

**S. S. Jain Subodh PG (Autonomous) College
Rambagh Circle, Jaipur -302004**

SYLLABUS

For

Bachelor of Science (B.Sc. Pass Course)

Subject- Zoology

SCHEME OF EXAMINATION AND COURSES OF STUDY



FACULTY OF SCIENCE

DEPARTMENT OF ZOOLOGY

(Semester system, *w.e.f. Academic Year 2014- 17*)

B.Sc. - I Semester

Max.Marks (Theory): 150

Max. Marks (Practical):75

Nomenclature			External/ Theories	Internal / Theories	Total Max Marks	Total Min. Marks
ZOO 101	Paper I	Life and Diversity of Nonchordata-I	35	15	50	20
ZOO 102	Paper II	Developmental Biology	35	15	50	20
ZOO 103	Paper III	Cell Biology	35	15	50	20
					150	60
ZOO P I Practical: Based on Theory Papers Max Marks					75	
Practical			45	30	75	

B.Sc. - II Semester

Max.Marks (Theory): 150

Max. Marks (Practical):75

Nomenclature			External/ Theories	Internal / Theories	Total Max Marks	Total Mini. Marks
ZOO 201	Paper I	Life and Diversity of Nonchordata-II	35	15	50	20
ZOO 202	Paper II	Genetics	35	15	50	20
ZOO 203	Paper III	Molecular Biology	35	15	50	20
					150	60
ZOO P II Practical: Based on Theory Papers Max Marks					75	
Practical			45	30	75	

B. Sc. - III Semester

Max. Marks (Theory): 150

Max. Marks (Practical):75

Nomenclature			External/ Theories	Internal / Theories	Total Max Marks	Total Mini. Marks
ZOO 301	Paper I	Life and Diversity of Chordate-I	35	15	50	20
ZOO 302	Paper II	Microbiology & Parasitology	35	15	50	20
ZOO 303	Paper III	Physiology -I	35	15	50	20
					150	60
ZOO P III Practical: Based on Theory Papers Max Marks					75	
Practical			45	30	75	

B. Sc. - IV Semester

Max. Marks (Theory): 150

Max. Marks (Practical):75

Nomenclature			External/ Theories	Internal / Theories	Total Max Marks	Total Mini. Marks
ZOO 401	Paper I	Life and Diversity of Chordate-II	35	15	50	20
ZOO 402	Paper II	Biochemistry	35	15	50	20
ZOO 403	Paper III	Physiology II	35	15	50	20
					150	60
ZOO P IV Practical: Based on Theory Papers Max Marks					75	
Practical			45	30	75	

B. Sc.- V Semester

Max.Marks (Theory): 150

Max. Marks (Practical):75

Nomenclature			External/ Theories	Internal / Theories	Total Max Marks	Total Mini. Marks
ZOO 501	Paper I	Ethnology	35	15	50	20
ZOO 502	Paper II	Instrumentation & Bioinformatics	35	15	50	20
ZOO 503	Paper III	Immunology & Biotechnology	35	15	50	20
					150	60
ZOO P V Practical: Based on Theory Papers Max Marks					75	
Practical			45	30	75	

B. Sc. - VI Semester

Max.Marks (Theory): 150

Max. Marks (Practical):75

Nomenclature			External/ Theories	Internal / Theories	Total Max Marks	Total Mini. Marks
ZOO 601	Paper I	Evolution & Biostatistics	35	15	50	20
ZOO 602	Paper II	Economic Zoology	35	15	50	20
ZOO 603	Paper III	Ecology & Environmental Biology	35	15	50	20
					150	60
ZOO P VI Practical: Based on Theory Papers Max Marks					75	
Practical			45	30	75	

Examination Scheme for each Paper

Part A 7 QUESTIONS (very short answer Questions)	7X 1 MARK EACH = 7 Marks
Part B 4 QUESTIONS (1 question from each unit with Internal choice)	4X 7 MARK EACH = 28 Marks
Total of End semester exam (duration of exam 3 hours)	= 35 Marks
Internal assessment	= 15 Marks
Maximum Marks (Each theory paper)	= 50Marks
Max. Practical Marks	= 75 Marks
(Internal Marks 30+ external marks 45)	
Total of Theory Papers: 3 X 50 Marks Each	= 150 Marks
(Min. Pass Marks 40%)	
Total of Practical Marks	= 75 Marks
Grand Total of Subject per Semester	= 225 Marks
Examination Scheme for each Paper	

Semester- I

THEORY

Paper I

ZOO-I01: [Life and Diversity of animals - Nonchordata-I]

Duration: 3 hrs.

Max. Marks: 35

Note: There will be two parts in end semester theory paper.

Part A of the paper shall contain 7 short answer questions of 7 marks. Each question will carry one mark for correct answer.

Part B of the paper will consist of four questions, one question from each unit with internal choice. Each question will carry 7 marks.

Unit I:

[6 Hours]

Principles of Taxonomy:

1.1 Nomenclature system, Binomial nomenclature, Trinomial nomenclature, Rules of nomenclature

1.2 Concept of five kingdoms, Levels of Organisation, Basis of classification (Number of Cells, Symmetry, Coelom, Embryogeny, Segmentation)

Unit II:

[10 Hours]

2.1 Phylum Protozoa

Salient features and classification of Protozoa up to Class

Type study – Paramecium (Salient Features, Locomotion, Nutrition and Reproduction)

2.2 Phylum Porifera

Salient features and classification of Porifera up to Class

Type study- Sycon

Canal system of Sponges

Skeletal System

Economic Importance

Unit III

[6 Hours]

3.1 Phylum Coelenterata

Salient features and classification of Coelenterata up to Class

Type study – Obelia

Polymorphism, Alternation of Generation

Coral Reefs

UNIT IV

[8 Hours]

4.1 Phylum Platyhelminthes

Salient features and classification of Platyhelminthes up to Class

Type study- Taenia(External features and life cycle)

Type study- Fasciola (External Features and Life Cycle)

4.2 Phylum Nematelminthes

Salient features and classification of Nematelminthes up to Class

Ascaris (External features and life cycle)

Semester I

THEORY

Paper II

ZOO-102: [DEVELOPMENTAL BIOLOGY]

Duration: 3 hrs.

Max. Marks: 35

Note: There will be two parts in end semester theory paper.

Part A of the paper shall contain 7 short answer questions of 7 marks. Each question will carry one mark for correct answer.

Part B of the paper will consist four questions one question from each unit with internal choice. Each question will carry 7 marks.

UNIT-I

(6 Hours)

- 1.1 Historical review and Scope of embryology
- 1.2 Gametogenesis: Spermatogenesis, Structure of sperm, Oogenesis, Structure of egg, Types of eggs

UNIT-II

(9 Hours)

- 2.1 Fertilization- Approximation of Gametes, Capacitation and contact, Acrosomal Reactions, activation of ovum, Migration of Pronuclei and amphimixis and Significance
- 2.2 Parthenogenesis
- 2.3 Planes and Patterns of cleavage, Blastulation, Gastrulation, Morphogenetic Movements, Fate Map

UNIT-III

(8 Hours)

- 3.1 Concept of embryonic induction; Primary organizers differentiation and competence.
- 3.2 Extra embryonic membranes, Type and physiology of Placenta
- 3.4 Structure of hen's egg, Development of chick up to 96 hrs stage.

UNIT-IV

(8 Hours)

- 4.1 Stem cells: Sources, types and their use in human welfare; Cloning
- 4.2 Elementary Idea of Teratogenesis
- 4.3 Elementary Idea of Artificial insemination, cryopreservation, amniocentesis, IVF, Embryo transfer-Test tube babies, GIFT, ZIFT and Bioethics

Semester I

THEORY

Paper III

ZOO-103: [Cell Biology]

Duration: 3 hrs.

Max. Marks: 35

Note: There will be two parts in end semester theory paper.

Part A of the paper shall contain 7 short answer questions of 7 marks. Each question will carry one mark for correct answer.

Part B of the paper will consist of four questions, one question from each unit with internal choice. Each question will carry 7 marks.

