehninger AL: Biochemistry. 2nd edition Kalyani Publishers, 1991.
 27. Lal SS: Practical Zoology Invertebrate. 11th revised edition, Rastogi Publications, 2014.
 28. Lehninger AL: Biochemistry. Kalyani Publisher, 2008.
 29. Lodish H, Berk A, Kaiser CA, Krieger M, Bertscher A, Ploegh H, Amon A, Scott M P. Molecular Cell Biology. 7th edition. Mac Millian High Education (International edition) England, 2013.
 30. Meyers R. A: Molecular Biology and Biotechnology (A comprehensive Desk References John Wiley & Sons, 1995.
 31. Murphy K: Janeway's Immunology. Garland Science: 8th edition, 2011.
 32. Nelson DL and Cox MM: Lehninger Principles of Biochemistry. 5th edition W. H. Freeman, 2008.
 33. Nelson DL and Cox MM: Lehninger Principles of Biochemistry. 6th edition W. H. Freeman, 2013.
 34. Owen J, Punt J, Stranford S: Kuby Immunology. 7th edition WH Freeman & Co. Ltd., 2013.
 35. Old RW and Primrose SB: Principles of Gene Manipulation: An Introduction to Genetic Engineering. University of California, 1980.
 36. Sastry KV: Animal Physiology and Biochemistry, 2nd edition Rastogi Publications, 2014-15.
 37. Vander AJ, Sheerman J, Luciano D: Human Physiology: The Mechanics of Body Function. Mc Graw Hill Co., New York, 1998.
 38. Verma PS and Jordan EL: Invertebrate Zoology. S.Chand & Co. Ltd. New Delhi, 2001.
 39. Verma PS, Tyagi BS, Agarwal VK: Animal Physiology. 6th edition S. Chand & Co., 2004.
 40. Voet D and Voet JG: Biochemistry. 4th edition, John Wiley & Sons, Inc., 2011.
 41. Voet D and Voet JG: Biochemistry. John Wiley & Sons, New York, 1990.
 42. Verma PS: A Manual of Practical Zoology: Invertebrates. S. Chand & Co. Ltd. New Delhi, 1971.
 43. Voet D and Voet JG: Biochemistry. 4th edition, John Wiley & Sons Inc., 2011.
 44. Wake MH: Hyman's Comparative Vertebrate Anatomy. 3rd edition University of Chicago Press Ltd. London, 1992.

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45. Trigunayat, M.M : A Manual of Practical Entomology. Scientific Publisher, Jodhpur (Raj.)
 46. Trigunayat, M.M and Kritika Trigunayat: Prayogic Manual Part-2 Scientific publishers, Jodhpur, Rajasthan.





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B.Sc. Part III (THIRD)

SESSION-2022-23

2022-23

(Zoology)

Scheme:
Max. Marks: 100

Min. Pass Marks: 36

Paper I	: 3 Hrs duration	33 Marks
Paper II	: 3 Hrs duration	33 Marks
Paper III	: 3 Hrs duration	34 Marks
Practicals	: 4 Hrs. duration	50 Marks

NOTE:

- There will be two parts of every theory question paper with total duration of 3 hours. First part of question paper will comprise question No. 1 containing 9 (Paper I & II) or 10 (Paper III) very short answer (Maximum 25 words) type questions, each of 1 mark. This part is compulsory to attempt. Questions should be evenly distributed covering entire syllabus. Second part of question paper will be of long answer type questions having three sections. There will be total 9 questions (Q. No. 2 to 10) in this part, i.e., three from each unit /section out of which candidate will be required to attempt any 4 question selecting at least one question from each unit/section. Each question will carry 6 marks.
- The candidate has to answer all questions in the main answer book only.

PAPER -I: Z-301

STRUCTURE AND FUNCTIONS OF CHORDATE TYPES

NOTE:

- There will be two parts of this theory question paper with total duration of 3 hours. First part of question paper will comprise question No. 1 containing 9 very short answer (Maximum 25 words) type questions, each of 1 mark. This part is compulsory to attempt. Questions should be evenly distributed covering entire syllabus. Second part of question paper will be of long answer type questions having three sections. There will be total 9 questions (Q. No. 2 to 10) in this part i.e. three from each unit /section. out of which candidate will be required to attempt any 4 question selecting at least one question from each unit/section. Each question will carry 6 marks
- The candidate has to answer all questions in the main answer book only.

Section - A

Chordates

- Comparison of habit, external features and anatomy of *Herdmania* and *Branchiostoma* (excluding development).
- Ascidian tadpole larva and its metamorphosis.
- Affinities of Hemichordata, Urochordata and Cephalochordata
- Habit, habitat and salient features of *Petromyzon*, Ammocoete larva.

