

Syllabus B. Sc. Part II (Pass Course)

Zoology

Scheme:

Max.Marks:150

Min. Pass Marks: 54

Paper I	: 3 Hrs duration	50 Marks
Paper II	: 3 Hrs duration	50 Marks
Paper III	: 3 Hrs duration	50 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 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 10 marks.
- The candidate has to answer all questions in the main answer book only.

PAPER - I: Z-201

STRUCTURE AND FUNCTION OF INVERTEBRATE TYPES

Total teaching Hrs. - 60

NOTE:

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

Section-A (Teaching hours: 20)

Structure and Function-I

Structure and functional organization of vital systems of non-choradates as exemplified by Amoeba, Paramecium, Euglena, Sycon, Obelia, 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).

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- 2. Skeleton: Endoskeleton (spicules of *Sycon*); exoskeleton, chitinous (*Palaemon*), calcareous (*Corals, Pila, Lamellidens* and *Asterias*), siliceous (*Radiolaria*).
- 3. 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*.
- 4. Sense-organs: Statocyst and ospharadum (*Lamellidens* and *Pila*), compound eye (*Palaemon*) and simple eye (*Nereis, Pila*); tactile and olfactory organs (*Palaemon*); nuchal organs (*Nereis*).

Section-B (Teaching hours: 20)

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, Obelia, 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 (Teaching hours: 20)

Invertebrate Adaptations

- 1. Salient features of Hemichordata.
- 2. Evolution of canal system of sponges.
- 3. Parasitic adaptations in Helminths.
- 4. Social organization in termites and bees.
- 5. Direct and indirect development in insects.
- 6. Water vascular system of starfish.
- 7. Larval forms (free swimming & parasitic).
- 8. Parasitism in Crustacea.
- 9. Torsion in mollusca.

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ANIMAL PHYSIOLOGY AND BIOCHEMISTRY

Total teaching Hrs. - 60

NOTE:

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

Section-A (Teaching hours: 20)

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

Section-B (Teaching hours: 20)

Regulatory aspect 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 relaxation of muscle fibers.
3. Types of endocrine glands their secretions and functions: Pituitary adrenal, thyroid, Islets of Langerhan's, testis and ovary.
4. Physiology of Reproduction: Hormonal control of male and female reproduction, puberty, implantation parturition and lactation in mammals. Menopause in human.
5. Preliminary idea of neurosecretion, hypothalamic control of pituitary function.

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Section-C (Teaching hours: 20)

Biochemistry

1. Carbohydrates: Structure, function, and significance; oxidation of glucose through glycolysis, Krebs'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. Disorders of metabolism. (Alpeptoneuria, Phenylketoneuria, Glycogen storage disease)

Paper - III: Z-203

Immunology, Microbiology & Biotechnology

Total teaching Hrs. - 60

NOTE:

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

Section-A (Teaching hours: 20)

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, haptens, antibody types.
3. Antigen-Antibody reactions: Precipitation reaction, agglutination reaction, neutralizing reaction, complement and lytic reactions and phagocytosis. Hypersensitivity (Reaction of immune system & drugs involved).
4. Immunity Regulating Cells: Macrophages, lymphocytes (B and T-Types) T-helper cells, T-Killer cells, plasma cells and memory cells.
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.

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Section-B (Teaching hours: 20)