Unit – I

(9 Hours)

- 1.1 Introduction to cell: Size, shape, ultra structure and characteristics of prokaryotic and eukaryotic cell, Cell theory
- 1.2 Plasma membrane: Structure- Fluid Mosaic Model and functions
- 1.3 Passive and active transport
- 1.4 Endoplasmic reticulum: Types, Ultra structure and functions
- 1.5 Golgi complex: Ultra structure and functions

Unit – II

(6 Hours)

- 2.1 Structure and Function of mitochondria; Mitchel's Hypothesis, Electron Transport Chain, Oxidative Phosphorylation, Krebs's cycle
- 2.2 Peroxisome
- 2.3 Lysosome: Structure, polymorphism and functions

Unit – III

(9 Hours)

- 3.1 Cytoskeleton: Organization and functions of Centrosome, Cilia and Flagella
- 3.2 Cell-cell communication: types of Cell Junctions
- 3.3. Cell proliferation: Events in different phases of cell cycle

Unit – IV

(9 Hours)

- 4.1 Ribosome: Structure, Types, Lake's model and functions
- 4.2 Somatic cell division/ Mitosis (Different Phases and Significance)
- 4.3 Meiosis (different phases and significance), Synaptonemal complex
- 4.4 Elementary idea of Cellular ageing cell death and Cancer

Semester I

Zoology Practical

Paper Code: ZOO- PI [PRACTICAL Based on paper I, II and III]

Max. Practical Marks = 75 Marks

Internal Marks = 30 Marks

External Practical Exam.(Duration : 3 hrs.) = 45 Marks

Note: Out of the following experiments, 8 experiments must be done by the students.

(4 hrs per week)

Notes:

1. With reference to whole mounts and museum specimens, in case of unavailability of certain animal types, diagrams, photographs, models and digital techniques etc. should be substituted. Study will include classification (up to orders) with diagnostic characters and comments.
2. Candidates will keep a record of all work done in the practical class.

Section A: Life and Diversity of Animals- Nonchordata – I (Protozoa to Aschelminthes)

I. Microscopic Techniques

- I. Organisation and working of optical microscopes: Dissecting and Compound Microscope
- II. general methods of microscopical permanent preparations:
 - a. Fixatives and Preservatives- Formalin, Bouin's Fluid
 - b. Stains- Borax carmine, Acetocarmine, Acetoorcein, Haematoxyline, Eosin
 - c. Common Reagents: Normal saline, Ringer's solution, Acid water, Acid alcohol , Mayer's egg albumin

II. Study of museum specimens (Classification of animals up to orders)

- I. Protozoa: Euglena, Volvox, Elphidium (Polystomella), Foraminiferous shell, Monocystis, Opalina, Paramecium, Paramecium showing Binary fission, Paramecium Conjugation, Balantidium, Nyctotherus, Vorticella
- II. Porifera: Sycon, Leucosolenia, Hyalonema, Euplectella, Spongilla
- III. Coelenterata : Obelia Colony & Medusa, Millepora, Physalia, Vellela, Aurelia, Alcyonium, Gorgonia, Pennatula, Metridium, Stone Corals
- IV. Platyhelminthes : Planaria, Fasciola, Taenia
- V. Aschelminthes : Ascaris, Dracunculus, Ancylostoma, Wuchereria

2. Study of Permanent Slides

- I. Porifera: Sponge gemmules, Sponge spicules, V.S. Sycon, T.S. Sycon,
- II. Coelenterata: Obelia medusa, Obelia Colony
- III. Platyhelminthes: Miracidium, Sporocyst, Redia and Cercaria, Metacercaria larvae of Fasciola, Hexacanth and Onchosphere larva of Taenia solium, Scolex of Taenia, Mature and gravid proglottids of Taenia solium

3. External features and Anatomy through audio visual presentation

- I. Cockroach: External features, Mouth parts, Digestive, nervous and reproductive system
- II. Earthworm: External Features, Digestive, nervous and reproductive system

4. Mounting

- I. Paramecium, Euglena
- II. Spicules, spongin fibres and Gemmules of Sponge
- III. Obelia colony

Section B: Developmental Biology

1. Study of development of chick with the help of

- a. Whole mounts: 18 Hours (Primitive streak stage), 21 hrs, 24 hours, 33 hrs, 48 hours 72 hours and 96 hours.
- b. Study of the embryo at various stages of incubation in vivo by making a window in egg shell.

Section C: Cell Biology

1. Study of pictures of ultra structure of prokaryotic cell & eukaryotic cell
2. Demonstration of mitotic cell division in onion root tips by squash method
3. Demonstration of meiosis through audio visual Presentation
4. Study of mitochondria in Buccal Epithelium

Semester I

Zoology Practical

Scheme of Practical Examination and Distribution of Marks

Time: 4 hrs.	Min Pass Marks: 27	Max. Marks: 75 External : 45
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1.	Permanent Preparation	05
2.	Exercise in Development Biology	06
3.	Exercise in Cell Biology	06
4.	Identification & Comments on spots (1 to 6)	18
5.	Viva Voce	5
6.	Class Record	5

Total		45
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List of Recommended Books

Life and Diversity of Animals – Non Chordates

1. Barnes, R. (1981). Invertebrate zoology. *W. B. Saunders Co*
2. Barrington, E. W. J. (1969). Invertebrate structure and function. *ELBS*
3. Barradaile L.A. & Potts F.A. The Invertebrate
4. Jordan, E. L. & Verma, P. S. Invertebrate Zoology. *S. Chand & Co.*
5. Kotpal, Agrawal & Khetrapal. Modern Text Book of Zoology - Invertebrates,
6. Puranik P.G. & Thakur R.S. Invertebrate Zoology
7. Majupuria T.C. Invertebrate Zoology
8. Dhama & Dhama. Invertebrate Zoology
9. Parker & Hashwell, Textbook of Zoology Vol. I (Invertebrates) A.Z.T.B.S. Publishers
10. R.L. Kotpal – Phylum Protozoa to Echinodermata (series), Rastogi and Publication, Meerut
11. Vidyarthi – Text Book of Zoology, Agrasia Publishers, Agra
12. Marshal & Williams. Text book of zoology.
13. Boolotin & Stiles. College zoology. *MacMillan*

Practical

14. A manual of Practical Zoology Invertebrates – P. S. Verma
15. Dr. S.S. Lal Practical Zoology Invertebrates 9th edition, Rastogi Publication Meerut & Distributors, New Delhi

Suggested Readings for Developmental Biology:

1. Gilbert, S. T. (2000). Developmental biology, 6th ed. *Sinauer, Sunderland.*
2. Hoar, W. S. (1983). General and comparative physiology. *Prentice Hall.*

3. Balinsky, B. I. (1976). An introduction to embryology, 6th ed. *W. B. Saunders & Co*
4. Prosser, C. L. Comparative animal physiology.
5. Saunders, J. W. Developmental biology: Patterns/Principles/Problems. MacMillan Publ.
6. Wilson, J. A. Principles of animal physiology. Collins MacMillan Publ.
7. Sandhu. T. B. of Embryology
8. Armugam. T. B. of Embryology
9. Pattern. Early Embryology of Chick
10. Verma & Agrawal. Chordate Embryology
11. Tomar. Chordate Embryology

Suggested Readings for Cell Biology:

1. Alberts et al (2001). Molecular biology of the cell. Garland publications.
2. De Robertis, E. D. P. & De Robertis, E. M. F. (1987). Cell and molecular biology. Lea & Febiger Intl. ed.
3. Powar, C. B. (1986). Cell biology. Himalaya Publ.
4. Burke, J. D. C. (1970). Cell biology. *William & Wilkins Co*
5. Dr. S.P. Singh, Dr. B.S. Tomar., Cell Biology 9th revised edition, Rastogi Publication, Meerut
6. Gupta P.K., Cell and Molecular Biology, Rastogi Publication, Meerut
7. Veer Bala Rastogi. Introduction to Cell Biology, Rastogi Publication, Meerut
8. Verma and Agrawal .Concepts of Cell Biology

Semester II

THEORY

Paper- I

ZOO-201: [Life & Diversity of Animals Nonchordata- II]

Duration: 3 hrs.

Max. Marks: 35

Note: There will be two parts in end semester theory paper.

Part A of the paper shall contain 7 short answer questions of 7 marks. Each question will carry one mark for correct answer.

Part B of the paper will consist of four questions, one question from each unit with internal choice. Each question will carry 7 marks.

Unit I:

[8 Hours]

Annelida: General characters and outline classification up to classes with examples.

Type-study: Morphology, Digestive, Excretory, Nervous & Reproductive systems of *Nereis*, leech

Arthropoda: General characters and outline classification up to classes with examples.

Type Study:

Prawn : - External characters, Skeletal, Digestive, Respiration, Nervous, Excretion & Reproductive systems.

Unit II:

[8 Hours]

Mollusca: General characters and outline classification up to classes with examples.

Type Study:

Pila,: External characters, Skeletal, Digestive, Respiration, Nervous, Excretion & Reproductive systems

Unio: External characters, Skeletal, Digestive, Respiration, Nervous, Excretion & Reproductive systems

Unit III:

[8 Hours]

Echinodermata: General characters and outline classification up to classes with examples.

Type Study: *Asterias* (External characters, Skeletal, Digestive, Respiration, Nervous, Excretion & Reproductive systems)

Hemichordata: General characters and outline classification up to classes with examples.

Salient features of *Balanoglossus*

Unit IV:

[8 Hours]

Metamerism in annelida and its significance

Mouth parts of arthropods; larval forms of crustaceans

Torsion

Water Vascular System.