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Section - B

SESSION-2022-23

Comparative Anatomy

1. Integument including structure and development of placoid scales, feathers and hair.
2. Basic plan of vertebrate endoskeleton.
3. Alimentary canal.
4. Heart and aortic arches.
5. Respiratory system.
6. Urinogenital system.
7. Brain.
8. Sense organs (ear and eye).

Section - C

Chordate Adaptations

1. Pisces: Scales and fins, migration and parental care.
2. Amphibia: Parental care.
3. Reptilia: Poisonous and non poisonous snakes, poison apparatus.
4. Aves: Flight adaptations, bird migration.
5. Mammals: Adaptive radiation, dentition.

PAPER -II: Z-302
ECOLOGY AND ENVIRONMENTAL BIOLOGY

NOTE:

1. There will be two parts of this theory question paper with total duration of 3 hours. First part of question paper will comprise question No. 1 containing 9 very short answer (Maximum 25 words) type questions, each of 1 mark. This part is compulsory to attempt. Questions should be evenly distributed covering entire syllabus. Second part of question paper will be of long answer type questions having three sections. There will be total 9 questions (Q. No. 2 to 10) in this part i.e. three from each unit /section, out of which candidate will be required to attempt any 4 question selection at least one question from each unit/section. Each question will carry 6 marks
2. The candidate has to answer all questions in the main answer book only.

Section - A

Ecology

1. Basic concepts in ecology. its meaning and history.
2. Concepts of limiting factors.
3. Ecosystem: Biotic and abiotic factors.
4. Ecosystem: Production, consumption and decomposition in an ecosystem: Concepts of food-chain, food web, trophic structure, ecological pyramids
5. Biogeochemical cycles of O_2 , CO_2 , H_2O , N, P and role of microbes.
6. Ecosystem: Homeostasis, functional aspects, productivity concepts and determination, ecotone, edge effects, niche.
7. Population ecology: Density and methods of its measurement, natality, mortality, age ratio and distribution, pyramids, fluctuations, biotic potential, dispersal, growth forms, population interactions and propagation, brief idea of demography.
8. Community ecology: Characteristics of natural communities, structure, composition, stratification.

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9. Ecological succession: Types and patterns, concept of climax, details of xerosere and hydrosere successions.
10. Habitat ecology: Brief account of fresh water, marine, terrestrial and estuarine water ecosystems.
11. Major biomes of the world.
12. Ecology and human future: Growth rate role of human kind in modifying natural communities in term of public health and welfare with respect to use of pesticides, conservation and pollution.

Section - B

Environmental Biology-I

1. Environment and its concepts, global environment, hydrosphere, lithosphere and atmosphere.
2. Natural resources: Present status and future needs.
3. Conservation and management of natural resources: Renewable (forest, wildlife, water) and non renewable (soil, minerals and energy).
4. Environmental pollution I: General outline and various types of pollution of water, air, and soil.
5. Environmental pollution II: Sources and remedies for noise, radiation, industrial chemicals, agrochemicals, insecticides, pesticides and household pollutants.
6. Green House effect, Ozone layer depletion, El-Nino and La I Nina effects.
7. Radiation and environment: Types of radiation, fallout effects of radiation nuclear accidents.
8. Basic concepts of bioaccumulation, biomagnifications, biodegradation of pollutants.

Section - C

Environmental Biology -II

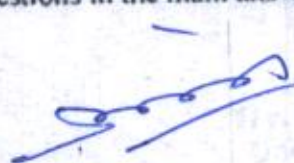
1. Wildlife conservation: Vanishing and threatened animals and plants with special reference in Rajasthan, Wildlife management efforts by Government and non Government organization (including wild life acts).
2. Impact of urbanization: Development and distribution of urban centers, factors , problems and solutions of urbanization, fauna of oriental region.
3. Space ecology: Space ecosystem, space problems and their solutions, colonization.

PAPER -III: Z-303

APPLIED ZOOLOGY, ETHNOLOGY AND BIOSTATISTICS

NOTE:

1. There will be two parts of this theory question paper with total duration of 3 hours. First part of question paper will comprise question No. 1 containing 10 very short answer (Maximum 25 words) type questions, each of 1 mark. This part is compulsory to attempt. Questions should be evenly distributed covering entire syllabus. Second part of question paper will be of long answer type questions having three sections. There will be total 9 questions (Q. No. 2 to 10) in this part i.e. three from each unit /section. out of which candidate will be required to attempt any 4 question selecting at least one question from each unit/section. Each question will carry 6 marks
2. The candidate has to answer all questions in the main answer book only.