Microbiology

1. Brief introduction to the History of Microbiology: Work of Antony Van Leeuwenhoek theory of spontaneous generation germ theory of fermentation and disease: work of Louis Pasteur, John Tyndall, Robert-Koch and 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 projection flagella and cilia.
3. Genetic material of Bacteria: Chromosome, plasmid (extra chromosomal DNA) & replication of bacterial DNA.
4. Reproduction in Bacteria: Asexual reproduction (binary fission, budding, endospore formation, exospores and cyst formation); Sexual reproduction (conjugation, transformation & transduction)
5. Microbial Nutrition :
 - a. Carbon and energy source
 - b. Nitrogen and minerals
 - c. Organic growth factors
 - d. Environmental factors : Temperature and pH
 - e. Growth curve of bacteria
6. Bacteria of Medical Importance:
 - (i) Gram-Positive
 - a. Cocci: *Staphylococci, Streptococci*
 - b. Bacilli: *Diphtheria, Tetanus.*
 - (ii) Gram-Negative
 - a. Cocci: *Neisseria gonorrhoea, Neisseria meningitidis*
 - b. Bacilli: *Diarrohea*
 - (iii) Mycobacteria: Tuberculosis, Leprosy
7. AIDS and hepatitis. The causative agents, transmission, pathogenicity, laboratory diagnosis, treatment and prevention (elementary idea only).

Section-C (Teaching hours: 20)

Biotechnology

1. Definition, history, scope and application of biotechnology major areas of biotechnology (microbial, plant and animal biotechnology).
2. Vectors for gene transfer (plasmids, bacteriophage, cosmids).
3. Basic concepts of animal cell, tissue, organ and embryo culture.
4. Protoplast fusion in prokaryotes and eukaryotes.

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5. Recombinant DNA technology: tools of rDNA technology and their applications. PCR, DNA finger printing, DNA foot printing; RFLP, RAPD & AFLP: Human genome project, Genomics & c-DNA library.
6. Hybridoma technique, Monoclonal antibodies and its applications.
7. Genetic engineering (outline idea only): Applications of genetic engineering, hazards and regulations.
8. Transgenic animals: definition, transfection and examples.
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.

Recommended Books:

1. Barnes, R. D.: Invertebrate Zoology, W. G. Saunders, Philadelphia.
2. Bell, J. N. and Davidson, Gh. H.: Text Books of Physiology and Biochemistry ELBS London.
3. Lehninger: Principles of Biochemistry.
4. Satyanarayana, U. : Biochemistry, Books and Allied (P) Ltd., Kolkata.
5. Sastry K. V.: Animal Physiology and Biochemistry, Rastogi Publications, Meerut.
6. Randall, D., Burggren W., French K. W. H.: Eckert Animal Physiology, Freeman and Company, New York.
7. Satyanaryana, U.: Biotechnology, Books and Allied (P) Ltd., Kolkata.
8. Gupta P. K.: Biotechnology and Genomics, Rastogi Publications, Meerut.
9. Bhatia, A. L. and Kohli K. S.: Animal physiology and Biochemistry, Ramesh Book Depot, Jaipur.
10. Prescott, L. M. Harley J. P. Klein, D. A.: Microbiology McGraw Hill, New Delhi.
11. Kotpal R. L. and Singh H. S.: Invertebrate structure and Function. Rastogi Publication, Meerut.

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Recommended Books:

1. Barnes R. D. Invertebrate Zoology. W. B. Saunders, 1969.
2. Barrington E.J.W. Invertebrate Structure and Function. 2nd edition John Wiley & Sons, Inc., 1978.
3. Barrington E.J.W. The Biology of Hemichordata and Protochordata. Oliver & Boyd, London 1965.
4. Barrett KE, Barman SM, Boctango, S and Brooks HL. Ganong's: Review of Medical Physiology. 24th edition McGrawHill Education India Pvt. Ltd., 2012.
5. Berril NJ. The Tunicates. The Roy Society, London.
6. Brusca RC and Brusca CJ. Invertebrates. 2nd edition Sinauer/Panama Books, 2003.
7. Cooper GM and Hausman RE. The Cell: A Molecular Approach. 6th edition ASM Press Washington, DC. 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 Freeman & Company, New York, 2001.
11. Eckert R, Randall D, J. Burggren W, French K. Eckert Animal Physiology and Burggren WW & Co. Ltd., 1997.
12. Fox SJ. Human Physiology. 8th edition McGraw Hill Education 2003.
13. Gardner EL, Simmonis 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. Ghick BR, Pueteriak J. 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, 2011.
26. Lehninger AL. Biochemistry. 2nd edition Kalyani Publishers, 1991.
27. Lal SS. Practical Zoology Invertebrate. 11th revised edition. Rastogi Publications, 2011.
28. Lehninger AL. Biochemistry. Kalyani Publisher, 2008.
29. Lodish H, Berk A, Kaiser CA, Krieger M, Berscher 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 Reference) John Wiley & Sons, 1995.