Semester II

THEORY

Paper- II

ZOO-202: Genetics

Duration: 3 hrs.

Max. Marks: 35

Note: There will be two parts in end semester theory paper.

Part A of the paper shall contain 7 short answer questions of 7 marks. Each question will carry one mark for correct answer.

Part B of the paper will consist of four questions one question from each unit with internal choice. Each question will carry 7 marks.

Unit – I

(8 Hours)

- 1.1 Mendelism: Brief history of Genetics and Mendel's work, Mendelian Laws, their significance and current status
- 1.2 Genetic Interactions- Epistasis-dominant and recessive, codominance, incomplete dominance, complementary, supplementary, inhibitory, duplicate and Lethal genes
- 1.3 Multiple Allelic interactions: Inheritance of blood group and Rh factor

Unit –II

(8 Hours)

- 2.1 Linkage and crossing over: Basic concept, types and theories, elementary idea of Chromosome mapping
- 2.2 Sex determination – ZZ, XY, XO, ZW pattern, Sex determination in *Drosophila*, Sex determination in Human

Unit – III

(7 Hours)

- 3.1 Chromosomal aberrations: addition, deletion, duplication and inversion
- 3.2 Gene mutations- Spontaneous and induced mutations, mutagenic agents
- 3.3 Cytoplasm inheritance: Kappa particles in *Paramecium*, CO₂ sensitivity in *Drosophila*, milk factor in mice

Unit –IV

(9 Hours)

- 4.1 Disorders related to chromosomal number- Turner syndrome, Klinefelter's syndrome and Down's syndrome
- 4.2 Elementary idea of Thalassemia, Sickle Cell Anaemia, Phenylketonurea, Diabetes mellitus
- 4.3 Elementary idea of DNA fingerprinting, karyotyping

Semester II

THEORY

Paper- III

ZOO-203: Molecular Biology- II

Duration: 3 hrs.

Max. Marks: 35

Note: There will be two parts in end semester theory paper.

Part A of the paper shall contain 7 short answer questions of 7 marks. Each question will carry one mark for correct answer.

Part B of the paper will consist of four questions, one question from each unit with internal choice. Each question will carry 7 marks.

Unit – I

(7 Hours)

- 1.1 Interphase Nucleus: Organization, Ultrastructure and functions of Nucleus, Pore Complex, Nuclear Membrane
- 1.2 Nucleolus: Structure and functions
- 1.3 Chromosome: Ultrastructure and types, Chromosomal Organisation: Nucleosome Model, Solenoid Model,
- 1.4 Giant chromosomes: Lamp-brush and Polytene chromosome

Unit - II

(8 Hours)

- 2.1 DNA: Structure of DNA, Polymorphism of DNA (A, B, C, D and Z)
- 2.2 RNA: Structure of RNA, types of RNA, RNA as a genetic material
- 2.3 Prokaryotic and eukaryotic gene structure

Unit - III

(7 Hours)

- 3.1 DNA replication: Meselson and Stahl experiments, Mechanism of replication –origin of replication, concept of replication, directionality of replication, Role of enzymes in replication
- 3.2 Bacterial DNA Structure
- 3.3 Replication in Bacterial DNA

Unit IV

(8 Hours)

- 4.1 Genetic code: Characteristics of genetic code, Wobble hypothesis
- 4.2 Protein synthesis: Central Dogma; Transcription Mechanism in Prokaryotes, Transcription in Eukaryotes, Enzymes and factors of transcription;
- 4.3 Protein Synthesis: Elementary idea of the mechanism of translation
- 4.3 Gene regulation models: Lac Operon

Semester II

Zoology Practical

Paper Code: ZOO- PI [PRACTICAL Based on paper I, II and III]

Max. Practical Marks = 75 Marks

Internal Marks = 30 Marks

External Practical Exam.(Duration : 3 hrs.) = 45 Marks

Note: Out of the following experiments, 8 experiments must be done by the students.

(4 hrs per week)

Section A: Life and Diversity of Animals – (Annelida to Hemichordata)

1. Study of museum specimens (Classification of animals up to orders)

I. Annelida: Nereis, Heteronereis, Aphrodite, Chaetopterus, Arenicola, Pontobdella, Hirudinaria, Glossiphonia

I. Arthropoda: Peripatus, Lepus, Balanus, Sacculina, Squilla, Palemon, Eupagurus (hermit Crab), Carcinus (Crab), Scolopendra, Julus, Scorpion, Spider, Limulus, Cysticerca/Locust, Dragonfly Praying mantis, Queen Termite, Cymax, Moth/ Butterfly,

II. Mollusca : Chiton, Dentalium, Cyprea, Pila, Aplysia, Mytilus, Pincteda, Loligo, Sepia, Octopus, Nautilus

III. Echinodermata : Antedon, Asterias, Ophiothrix, Echinus, Holothuria

iv. Hemichordata : Balanoglossus

2. Study of permanent slides

I. Annelida: Parapodia of Nereis, T.S. of Leech through Buccal Cavity and Crop

II. Arthropoda: Crustacean Larvae- Nauplius, Zoea, Metazoea, Megalopa, Mysis

III. Mollusca: Veliger and Glochidium larvae, T.S. of Unio Shell

IV. Echinodermata: T.S. of arm of star fish

V. Hemichordata: Balanoglossus through collar and proboscis

3. Audiovisual demonstration

I. Prawn: Appendages, digestive, Nervous and Reproductive system, Statocyst, Hastate Plate

ii. Pila: Nervous system, Osphradium, Gills, Radula

4. Mounting- Study via chart / Model / Fig.

Daphnia, Hastate Plate, Statocyst of Prawn; Gill lamella, Osphradium and Radula of Pila

Section B: Genetics

1. Life cycle of Drosophila; Identification of male and female drosophila;. Study of mutants in Drosophila (Bar eye, white eye, yellow body, sepia eye, curled wing, vestigial wing)

2. Identification of blood groups & Rh. Factor

Section C: Cell Biology

1. Demonstration of salivary gland chromosome in Chironomous larva

2. Use of colchicine in arresting anaphase movement (onion root tips)

3. Study of cell permeability using mammalian RBCs.

Semester II

Zoology Practical

Scheme of Practical Examination and Distribution of Marks

Time: 4 hrs.	Min Pass Marks: 27	Max. Marks: 75
		External : 45
1.	Permanent Preparation from preserved materials	05
2.	Exercise in Genetics	06
3.	Exercise in Cell Biology	06
4.	Identification & Comments on spots (1 to 6)	18
5.	Viva Voce	05
6.	Class Record	05
Total		45

Suggested Readings:

1. Genetics; Winchester, A. M.; Oxford and IBH Publishing Co.
2. Cell and Molecular Biology; De Robertis and De Robertis; Saunders College.
3. Genetics; Strickberger W. M.; Prentice Hall of India.
4. Cell Biology; Powar, C.B; Himalayan Publishing House.
5. Principles of Genetics; Gardener, E. J.; Wiley eastern, New Delhi.
6. A Textbook of Genetics; Rastogi, V.B.; Ramnath and Kedarnath
7. Molecular Biology of the gene; Watson, J.D; Benzamin/ Cummings.
8. Biochemistry; Voet & Voet; John Wiley & Sons.
9. Cytology and Genetics. Dyansagar, C.R. Tata McGraw Hill Publ. Co. New Delhi.
10. Cell Biology : Dyson, R.D. Allen and Bacon, New York.
11. Cell Biology. Rastogi S.C. : Tata McGraw Hill Publ. Co. New Delhi.
12. Cell Biology and Genetics. Kohli, S. jain, S. and Ramesh Book Depot. Jaipur.
13. Cytology : Verma, P.S. and Agrawal V.K : S.Chand and Co. New Delhi.
14. Genetics. Verma, P.S. and Agrawal V.K. S.Chand and Co., New Delhi.
15. Cell Biology and Genetics; Kohli, K.S; Ramesh Book Depot
16. Genetics; Winchester, A.M; Oxford and IBH Publishing Co.
17. Cell and Molecular Biology; De Robertis and De Robertis; Saunders College.
18. Genetics; Strickberger; Macmillan, Prentice Hall of India.
19. Cell Biology; Powar, C.B; Himalayan publishing House.
20. Principles of Genetics; Gardener, E.,J; Wiley eastern, New Delhi.
21. A Textbook of Genetics; Rastogi, V.B.; Ramnath & Kedarnath.
22. Cell and Molecular Biology; Gerald Karp; John Wiley and Sons, inc
23. Molecular Biology of the cell; Bruce Alberts, Julian Lewis, James D. Watson; Garland Publishings

24. Cell and Molecular Biology; Phillip Sheeler Donald E. Bianchi; John Wiley and Sons. Invertebrate Zoology; Barns, R. D; W. B. Saunders Co.
25. Textbook of Zoology; Shivapuri, Jacob, D. and Vyas, D.K.; Ramesh Book Depot.
26. Text book of Invertebrate Zoology I; Sandhu, G.S and Bhaskar, H; Campus Books
27. Modern textbook of Zoology-Invertebrates; Kotpal; Rastogi Publications. Invertebrate Diversity of Life: Rounds H.
Genera
28. Zoology: Storer, T.I. and Using, K.L.: Tata McGraw Hill Publishing Co., New Delhi.
29. D. Reinhold, New York (Indian reprinting : Affiliated East West Press, New Delhi.)
30. The invertebrates. Vol.1. Protozoa through Ctenophora, Hyman, L.H. McGraw Hill Co., New York.
31. Student Text Book of Zoology. Vol.I.II and III. Sedgwick.A.
32. Text book of Zoology. Parker, T.J., Haswell. W.A.Macmillan Co., London.