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Section - A

SESSION-2022-23

Applied Zoology

Principles and Practices of the following:

1. -Vermiculture.
2. Sericulture (including ericulture).
3. Lac culture.
4. Apiculture.
5. Prawn culture.
6. Poultry keeping.
7. Pisciculture.

Economic Importance of the following:

1. Protozoa.
2. Corals and coral reefs.
3. Helminthes.
4. Arthropods; Insects and their management
5. Mollusca: Outline idea of pearl culture.

Section - B

Ethology

1. Introduction and history of Ethology.
2. Concepts of Ethology : Fixed action pattern, sign stimulus, innate releasing mechanism, action specific energy, motivation imprinting and learning.
3. Methods of studying brain behavior: Neuroanatomical , neurophysiological and neurochemical techniques.
4. Pheromones and their role in alarm spreading
5. Societies: Characteristics and advantage with special reference to honey bee, deer and monkey.
6. Biological rhythms and biological clocks.
7. Methods of studying animal behavior.

Section - C

Biostatistics

1. Introduction, scope and application of Biostatistics.
2. Understanding the concepts of descriptive and inferential statistics.
3. Frequency distribution.
4. Graphical and tabular presentation of data.
5. Mean, median, mode and their significance.
6. Standard deviation, standard error and their significance.
7. Hypothesis: Null and alternative; Student's t- test.

By Registrar (Acad.)
University of Rajasthan
Jaipur

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Zoology Practical

~~2021-2022~~

Min. Marks: 18

4 Hrs. / Week

Max. Marks: 50

I. Anatomy:

- (a) Any edible fish (*Wallago*, *Labeo*, etc.): External features, general viscera, afferent and efferent branchial blood vessels, eye muscles and their innervations, brain, cranial nerves and internal ear.
- (b) Rat or any other suitable mammal: Blood vascular, urino-genital and nervous system (brain, cranial nerves). In this exercise CAL (Computer Assisted Learning) May be used with a software COMPURAT.

II. Study of the following through Permanent Slide preparations:

Striped muscle fibers; Smooth muscle fibers, scales of edible fish, hair of man, dog, goat and cow.

III. Study of Microscopic Slides: Whole mounts of oral hood, velum and pharyngeal wall of *Amphioxus*; T. S. of *Amphioxus* through various regions; tadpole larva of *Ascidia*; whole mounts of *Salpa*, *Doliolum* and *Oikopleura*, V. S. of skin of fish, T. S. body of fish through various regions, V. S. of skin of bird, V. S. mammalian skin, T. S. mammalian liver, kidney, stomach, intestine, bone, spinal cord, lung, duodenum, pancreas, testis and ovary.IV. Study of Museum Specimens: *Ascidia*, *Ciona*, *Botryllus*, Ammocoete larva, *Petromyzon*, *Myxine* or *Bdellostoma*, *Zyguena* (*Sphyrna*), *Torpedo*, *Chimaera*; *Acipenser*, *Amia* or *Lepidosteus*, *Labeo*, *Clarias*, *Anguilla*, *Hippocampus*, *Exocoetus*, *Echeneis*, any flat-fish, Protopterus, *Ichthyophis* or any blind-worm, *Proteus*, *Ambystoma*, Axolotl, Siren, *Alytes*, *Hyla*, *Testudo*, *Chelone*, and Fresh Water Tortoise. *Sphenodon*, *Hemidactylus* *Phrynosoma*, *Draco*, Chameleon; *Eryx*, *Hydrophis*, *Naja*, *Viper*, *Crocodilus*, *Alligator*, *Archaeopteryx*, any Running Bird, *Pavo cristatus*, *Choriotis nigriceps* *Ornithorhynchus*, *Tachyglossus*, *Didelphys*, *Macropus*, Bat, *Loris*, Scaly anteater.

V. Osteology: A comparative study of articulated and disarticulated bones of skull, vertebrae, limb bones and girdles of any amphibian, reptile, bird and mammal with the help of models/ charts/ artificial skeleton/bones.

VI. Environmental Biology:

Analysis of Environment:

1. Soil pH
2. Water analysis: pH, alkalinity, acidity, dissolved O₂ and free CO₂, Salinity (Chloride).
3. Qualitative estimation of zoo-plankton in given sample of water.
4. Methods of ecological census of soil fauna.

VII. Ethology:

1. Study of any stored insect pest (food preference and response to light)
2. Antennal grooming in cockroach.
3. Chemical communication: Ants/earthworm.