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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, Pant 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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 1. A signature that appears to be "Vishwanath" written in blue ink.
 2. A signature that appears to be "M. S. R." written in blue ink.
 3. A checkmark or similar mark written in blue ink.

Official stamp and signature:
 1. A signature in blue ink above the text.
 2. The text "प्रभारी अधिकारी" (Prabari Adhikari) in Devanagari script.
 3. The text "अकादमिक-प्रश्न" (Akadimik-Prashna) in Devanagari script below it.

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

Min. Marks: 18

4 Hrs. / Week

Max. Marks: 50/75

I. Study of Museum Specimens:

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

II. Study of Microscopic Slides:

Annelida	:	T.S. body of <i>Nereis</i> through various regions.
Arthropoda	:	V.C. of integument (cuticle), <i>Pediculus</i> , Bedbug, Termite and its castes, <i>Cyclops</i> , <i>Daphnia</i> , crustacean larvae (<i>Nauplius</i> , <i>Zoea</i> , <i>Mysis</i> , <i>Megalopa</i>), statocyst of prawn.
Mollusca	:	V.C. shell, T.S. gill of <i>Pila</i> ; Glochidium larva.

III. Study of the Following Through Permanent Slide Preparation:

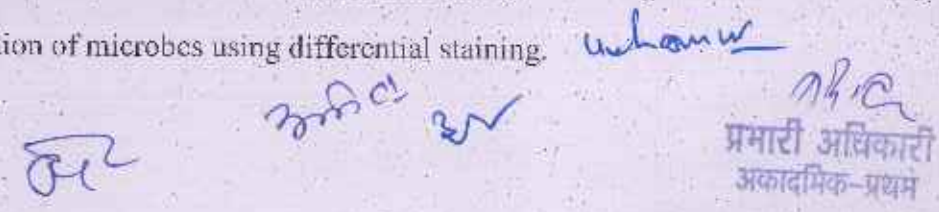
- (i) Larval forms of liver fluke
- (ii) Differential staining and identification of various types of blood cells.

IV. Anatomy:

<i>Prawn/Squilla</i>	:	External features, appendages, alimentary canal and nervous system; hastate Plate
<i>Pila</i>	:	External, features pallial organs and nervous system; osphradium, radula.

V. Microbiology, Immunology and Biotechnology:

- 1. Preparation and use of culture media for microbes.
- 2. Identification of microbes using differential staining.



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3. Study of microbes in food materials like curd, etc. (*Lactobacillus Aspergillums, Mucor, Rhizopus, Alternaria, Penicillium*).
4. 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.
5. Antigen-antibody reactions: Precipitation, agglutination, ELISA.
6. Effect of antibiotic/vitamins on microbial culture (air/water/soil).

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.

VII. Biochemistry:

1. Detection of protein, carbohydrate and lipid in the animal tissue/food samples.
2. Identification of different kinds of mono-, di- and poly-saccharides 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 and Distribution of Marks

Time: 4 Hrs.

Min Pass Marks: 18

Max. Marks: 50/75

	Regular	Ex. /N.C. Students
1. Anatomy (any system)	3/4	3/5
2. Permanent Preparation	4/5	6/8
3. Exercise in Microbiology/Immunology/Biotechnology	5/6	6/8
4. Exercise in Animal Physiology	6/8	7/10
5. Exercise in Biochemistry	6/8	7/10
6. Identification and comments on Spots (1 to 8)	16/24	16/24
7. Viva Voce	5/10	5/10
8. Class Record	5/10	-
	50/75	50/75

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 (CAI) and other softwares.
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.

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