Semester III

THEORY

Paper- I

ZOO-301: [Life and Diversity of animals – Chordata I]

Duration: 3 hrs.

Max. Marks: 35

Note: There will be two parts in end semester theory paper.

Part A of the paper shall contain 7 short answer questions of 7 marks. Each question will carry one mark for correct answer.

Part B of the paper will consist of four questions one question from each unit with internal choice. Each question will carry 7 marks.

Unit I: Protochordates

(7 Hours)

1.1 **Protochordata:** General characters and classification up to order

Type Study:

1.2 **Herdmania** : Morphology, digestive system, Nervous System and sense organs, Excretory System, Reproductive system, Ascidian tadpole larva

1.3 **Amphioxus** : Structure, digestive system, respiratory system, circulatory system, sense organs , excretory system

Unit – II [Agnatha and Pisces]

(7 Hours)

2.1 **Agatha:** General features of Agnatha and classification up to classes

Type study: General Features of Petromyzon, Ammocete Larva

2.2 **Pisces:** Classification of pisces upto classes; Difference between Chondrichthyes and Osteichthyes

Type Study: General Morphology and anatomy of Scoliodon

UNIT-III [Tetrapoda]

(8 Hours)

3.1 Amphibia: Classification and characters with suitable examples, adaptations for amphibious life

3.2 Reptilia: Classification and characters with suitable examples, difference between lizards and snakes

3.3 Aves: General classification and characters with important examples; difference between Ratitae and Carinatae

3.4 Mammalia-I: Classification and characters with suitable examples

Unit – IV [Miscellaneous]

(8 Hours)

4.1 Protochordates: General features and phylogeny of Urochordates & cephalochordates; Retrogressive metamorphosis

4.2 Pisces: Fins (structure and origin); Types of scales; Migration; Parental Care

4.3 Amphibia: Parental care; Neoteny & Paedogenesis.

Semester III

THEORY

Paper- II

ZOO-302: [Microbiology & Parasitology]

Duration: 3 hrs.

Max. Marks: 35

Note: There will be two parts in end semester theory paper.

Part A of the paper shall contain 7 short answer questions of 7 marks. Each question will carry one mark for correct answer.

Part B of the paper will consist of four questions, one question from each unit with internal choice. Each question will carry 7 marks.

Unit –I: Microbiology

(7 Hours)

- 1.1** The scope of Microbiology: Characterization, Classification and identification of Microorganisms.
- 1.2** History and landmark events in Microbiology: Working of A.V. Leeuwenhock, Louis Pasteur, Robert Koch, Germ Theory of diseases.
- 1.3** World of Microbes: General Morphology of Protozoa, fungi – Molds and Yeasts

UNIT-II: Bacteria

(7 Hours)

- 2.1** The World of Bacteria – Morphology of Bacteria; Difference between Gram-positive and Gram-negative Bacteria
- 2.2** Growth & nutrition: Microbial Nutrition, Growth and Control: Nutritional requirements (macro & micronutrients), Factors affecting growth of bacterial culture
- 2.3** Basic idea of Culture: Types of culture media, uptake of nutrients, Maintenance of pure cultures
- 2.4** Growth & Reproduction: Bacterial division, growth curve, generation time, measurement of growth. Asepsis, sterilization with physical and chemical agents; Reproduction- Asexual and sexual

UNIT-III: Other Microbes

(8 Hours)

- 3.1** Virus: Structure, Classification; Life Cycle- Lytic and Lysogeny; A Bacteriophage
- 3.2** Hepatitis: Structure and types of causative agent, Precaution, Prevention and Control
- 3.3** HIV and AIDS: Epidemiology, prevention, control and treatment
- 3.4** Applied Microbiology: Fermented Food production (Dairy Products, Alcoholic Beverages); Microbial spoilage and techniques of Food Preservation

UNIT-IV: Parasitology

(8 Hours)

- 4.1** Parasitic Protozoans: life cycle, pathogenesis and disease caused by Entamoebae; Plasmodium, Trypanosoma, Leishmania
- 4.2** Parasitic Helminths: life cycle, pathogenesis and disease caused by Paragonimus westermani, Trichinella spiralis
- 4.3** Epidemiology of infectious diseases with reference of Human:
 - Bacterial [Tuberculosis, Leprosy, Meningitis]
 - Fungal[any one]diseases
- 4.4** Antibiotics and other chemotherapeutic agents.

Semester III

THEORY

Paper- III

ZOO-302: [Physiology- I]

Duration: 3 hrs.

Max. Marks: 35

Note: There will be two parts in end semester theory paper.

Part A of the paper shall contain 7 short answer questions of 7 marks. Each question will carry one mark for correct answer.

Part B of the paper will consist of four questions, one question from each unit with internal choice. Each question will carry 7 marks.

Unit I [Respiration]

(7 Hours)

- 1.1 Mechanism and regulation of Respiration
- 1.2 Transport of oxygen and carbon dioxide, Respiratory Pigments
- 1.3 Respiratory quotient, Respiratory volumes and capacities
- 1.4 Respiratory Disorders and effect of smoking

Unit II [Circulation]

(8 Hours)

- 2.1 Body Fluid: Composition and functions of blood; Lymph composition & function; Blood Pressure, Regulation of Blood Pressure
- 2.2 Blood clotting – Intrinsic and extrinsic factors, Blood groups and Rh factor
- 2.3 Physiology of cardiac muscles, structure & function of heart; Human Cardiac Cycle; Cardiac Rhythm; Origin of Heart Beat; Regulation of Heart Beat
- 2.4 Elementary idea of Haemostasis, ECG, factors contributing to heart problems; Angioplasty; Angiography

Unit III [Nutrition and Digestion]

(7 Hours)

- 3.1 Balanced diet
- 3.2 Digestion and absorption of carbohydrates, proteins and fats
- 3.3 Hormonal regulation of gastrointestinal function
- 3.4 Vitamins- Fat soluble and water soluble vitamins; Sources, deficiency and diseases

Unit IV [Excretion]

(8 Hours)

- 5.1 Types of Nitrogenous waste products (ammonotelic, uricotelic, ureotelic)
- 5.2 Structure and function of kidney; Nephron; Renal blood supply
- 5.3 Mechanism of Urine formation in mammals; Counter Current Principle;
- 5.4 Hormonal control of renal function; Rennin- Angiotensin System, Micturition, Regulation of Body Fluids & Acid Base balance

Semester III

Zoology Practical

Paper Code: ZOO- 300 [PRACTICAL Based on paper I, II and III]

Max. Practical Marks = 75 Marks

Internal Marks = 30 Marks

External Practical Exam.(Duration : 3 hrs.) = 45 Marks

Note: Out of the following experiments, 8 experiments must be done by the students.