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4. Visit to a Zoo/ Museum of Natural History /Wild life Sanctuary and/or Study of local faunal biodiversity (Candidates are expected to submit a detailed report of such visit).

VIII. Biostatistics:

1. Construction of frequency table, bar diagram, line diagram, histogram, frequency polygon and pie chart.
2. Exercises on mean, median and mode (direct, short-cut and step-deviation methods).
3. Standard deviation and standard error.

Scheme of Practical Examination and Distribution of Marks

Time: 4 Hrs.

Min Pass Marks: 18

Max. Marks: 50

	Regular	Ex. /N.C. Students
1. Anatomy (any system)	3	4
2. Permanent Preparation	6	6
3. Environmental Biology	7	7
4. Ethology	3	5
5. Biostatistics	5	7
6. Identification and comments on Spots (1 to 8)	16	16
7. Viva Voce	5	5
8. Class Record	5	-
	50	50

Notes:

1. With reference to anatomy and study of museum specimens, candidates must be well versed in the study of various systems with the help of charts/models/CD- ROMs, multimedia computer based simulations including computer assisted learning (CAL) and other softwares.
2. With reference to permanent preparations and microscopic slides, in case of non-availability, the exercise should be substituted with diagrams, photographs, models, charts, etc.
3. Candidates must keep a record of all work done in the practical class and submit the same for inspection at the time of the practical examination.
4. The candidates may be asked to write detailed methodology wherever necessary and separate marks may be allocated for the same.
5. Mounting material for permanent preparations would be as per the syllabus or as available through collection and culture methods.

[Signature]
Date: 21/11/22 (25)

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भरतपुर (राज.)

It should be ensured that animals used in the practical exercises are not covered under the wild life act 1972 and amendments made subsequently.

SESSION-2022-23

Recommended Books:

1. Ahsan J and Sinha SP: A Hand book on Economic Zoology. 9th edition S. Chand & Co. Ltd., 1981.
2. Alcock J: Animal Behavior: An Evolutionary Approach. Sinauer Associates 2013.
3. Animal Societies and Evolution. Scientific American Publications.
4. Alexander R. M: The Chordates, Cambridge University Press. 1975.
5. Bailey NTJ: Statistical Methods in Biology. English Universities Press, 1964.
6. Breed MD and Moore J: Animal Behavior. Academic Press. 2015.
7. Grizimek's Encyclopedia of Ethology.
8. Gurumani N: An Introduction to Biostatistics. MJP Publishers, 2011.
9. Hand book of Ethological Method. Laharen Publications Garland STPM Press.
10. Kotpal RL: Modern Text Book of Zoology: Vertebrates. Global Media Publications 2010.
11. MacFarland D: Animal Behavior: Psychobiology, Ethology and Evolution 3rd edition Longman 1998.
12. Mahajan BK: Methods in Biostatistics. 7th edition Jaypee Publishers, 2010.
13. Manning A, Dawkins MS: An Introduction to Animal Behavior. Cambridge University Press 2012.
14. Mathur R: Animal Behavior. Rastogi Publications 2010.
15. Odum: Fundamentals of Ecology. Thomson Books/Cole 2005.
16. Odum: Ecology: A Bridge Between Science and Society Sinauer Associates 1997.
17. Prasad SN and Kashyap V: A Textbook of Vertebrate Zoology. 13th edition Wiley Eastern Ltd. 2011.
18. Primrose S. B. and. Twyman R. M: Principles of Gene Manipulation and Genomics. John Wiley & Sons. 2013.
19. Rana S. V. S: Environmental Studies. 4th edition. Rastogi Publications 2012.
20. Rastogi VB Organic Evolution 6th edition Kedar Nath Ram Nath Publications, Meerut, Delhi. 1993.
21. Rastogi VB and Jayaraj MS Animal Ecology & Distribution of Animals Kedar Nath Ram Nath Publications, Meerut, Delhi. 1983.
22. Sharma P. D: Environmental Biology and Toxicology. 3rd edition Rastogi Publications, 2013.
23. Sunder Rao PSS and Richard J: Introduction to Biostatistics and Research Methods. PHI Publishers, 2012.
24. Sharma P. D: Ecology and Environment. 12th revised edition, Rastogi Publications 2014-2015.
25. Werlace RA: Animal Behavior. Good Year Publishing Co., Inc.
26. Young JZ: The Life of Mammals. Oxford University Press 1970.
27. Young JZ: The life of Vertebrates. 2nd edition Oxford University Press. London 1962.

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University of Jammu
Date: 21/11/22
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