

Syllabus: B.Sc. Part-I (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-101

BIODIVERSITY, BIOSYSTEMATICS AND EVOLUTION

Total teaching Hrs. - 60

NOTE:

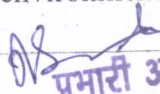
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- The candidate has to answer all questions in the main answer book only.

Section – A

(Teaching hours: 20)

Biodiversity

- Zoogeographical distribution: Principal zoogeographical regions of the world with special reference to their mammalian fauna.
- Bio-diversity of fauna of India and World.
- Reasons of depletion of biodiversity and conservation measures of biodiversity where required.
- Adaptation of animals to their modes of life and environment.
- Continental drift.


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Section – B (Teaching hours: 20)

Biosystematics

1. General principles of taxonomy, concepts of the five kingdom scheme. International code of zoological nomenclature, cladistics, molecular taxonomy.
2. Concept of Protozoa, Metazoa and levels of organization.
3. Basis of classification of non-chordata and chordata: symmetry, coelom, segmentation and embryogeny.
4. Detailed classification of various phyla of Non-chordata with diagnostic features of classes and sub-classes with examples.

Section –C (Teaching hours: 20)

Evolution

1. Evidences of evolution and theories of evolution (Lamarckism and Darwinism).
2. Natural selection (Differential reproduction), Genetic basis of evolution and Speciation.
3. Variations and isolation.
4. Paleontology: Fossils, geological time scale.
5. Study of extinct forms: Dinosaurs, *Archeopteryx*.
6. Evolution of man.

**PAPER –II: Z-102
CELL BIOLOGY AND GENETICS**

Total teaching Hrs. - 60

NOTE:

1. 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.
2. The candidate has to answer all questions in the main answer book only.

Section –A (Teaching hours: 20)

Cell Biology

1. Introduction to cell: Morphology, size, shape, characteristics and structure of prokaryotic and eukaryotic animal cell; basic 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; Gap junctions.
3. Cell membrane transport: Passive (diffusion and osmosis, facilitated, mediated) and active transport.
4. **Cell organelles** : Structure, composition and functions of- Endoplasmic reticulum, golgi-complex, lysosome, ribosome, mitochondria, microbodies, centrioles, cilia, flagella, microvilli and cytoskeletal elements.

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Section -B

(Teaching hours: 20)

1. **Nuclear Organization:**
 - (i) Interphase nucleus: Structure and function of nuclear envelope, nuclear matrix and nucleolus.
 - (ii) Chromosomes: Morphology, chromonema, chromomeres, telomeres, primary and secondary constrictions, chromatids; prokaryotic chromosome.
 - (iii) Giant chromosomes: Polytene and Lampbrush.
 - (iv) Chromosomal organization: Euchromatin, heterochromatin, folded fibre model and nucleosome concept.
2. **Nucleic Acids:**
 - (i) DNA structure, polymorphism(A, B and Z types) and replication (semi conservative mechanism) experiments of Messelson and Stahl: elementary idea about polymerases, topoisomerase, single strand binding protein replicating forks (both unidirectional and bidirectional), leading and lagging strands, RNA primers and Okazaki fragments, elementary idea about DNA repairs.
 - (ii) RNA structure and types (mRNA, rRNA and tRNA).
3. **Genetic code and protein synthesis:** Triplet code, characteristics of triplet code;transcription and translation.
4. **Cell reproduction:**
 - (i) **Cell cycle:** S, G-1, G-2 and M phase.
 - (ii) **Mitosis:** Different stages, structure and function of spindle apparatus; anaphasic movement.
 - (iii) **Meiosis:** Different stages, synapses and synaptonemal complex, formation of chiasmata and significance of crossing over.

Section -C

(Teaching hours: 20)

Genetics

1. **Mendelism:** Brief history of genetics and Mendel's work; Mendelian laws, their significance and current status; chromosomal theory of inheritance; Gene concept:Recon, muton and cistron.
2. **Gene - interaction:** Supplementary genes, complementary genes, duplicate genes, epistasis, inhibitory and polymorphic genes.
3. Linkage and crossing over, elementary idea of chromosome mapping.
4. Multiple gene inheritance: ABO blood groups, Rh factor and their significance.
5. **Chromosomal mutations:** Translocation, inversion, deletion and duplication; Variations in chromosome numbers:haploidy, diploidy, polyploidy, aneuploidy, euploidy and polysomy.
6. Cytoplasmic inheritance.
7. Sex determination in *Drosophila* and man.
8. Genetic disorders: Down's, Turner's, Klinefelter's syndromes; sexed linked and sex limited diseases.

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PAPER – III: Z-103
DEVELOPMENTAL BIOLOGY

Total teaching Hrs. - 60

NOTE:

1. 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.
5. The candidate has to answer all questions in the main answer book only.