(4 hrs per week)

I. Study of Chordates:

A. Study of Specimen.

- a) **Protochordata:** Herdmania, Ciona, Salpa, Doliolum, Amphioxus
- b) **Lower Chordates:** Petromyzon, Myxine/Bdellostoma, Ammocete larva,
- c) **Pisces:** Sphyrna, Trygon (Sting ray), Pristis (Saw Fish), Raja (Skate), Torpedo, Chimaera (Rat Fish), Acipensor, Amia, Lepidosteus, Notopterus, Labeo, Clarius, Anguilla (eel), Exocoetus, Hippocampus, Echenesis Sucker Fish), Protopterus,
- d) **Amphibia:** Ichthyophis, Cryptobranchus, Ambyostoma (Tiger Salamander), Axolotl Larva, Salamandra, Proteus, Siren, Alytes, Pipa, Hyla, Rhacophorous (Flying Frog)

B. Study of Slides.

- a) Tadpole larva of Herdmania, Herdmania Spicules, T.S. of Amphioxus (Through Oral hood, Pharyngeal, Intestinal and Caudal regions)
- b) V.S. of Skin of Scoliodon, Amphibia

C. Mounting.

- a) Herdmania Spicules, Placiod Scale

D. Dissection: [Through demonstration by chart/ CAL/ Video]

- **Major:** Afferent branchial vessels; Efferent branchial vessels; Cranial nerves of Scoliodon.
- **Minor:** Internal Ear; Eye Muscles; Ampulla of Lorenzini

II. Microbiology and Parasitology

1. Preparation and use of culture media for microbes
2. Study of microbes in food material (milk, Curd etc.)
3. Staining procedure for parasites
4. Identification of Protozoan parasites from permanent slides.
 - Trypanosoma(epimastigote or trypomastigote form); Leishmania (promastigote and amastigote form); Plasmodium (sporozoites and signet ring); Giardia; Entamoeba (trophozoites);;
5. Identification and characterization of helminth parasites from permanent slides
 - Cercaria of Fasciola; Eggs of Schistosoma; Cyst of Echinococcus granulosus; Microfilarie of Wuchereria

I. Physiology:

1. Demonstration of ptyalin enzyme activity
2. Estimation of haemoglobin content; RBC Counting, WBC Counting; Haematocrit value and ESR of given blood sample
3. Histological Slides of mammalian T.S. of spinal Cord, stomach, duodenum, ileum, liver, lung, kidney



Semester III

Zoology Practical

Scheme of Practical Examination and Distribution of Marks

Time: 4 hrs.	Min Pass Marks: 27	Max. Marks: 75 External : 45
1.	Permanent Preparation/ Anatomy Study	05
2.	Exercise in Microbiology	06
3.	Exercise in Physiology	06
4.	Identification & Comments on spots (1 to 6)	18
5.	Viva Voce	05
6.	Class Record	05
Total		45

Suggested Readings:

Chordates:

1. Colbert's evolution of the vertebrates; Colbert, E.H; John Wiley & Sons
2. Text book of Chordate Zoology vol. II ; Sandhu, G.S. and Sandhu, G.S; Campus Books.
3. Modern text book of Zoology-Vertebrates; Kotpal, Rastogi Publication.
4. Vertebrate Zoology; Rastogi, V.B.; Ramnath & Kedarnath.
5. Young, O.Z.: The Life of Vertebrates, Oxford University Press, Oxford.
6. Young, J.Z.: The life of vertebrates. Oxford University Press London 1962(Low Priced Text Reprint English Language Book Society London, 1962).
7. Barrington, E.J.W.: The Biology Hemichordata & Protochordata Oliver & Boyd, London, 1965
8. Young J. Z : The life of mammals Oxford University Press London 1963

Parasitology:

1. Burton J Bogitsh Human Parasitology 3rd edition Elsevier.
2. Roberts, L. S. and J. Janovy, Jr. 2004. Foundations of Parasitology. 7th Edition. McGraw Hill, Boston.
3. Smith. Animal Parasitology 1996. Cambridge University Press.
5. Marr et al. Molecular Medical Parasitology 2003, Elsevier.
6. Lawrence R. Ash and Thomas C. Orihel. Atlas of Human Parasitology. American Society for clinical pathology press 5th edition, 2007.
8. Janet Amundson Romich. Understanding Zoonotic Diseases. 2007

9. Paul Schmid-Hempel. The Integrated Study of Infections, Immunology, Ecology, and Genetics (Oxford Biology), 2011

Microbiology

1. Mani,A., Selvaraj, A.M., Narayanan, L.M. & Arumugam, N. 1996 : Microbiology – saras publications – Nagercoil-India.
2. Sharma, P.D. 1998: Microbiology – Rastogi Publ. Meerut, India
3. Subba Rao, N.S., 1999: Soil Microbiology, Oxford IBH Co. New Delhi, India.
4. Sullia,S.B. & Santharam,S. 2004-General Microbiology, Oxford IBH, India.
5. Meenakumari, S. Microbial Physiology, MJP-Publ.-Chennai, India.
6. Purushotam Kaushik, 2005: Microbiology –S.Chand & Co. New Delhi, India
7. Vijaya Ramesh, 2005: Environmental Microbiology, MJP.Publ., Chennai, India
8. Vijaya Ramesh, 2007: Food Microbiology, MJP.Publ. Chennai, India.
9. Rajan,S. 2007: Medical Microbiology – MJP.Publ. Chennai, India.
11. Purohit, S.S. 2007: Microbiology - Agrobios Publ. India
12. Trivedi, P.C.2008: Applied Microbiology - Agrobios Publ. India
13. Prescott, 2009: Industrial Microbiology - Agrobios Publ. India
14. Parihar, L. 2008: Advances in Applied Microbiology - Agrobios Publ. India
15. Agarwal,A.K.2008: Industrial Microbiology, Agrobios Publ. India.
16. Bohra, A. 2006: Food Microbiology, Agrobios Publ. India

Physiology:

1. Ganong: Review of Medical Physiology (22nd ed. 2005, Lange Medical)
2. Guyton and Hall: A text book of Medical Physiology (11th ed. 2006, Saunders).
3. Keele & Neil: Samson Wright's Applied Physiology (13th ed. 1989, Oxford)
4. K.V. Shastri : Physiology, Rastogi Publication, Merrut
5. William S. Hoar, 1976. General and Comparative Physiology, Prentice
6. Hall of India Pvt. Ltd., New Delhi - 110 001.
7. Wood, D.W., 1983. Principles of Animal Physiology 3rd Ed.,
8. Prosser, C.L. Brown 1985. Comparative Animal Physiology, Satish Book Enterprise, Agra - 282 003.
9. Wilson, J. A. Principles of animal physiology. Collins MacMillan Publ.
10. Chordate zoology and animal physiology. S. Chand and Co

Endocrinology

1. Hadley: Endocrinology (5th ed. 2000, Prentice Hall)
2. Turner and Bagnara: General Endocrinology (6th ed. 1984, Saunders)
3. Norris: Vertebrate Endocrinology, Fourth Edition, 2007, Academic Press

Semester IV

THEORY

Paper I

ZOO-40I: Life and Diversity of animals – Chordata II

Duration: 3 hrs.

Max. Marks: 35

Note: There will be two parts in end semester theory paper.

Part A of the paper shall contain 7 short answer questions of 7 marks. Each question will carry one mark for correct answer.

Part B of the paper will consist of four questions, one question from each unit with internal choice. Each question will carry 7 marks.

UNIT-I: Comparative Anatomy of Vertebrates-I

(7 Hours)

Comparative anatomy of the following organ systems of Scoliodon, Rana, Uromastix / Varanus, Collumba and Oryctolagus:

- 1.1 Integument and its derivatives.
- 1.2 Alimentary canal and accessory digestive glands.
- 1.3 Respiratory organs.

UNIT-II Comparative Anatomy of Vertebrates-II

(8 Hours)

Comparative anatomy of the organ systems of Scoliodon, Rana, Uromastix / Varanus, Collumba and Oryctolagus:

- 2.1 Heart, aortic arches and their evolution.
- 2.2 Brain and cranial nerves,
- 2.3 Comparative structure and evolution of urinogenital system (pro, meso and metanephric kidney and genital ducts in males and females).

Unit III: Comparative Anatomy of Vertebrates-III

(8 Hours)

Comparative anatomy of the organ systems of Scoliodon, Rana, Uromastix / Varanus, Collumba and Oryctolagus:

- 3.1 Osteology: Girdles, limb bones, Vertebrae, ribs and sternum; jaw suspension, Structure and types of vertebrae
- 3.2 Sense Organ: Comparative anatomy of eye
- 3.3 Sense Organ: Membranous labyrinth; sound production

Unit IV: Miscellaneous

(7 Hours)

4.1 Reptila: Poisonous and Non Poisonous Snakes of India; Snake Venom.

4.2 Aves: Flight Adaptation; Flight Muscles; Perching Mechanism

4.3Mammalia-I: Dentition; Adaptive radiation

Semester IV

THEORY

Paper II

ZOO-402: [Biochemistry and Endocrinology]

Duration: 3 hrs.

Max. Marks: 35

Note: There will be two parts in end semester theory paper.

Part A of the paper shall contain 7 short answer questions of 7 marks. Each question will carry one mark for correct answer.

Part B of the paper will consist of four questions, one question from each unit with internal choice. Each question will carry 7 marks.

Unit I: Carbohydrates and their metabolism

(7 Hours)

- 1.1 Biomolecule: Structure, types, function and properties of Carbohydrate
- 1.2 Metabolism: Glycolysis; fermentation; citric acid cycle; gluconeogenesis;
- 1.3 Glycogen metabolism (glycogenesis and glycogenolysis).

Unit II: Lipids and their metabolism

(8 Hours)

- 2.1 Biomolecule: Structure, types, function and properties of Lipid
- 2.2 Fatty acid; Triglycerides and Steroids
- 2.3 Metabolism: Biosynthesis and β -oxidation of saturated fatty acids, ketogenesis
- 2.4 Lipid Disorders: Ketosis, Lipidosis

Unit III: Proteins and their metabolism

(8 Hours)

- 1.1 Biomolecule: Amino acids; essential and non-essential amino acids
- 1.2 Biomolecule: Structure, types, function and general properties of Proteins; four levels of structures in proteins
- 1.3 Metabolism: Transamination, deamination, decarboxylation; urea cycle
- 1.4 Enzymes: Major classes, Basic mechanism of action, kinetics and factors affecting enzyme activities

Unit IV: Endocrine Glands and Disorders

(7 Hours)

Structure, biological actions and regulation of following endocrine glands:

- 4.1 Pituitary
- 4.2 Thyroid; Thymus
- 4.3 Adrenal; Pineal; Pancreas
- 4.4 Testes and Ovary

Semester IV

THEORY

Paper III

ZOO-403: [Physiology- II]

Duration: 3 hrs.

Max. Marks: 35

Note: There will be two parts in end semester theory paper.

Part A of the paper shall contain 7 short answer questions of 7 marks. Each question will carry one mark for correct answer.

Part B of the paper will consist of four questions, one question from each unit with internal choice. Each question will carry 7 marks.

Unit –I: Nerve and Muscle Physiology

(9 Hours)

1.1 Nerves: Types of neurons, E.M. structure of neuron; Myelinated and non-myelinated nerve fibres

1.2 Nerves: Resting and action potential; Conduction of nerve impulse; Types of synapses and chemical transmission; Reflex Arc and Reflex Action

1.3 Muscles: Ultra structure of striated muscle, Physiology of Muscle Contraction; sliding filament theory of muscle contraction; Neuromuscular Junction

1.4 Muscles: Properties of muscles (Twitch, Tetanus & Rigor mortis, Tonus, Summation, All or None Principle, Muscle fatigue, muscle dystrophies)

Unit II: [Sensory Physiology]

(8 Hours)

2.1 Structure of human eye; image formation and colour vision

2.2 Structure of human ear, mechanism of hearing

2.3 Elementary idea of EEG, MRI, CT-scan, mental health (epilepsy, neurosis, psychosis)

Unit III [Reproduction]

(6 Hours)

3.1 Oestrous and menstrual cycle

3.2 Male and female sex hormones

3.3 Causes of infertility in male and female

Unit IV [Hormones]

(7 Hours)

4.1. General mechanism of hormone action: Peptide hormone; Steroid hormone

4.2. Hypothalamo-hypophysial system: Structure

4.3 Neurohypophysial hormones – Oxytocin and Vasopressin

4.4 Hormones of the Adenohypophysis; Hypothalamic control of Adenohypophysis; Dwarfism; Acromegali

Semester IV

Zoology Practical

Paper Code: ZOO- 400 [PRACTICAL Based on paper I, II and III]

Max. Practical Marks = 75 Marks

Internal Marks = 30 Marks

External Practical Exam.(Duration : 3 hrs.) = 45 Marks

Note: Out of the following experiments, 8 experiments must be done by the students.

(4 hrs per week)

Section A: Study of Chordates:

A. Study of Specimen.

- a) **Reptilia:** Chelone, Trionyx, Testudo, Sphenodon, Hemidactylus, Draco, Phrynosoma, Chamaeleon, Typhlops, Python, Eryx (Sand Boa), Bungarus, Naja, Vipera, Hydrophis, Crocodylus, Alligator, Gavials
- b) **Aves:** Archeopteryx, Pavo cristatus, Psittacula (parrot), Great Indian Bustard, Saras crane
- c) **Mammals:** Echidna (Tachyglossus/ Spiny Anteater), Ornithorhyncus (Duck-billed Platypus), Macropus (Kangaroo), Bat, Loris, Manis, Herpestes (Mongoose)

B. Study of Permanent Slides.

- a. V.S. of Skin of Reptiles, Aves and Mammals

D. Osteology (Comparative study of amphibia to mammals articulated and disarticulated)

- a) Vertebrae.
- b) Limb bones.
- c) Girdles.
- d) Ribs.

E. Dissection:

- A Rat: External Feature, General anatomy, General Viscera [through chart/ video/ CAL]

Section B: Biochemistry

1. Biochemical detection of carbohydrates, proteins and lipids in a given sample
2. Calorimetric estimation of glucose / Protein in a given solution

Section C: Physiology II

I. Study of Permanent Slides

1. Histological Slides: Bone, Cartilage, Striated Muscle Fibre
2. Endocrine Glands: Pituitary, Thyroid, Parathyroid, Thymus, Adrenal cortex, Adrenal Medula, ovary, testis
3. To study the knee jerk reflex in man

Semester IV

Zoology Practical

Scheme of Practical Examination and Distribution of Marks

Time: 4 hrs.	Min Pass Marks: 27	Max. Marks: 75
		External : 45

1.	Permanent Preparation	05
2.	Exercise in Biochemistry	06
3.	Exercise in Physiology	06
4.	Identification & Comments on spots (1 to 6)	18
5.	Viva Voce	05
6.	Class Record	05

Total		45
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Suggested readings:

Biochemistry:

1. Stryer, I. (1988). Biochemistry II. *Freeman and Co.*
2. Plummer, L. (1989). Practical biochemistry. *Tata McGraw.*
3. Murray, R. K. *et al* (1995). Harper's biochemistry, 24th ed. *Prentice Hall.*
4. Lewin, B. (2000). Gene. *John Wiley & sons.*
5. Strikburger, M. W. (1994). Genetics. *Macmillan Publ. Co.*
6. Russel, P. J. (1998). Genetics. *The Benjamin Cummins Publishing Co.*
7. Lehninger (2004). Principles of biochemistry 4th ed.
8. Gilbert, F. (2000). Basic concepts in biochemistry: A student's survival guide. 2nd ed. *McGraw Hill*
9. Price, N. E. & Stevens, L. (1982). Fundamentals of enzymology. *OUP*

Physiology:

11. Ganong: Review of Medical Physiology (22nd ed. 2005, Lange Medical)
12. Guyton and Hall: A text book of Medical Physiology (11th ed. 2006, Saunders).
13. Keele & Neil: Samson Wright's Applied Physiology (13th ed. 1989, Oxford)
14. K.V. Shastri : Physiology
15. William S. Hoar, 1976. General and Comparative Physiology, Prentice

Semester V

THEORY

Paper I

ZOO-501 [Ethology]

Duration: 3 hrs.

Max. Marks: 35

Note: There will be two parts in end semester theory paper.

Part A of the paper shall contain 7 short answer questions of 7 marks. Each question will carry one mark for correct answer.

Part B of the paper will consist of four questions, one question from each unit with internal choice. Each question will carry 7 marks.

Unit I: Concept of Ethology

[9 Hours]

- 1.1 Introduction and history of Ethology
- 1.2 Concepts and patterns of behaviour: FAP, Sign Stimulus, Innate Releasing Mechanism, Action Specific Energy, Concept of motivation
- 1.2 Instinct and Innate Behaviour, Imprinting
- 1.3 Learned behaviour and types of learning

Unit II: Study of Behaviour

[9 Hours]

- 2.1. Methods of studying Brain Behaviour: Neurotransmitter, Physiological and Neurochemical Technique
- 2.2 Genetic basis of behaviour
- 2.3 Control of behaviour: Neural control, Hormonal control
- 2.4 Elementary idea of role of Pheromones

Unit III: Social Organisation

[6 Hours]

- 3.1 Communication in primates
- 3.2 Living in groups: Characteristics and advantages with respect to Honey bee, Deer, monkey
- 3.3 Eusocial organization: Termites and Ants
- 3.4 Migration in Birds; Orientation and Navigation

Unit IV Biological Rhythms

[6 Hours]

- 4.1 Faunal diversity in India and World; Endangered Mammals and Birds of India
- 4.2 Wild life Conservation with reference to India & Rajasthan
- 4.3 National Parks, Sanctuaries and Biosphere Reserves of India
- 4.4 Wildlife Management efforts by Government and Non-Government Organizations

Semester V

THEORY

Paper II

ZOO-502: [Biotechniques, Instrumentation and Bioinformatics]

Duration: 3 hrs.

Max. Marks: 35

Note: There will be two parts in end semester theory paper.

Part A of the paper shall contain 7 short answer questions of 7 marks. Each question will carry one mark for correct answer.

Part B of the paper will consist of four questions, one question from each unit with internal choice. Each question will carry 7 marks.