Section –A (Teaching hours: 20)

Developmental Biology: Scope and Early Events

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

Section –B (Teaching hours: 20)


Developmental Biology: Pattern and Processes

1. Cleavage: Definition, planes and patterns among non-chordates and chordates, significance of cleavage, blastulation and morulation.
2. Fate maps, gastrulation, morphogenetic cell movements, significance of gastrulation.
3. Embryonic induction, primary organizer, differentiation and competence.
4. Development of chick up to 24 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 (Teaching hours: 20)

Developmental Biology: Dimensions

1. Regeneration.
2. Various types 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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Syllabus: B.Sc. Part-I (Pass Course)

Zoology Practical

Min. Marks: 18

4 Hrs. / Week

Max. Marks: 50/

I. Microscopic Techniques:

1. Organization 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-carmine, Aceto-orcein, 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 – processes and behavior in live state.

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.), *Miracidium*, *Sporocyst*, *Redia*, *Cercaria* and *Metacercarialarvae* of *Fasciola*; *Scolex*, T. S. mature proglottid of *Taenia*, *Cysticercus* larva.

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

III. Anatomy:

Earthworm: External features, general viscera, alimentary canal, reproductive system and nervous system.

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Cockroach: External features, appendages (wing and leg), mouth parts, alimentary canal, reproductive and nervous system.

IV. Study of the Following through Permanent Slide Preparation: *Paramecium*, *Euglena*, Foraminiferous shells, Sponge spicules, Sponginfibres, Gemmule, *Hydra*, *Obelia* colony and *Medusa*; Parapodium of *Nereis* and *Heteronereis*.

V. Exercises 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 testes,
3. Study of giant chromosomes in salivary glands of *Chironomus* larvae or *Drosophila*
4. Study of cell permeability using mammalian R.B.Cs.
5. Permanent slides of mitosis and meiosis (all stages).

VI. Exercises 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.

B. Identification of blood groups (A, B, O & Rh factor).


VII. Developmental Biology:

1. Study of development of frog/toad with the help of Charts/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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B.Sc. Part – I

Scheme of Practical Examination and Distribution of Marks

Time: 4 Hrs.

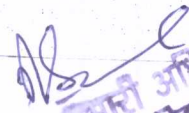
Min Pass Marks: 18

Max. Marks: 50.

	Regular	Ex. /N.C. Students
1. Anatomy (any system)	3/5	3/6
2. Permanent Preparation	5/7	7/9
3. Cell Biology and Genetics	5+5/6+6	6+6/8+8
4. Developmental Biology	6/7	6/9
5. Identification and comments on Spots (1 to 8)	16/24	16/24
6. Viva Voce	5/10	5/10
7. Class Record	5/10	-
	50/75	50/75

Notes:

1. With reference to anatomy, study of museum specimens and developmental biology, candidates must be well versed in the study of various systems with the help of dissections / 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.
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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Recommended Books:

1. Batinsky B. I. and Fabian BC: Introduction to Embryology. CENGAGE Learning 2012.
2. Barrington EJW: The Biology of Hemichordata and Protochordata. Oliver & Boyd, London 1965.
3. Berril N. J: Development Biology. Tata McGraw Hill. 1971.
4. Colbert EH: Evolution of the Vertebrates. 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 Animals Through Time. 5th edition Wiley Liss 2001.
6. Costanzo LS: Physiology 4th edition Saunders Inc. 2009.
Costanzo LS: Physiology. 4th edition Saunders Inc. 2009.
7. Davenport R: An Outline of Animal Development. Addison-Wesley Longman Inc. 1979
8. De Robertis EDP and De Robertis Jr FME. Cell and Molecular Biology. 8th edition Lippincot Williams & Wilkins. 2006.
9. Gasque CD Manual of Laboratory. Experiences Cell Biology. Mc Graw-Hill Professional Publishing 1989.
10. Gilbert SF and Singer SR: Development Biology. Sinauer Associates, 9th edition 2010.
11. Lodish H, Berk A, Kaiser CA, Krieger M, Scott MP, Bertscher A, Ploegh H, Matsudaira P: Molecular Cell Biology. 6th edition W.H Freeman and Company, New York, 2008.
12. 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.
13. Lodish H, Berk A, Matsudaira P, Kaiser CA, Krieger M, Scott MP, Zipursky SL, Darnell J: Molecular Cell Biology. 5th edition 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 edition WH Freeman & Company, New York, 2000.
15. Morgan DD: The Cell Cycle: Principles 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 Publishers.
19. Rastogi VB: Evolutionary Biology. Kedar Nath Ram Nath Education Publisher.
20. Singh SP and Tomar BS: Cell Biology. 10th edition Rastogi Publications, Meerut, New Delhi. 2014
21. Snustad DP and Simmons MJ: Principles of Genetics. 4th edition John Wiley & Sons, Inc., 2005.
22. Verma PS. A Manual of Practical Zoology: Invertebrates. S. Chand & Co. Ltd. New Delhi. 1971.
23. Verma PS and Agarwal VK: Chordate Embryology: Development Biology. S. Chand & Company Ltd. 2012.
24. Verma PS and Agarwal VK: Cell Biology. Genetics, Molecular Biology, Evolution and Ecology. 14th edition, S. Chand 2004.
25. Winchester AM: An Introduction to Genetics. Barners & Noble, Canada, 2002.
26. Winchester AM: Genetics: A Survey of Principles of Heredity. Oxford & IBH Publishing Co., 1967.
27. Winchester AM: Human Genetics. Ohio Charles E. Merrill Publishing Co., 1971.