Unit –I: Biotechniques

(8 Hours)

1.1 Concepts of sterilization: Filtration, autoclaving, dry heat sterilization, wet sterilization and radiation

1.2 Separation of biomolecules: Centrifugation (Sedimentation, density gradient); Chromatography (Elementary idea of Paper – ascending and Circular, thin layer, gel filtration and ion exchange- Principles and applications)

1.3 Electrophoresis: Agarose Gel Electrophoresis, SDS-PAGE

Unit-II: Micro Technique

(8 Hours)

2.1 Fixation, dehydration, clearing, embedding & section cutting

2.2 Difficulties encountered during section cutting (causes and remedies)

2.3 Double staining with Haematoxylin and Eosin

2.4 Histochemical staining techniques for carbohydrates (Periodic acid schiff), proteins (Mercury-bromophenol blue) and lipids (Sudan black-B)

Unit-III: Instrumentation

(5 Hours)

3.1 Microscope: Principle of Microscopy and types

3.2 Principles of colorimeter

3.3 Principles of spectrophotometers

Unit-IV: Bioinformatics

(9 Hours)

4.1 Bioinformatics: Definition, Scope, Basic concepts in bioinformatics, importance and role of bioinformatics in life sciences

4.2 Bioinformatics databases- introduction, types of databases

4.3 Nucleotide sequence databases, Elementary idea of protein databases

4.4 BLASTA, FASTA, PHYLOGENY TREE Analysis

Semester V

THEORY

Paper III

ZOO-503: [Immunology & Biotechnology]

Duration: 3 hrs.

Max. Marks: 35

Note: There will be two parts in end semester theory paper.

Part A of the paper shall contain 7 short answer questions of 7 marks. Each question will carry one mark for correct answer.

Part B of the paper will consist of four questions one question from each unit with internal choice. Each question will carry 7 marks.

Unit –I: (Basics of Immunology)

(9 Hours)

- 1.1. Characteristics of Immune System; Types of immunity: Active, passive, innate and acquired immunity
- 1.2. Antigens, Haptens, Antigenicity.
- 1.3. Types of antibodies and their structure and function.
- 1.4. Mechanism of Antigen Antibody reactions: Precipitation, agglutination, Neutralisation, Opsonization, Complement

Unit –II: (Cells and Organs in Immunity)

(8 Hours)

- 2.1 Immune Cells & Organs: B and T Lymphocytes, Plasma Cell, Null Cell, Primary and Secondary Lymphoid Organs; tonsils, adenoids, thymus, bone marrow, bursa fabricus, macrophages
- 2.2 Mechanism: Humoral and Cell- Mediated Immunity.
- 2.3 Complement System, Interferons, Vaccines
- 2.4 Elementary idea of Immune disorders & Techniques: Basic Idea of Auto Immune Diseases, Organ Transplant: (Allograft, Xenograft, Autograft), Major histocompatibility Complex

Unit –III: (Biotechnology)

(7 Hours)

- 3.1 History, Scope and application of recombinant DNA technology; Genetic Engineering
- 3.2 Basic concepts in recombinant DNA technology, cDNA Library; DNA manipulation enzymes (Nucleases, Ligases, Polymerases)
- 3.3 Vectors for Gene Transfer (Plasmids and Phages)

Unit –IV: (Applications of Biotechnology)

(6 Hours)

- 4.1 Monoclonal antibodies and their production and applications
- 4.2 Protoplast Fusion and their Application
- 4.3 Environmental Biotechnology: Metal recovery; Petroleum recovery; Pest Control; Waste Water Treatment
- 4.4 Biotechnology in Medicine and health: Antibiotics, Vaccines, Enzymes, Vitamins, Steroids, Artificial Blood, PCR

Semester V

Zoology Practical

Paper Code: ZOO- 500 [PRACTICAL Based on paper I, II and III]

Max. Practical Marks = 75 Marks

Internal Marks = 30 Marks

External Practical Exam.(Duration : 3 hrs.) = 45 Marks

Note: Out of the following experiments, 8 experiments must be done by the students.

(4 hrs per week)

Section A: Ethology

1. Locomotory behaviour of (Tribolium):
 - Effects of light intensity and light quality on the rate of locomotion
2. Study of individual and social behavioural patterns of a troop of monkey through visual aids
3. Antenal Grooming in Cockroach

Section B: Biotechniques, Instrumentation & Bioinformatics

1. Separation of amino acids by paper chromatography and TLC
2. Separation of proteins by electrophoresis technique
3. Double staining method
4. Demonstration of carbohydrates, proteins and lipids by histochemical methods
5. Introduction to basic laboratory instruments and equipments- Autoclave, Centrifuge, pH meter, Micropipettes, Digital balance, Homogenizer, Electrophoresis apparatus; Molar and normal solutions calculations
6. Use of internet for survey of literature using protein and nucleotide databases(NCBI)
7. Use of softwares like Microsoft offices, BLASTA, FASTA

Section C: Immunology & Biotechnology

1. Antigen – Antibody interaction by double diffusion method (Ouchterlony)
2. Study of histological slides of organs of immune system – Thymus, Lymph nodes and Spleen
3. Isolation of DNA/ Plasmid (Genomic DNA from any available source) by phenol extraction method.

Semester V

Zoology Practical

Scheme of Practical Examination and Distribution of Marks

Time: 4 hrs.	Min Pass Marks: 27	Max. Marks: 75 External : 45
1.	Experiment in Ethology	3
2.	Exercise in bioinformatics	6
3.	Exercise in Immunology /Biotechnology	8
4.	Identification & Comments on spots (1 to 6)	18
5.	Viva Voce	5
6.	Class Record	5
Total		45

List of Recommended Books:

Biotechnology

1. Elements of Biotechnology – Gupta
2. T. B. of Biotechnology – Dubey
3. Modern Concept of Biotechnology – Kumar H. D
4. Advances in Biotechnology – Jogdand
5. T. B. of Biotechnology – Chatwal

Biotechnique and Microtechnique

1. Animal Tissue Technique – Humason
2. Histological Technique – Devaenport
3. Microtechnique – Jiwaji&Patki
4. Microtechnique – Wankhede
5. Biophysical Chemistry – Upadhyay, Upadhyay and Nath
6. Techniques in Life Sciences – D. B. Tembhare

Bioinformatics

1. Mount W. 2004. Bioinformatics and Sequence Genome Analysis 2nd Editon CBS Pub. New Delhi.
2. Bergman, N. H. Comparative Genomics. Humana Press Inc. Part of Springer Science+BusinessMedia, 2007.
3. Baxevanis, A. D. Ouellate, B. F. F. 2009. Bioinformatics: A Practical Guide to the

Analysis of Genes and Proteins. John-Wiley and Sons Publications, New York.

4. Campbell A. M. and Heyer, L. J. 2007. Discovering Genomics, Proteomics and Bioinformatics, 2nd Edition. Benjamin Cummings.

5. Des Higgins and Willie Taylor 2000. Bioinformatics: Sequence, Structure and Databanks. Oxford University Press.

6. Rashidi H. H. and Buehler 2002. Bioinformatics Basics: Applications in Biological Science and Medicine, CRC Press, London.

7. Gibas Cynthia and Jambeck P. 2001. Developing Bioinformatics Computer Skills: Shroff Publishers and Distributors Pvt. Ltd. (O'Reilly), Mumbai.

Semester VI

THEORY

Paper I

ZOO-601: Evolution and Biostatistics

Duration: 3 hrs.

Max. Marks: 35

Note: There will be two parts in end semester theory paper.

Part A of the paper shall contain 7 short answer questions of 7 marks. Each question will carry one mark for correct answer.

Part B of the paper will consist four questions one question from each unit with internal choice. Each question will carry 7 marks.

Unit –I: Evolution

[8 Hours]

1.1 Basics and origin of life: Definition, pre-darwinian theories of evolution; Oparin-Haldane concept of origin of life; Miller- Urey experiment

1.2 Micro-evolution: Lamarckism; Darwinism; Neo-Darwinism

1.3 Evidences of evolution: Various evidences favouring evolution: Homology, analogy, vestigial organs; palaeontological, embryological, biogeographical and biochemical evidences

1.4 Product of Evolutionary Process: Speciation, concept of species, sub species, isolation mechanisms, modes of speciation (allopatric, sympatric, peripatric)

UNIT II: Evolution II

[8 Hours]

2.1 Macro-evolution: Geological time scale, Continental Drift

2.2 Genetic basis of evolution: Hardy-Weinberg law, Gene Frequency, genetic drift, factors affecting Hardy-Weinberg law, Sewall -Wright effect;

2.3 Variation, Adaptations and Isolation, Mimicry

2.4 Fossils; Evolution of Man

UNIT III: Biostatistics Concept

[7 Hours]

3.1 Biostatistics : Definition and Scope

3.2 Census and sampling methods

3.3 Collection and Tabular Presentation of Data: Tabulation of data; Frequency Distribution Table; Continuous and Discontinuous Series

3.4 Graphical Presentation of Data: Bar, Histogram, Line graph, Polygon, Pie Diagrams
Ogives

UNIT IV: Biostatistical Tools

[7 Hours]

3.1 Measures of Central tendency: mean, median mode

3.2 Measures of Dispersion, Mean deviation & Standard deviation, Standard error.

3.3 Probability

Semester VI

THEORY

Paper II

ZOO-602: [Economic Zoology]

Duration: 3 hrs.

Max. Marks: 35

Note: There will be two parts in end semester theory paper.

Part A of the paper shall contain 7 short answer questions of 7 marks. Each question will carry one mark for correct answer.

Part B of the paper will consist four questions one question from each unit with internal choice. Each question will carry 7 marks.

Unit I: Economic Entomology- Insects of economic importance

(7 Hours)

1.1 Sericulture: Types of Silkworm. Life cycle and rearing of Bombyx mori; Brief idea of cocoon processing for silk fabric cocoon boiling, reeling, winding, doubling, twisting and weaving

1.2 Apiculture – Types of honey bees, Life cycle and culture, bee product and its economic importance

1.3 Lac culture – Lac insect, Laccifer lacca - Life cycle, Lac processing, Lac products and Economic Importance

Unit-II: Economic Entomology

(7 Hours)

2.1 Chemical control of Insecticides: Pyrethroids, Carbamate and HCN (mode of action, merits and demerits)

2.2 Biological control of Pests: Biological agents (predators and parasites; merits and demerits)

2.3 Crop pest: Life cycle, damage and control of

I. Cotton spotted boll worm -Eariasvitella

II. Stored grain pest- Rice Weevil, Sitophilus oryzae

2.4 Animal pest: Life cycle, damage and control of

I. House fly – Musca nebulosa

II. Stable fly – Stomoxys calcitrans

Unit III: Economics of aquaculture

[8 Hours]

3.1 Pisciculture – Techniques of induced breeding; Edible Fishes; By-Products of Fishing and its commercial values

3.2 Prawn culture -Culture techniques of fresh water Prawn (Macrobrachium rosenbergii) & Marine water Prawn (Penaeus monodon)

3.3 Pearl culture: Formation and nature of Pearls – Commercial importance of Pearl Culture in India.

Unit IV: Economic importance of other animals

[8 Hours]

4.1 Vector borne diseases. A brief account of insect vectors affecting the health of man and domestic animals

4.2 Animal husbandry: Introduction to common dairy animals; Techniques of dairy management

4.3 Vermiculture: Vermitechnology, Bio-Fertilizers

4.4 Future strategies for Livestock Development: Transgenic Animal Technology; Genetic improvement for best breeds; Economic importance of Dairy, Leather, Wool, Fur

Semester VI

THEORY

Paper III

ZOO-603: [Ecology and Environmental Biology]

Duration: 3 hrs.

Max. Marks: 35

Note: There will be two parts in end semester theory paper.

Part A of the paper shall contain 7 short answer questions of 7 marks. Each question will carry one mark for correct answer.

Part B of the paper will consist of four questions, one question from each unit with internal choice. Each question will carry 7 marks.

Unit I: Atmosphere

[7 Hours]

- 1.1 Atmosphere: Major zones and its importance, Composition of air
- 1.2 Hydrosphere: Global distribution of water, Physico-chemical characteristics of water
- 1.3 Lithosphere: Soil Layer; formation of soil
- 1.4 Light: As Abiotic factor; Physico- chemical characteristics of Light; Photoperiodism

Unit II: Ecosystem

[10 Hours]

- 2.1 Ecosystem: Definition, Structure and functions; Types of Ecosystem; Food chain, Food web and ecological pyramids
- 2.2 Ecosystem: Biogeochemical Cycle (O₂, CO₂, N, P, S); Energy flow in an ecosystem, Y – shape and Universal model, Gause's Exclusion principle
- 2.3 Population Dynamics: Population characteristics, Population growth patterns: (exponential/Malthusian and sigmoid growth patterns)
- 2.4 Community: Structure and Components of Community, Community Stratification, Niche, Ecotone/ Edge Effect, Ecological Indicators, Succession; Climax Community

Unit III: Biodiversity & Conservation

[6Hours]

- 3.1 Biodiversity and its conservation; Major Biomes
- 3.2 Ex situ and In situ Conservation; Alpha, Beta and Gama Diversity; Causes of reduction of Biodiversity
- 3.3 Wildlife conservation acts (1972 and 1984)
- 3.4 Hot spots of biodiversity in India, Biosphere Reserves of India

Unit IV: Pollution

(7 Hours)

- 4.1 Sources, effect and control measures of air pollution, Acid rain, green house effect, Ozone depletion and global warming
- 4.2 Sources, effect and control measures of water pollution
- 4.3 Sources effect and control measures of noise pollution
- 4.4 Toxic effect of heavy metals (lead, cadmium and mercury)

Semester VI

Zoology Practical

Paper Code: ZOO- 600 [PRACTICAL Based on paper I, II, III]

Max. Practical Marks = 75 Marks

Internal Marks = 30 Marks

External Practical Exam. (Duration: 3 hrs.) = 45 Marks

**Note: Out of the following experiments, 8 experiments must be done by the students.
(4 hrs per week)**

Section A: Evolution and Biostatistics

1. Construction of frequency table, histograms, Polygons, Pie Charts
2. Exercise on Mean, Mode, Median, Std. Deviation, Std. error, Probability

Section B: Economic Zoology

1. Study of the following prepared slides/specimens: Honey Bee, Silk Worm, Termite, Earthworm types (any two) -(Drawida modesta, Pheretima posthuma ; Fish parasites, Larvivorous fishes (Guppy, Gambusia)
2. Economic importance of commonly occurring insect pests and preparation of life cycle of these pests.
3. Study of Beneficial insects and their life stages.

Section C: Ecology & Environmental Biology

1. Determination of population density in a terrestrial community or hypothetical community by quadrat method.
2. Study of life table and fecundity table, plotting of the three types of survivorship curves from the hypothetical data.
3. Estimation of pH, chlorides and water vapour quantity in soil
6. Estimation of Dissolved oxygen, Salinity, pH, free CO₂ in water samples
7. Plankton study in Fresh water
8. Study of natural ecosystem and field report; Visit to a National park and Sanctuary (candidates are required to submit the report of the visit)

Semester VI

Zoology Practical

Scheme of Practical Examination and Distribution of Marks

Time: 4 hrs.	Min Pass Marks: 27	Max. Marks: 75 External : 30
2.	Experiment in Evolution / Biostatistics	5
3.	Exercise in Economic Zoology	6
4.	Exercise in Ecology	6
6.	Identification & Comments on spots (1 to 6)	18
7.	Viva Voce	5
8.	Class Record	5
Total		45

Suggested readings:

Evolution

1. Gupta, P.K., A Text Book of Cytology, Genetics and Evolution, Rastogi Publication, Meerut
2. Ridley, M. (2004) Evolution. III Editio. Blackwell Publishing
3. Stricberger, M.W. Evolution. Jones& Bartlett, USA 1996
4. Hall and Hallgrímsson: Strickberger's Evolution (2008, Jones and Bartlett)
5. Moody: Introduction to Evolution (1978, Kalyani).
6. Rastogi: Organic Evolution (2007, Kedarnath & Ramnath)

Statistics:

1. Probability and Statistics for Engineers and Scientists by Walpole, Myers, Myers and Ye, 7th Edition, Pearson Education.
2. Mathematical Statistics by Freund, Prentice Hall, India
3. Introduction to Statistical Quality Control by Montgomery, John Wiley and Sons.
4. Principles of Biostatistics by M. Pagano and K. Gauvreau: Thompson learning (2nd edition)
5. Biostatistics: A Foundation for Analysis in the Health Sciences by W. W. Daniel: John Wiley and Sons Inc (7th edition); Indian Reprint 2006.
6. Biostatistics by Satguru Prasad: Emkay Publication.

Economic Zoology:

1. Shukla and Upadhyaya : Economic Zoology (Rastogi Publishers, 1999-2000)
2. Shrivastava: Test book of Applied Entomology, Vol. I &II (Kalyani Publishers, 1991)
3. Mani: Insects, NBT, India, 2006.
4. Jabde: Text Book of Applied Zoology: Vermiculture, Apiculture, Sericulture, Lac culture, Agricultural Pests and their Control, 2005 Publisher Vedams eBooks (P) Ltd. New Delhi

Ecology & Environmental Biology

1. Odum, E. P. (1996). Ecology: A bridge between science and society. *Sinauer Associates Inc.*
2. Chapman, J. L. And Reiss, M. J. (1992). Ecology, principles and applications. *Cambridge University Press.*
3. Verma, P. S. & Agarwal, V. K. (1983). Environmental biology (principles of ecology). *S. Chand & Co.*
4. Singh, J. H. *et al* (2006). Ecology, environment and resource conservation. *Anamaya Publ. N. Delhi*
5. Kendeigh, S. C. Animal ecology. *Prentice Hall*
6. Kormondy, E. T. Concept of ecology. *Prentice Hall*