S.S. JAIN SUBODH P.G. COLLEGE, JAIPUR

(AN AUTONOMOUS INSITUTION)

SYLLABUS

For

Bachelorof Science (B.Sc. Hon.)

Subject-Zoology

SCHEME OF EXAMINATION AND COURSES OF STUDY

FACULTY OF SCIENCE

DEPARTMENTOFZOOLOGY

(Semestersystem, w.e.f.AcademicYear2023-26)

RambaghCircleJaipur-302004, Rajasthan(INDIA)
Callus Fax: +91-141-2574780, 2569850, 2565989, Fax: +91-141-2569126,
Web&Email:www.subodhpgcollege.com,admin@subodhpgcollege.com

I Semester (CBCS)
Max. Marks (Theory): 225
Max. Marks (Practical): 150

Paper Code	Paper No	Nomenclature	External / Theories	Internal / Theories	Total Max Marks
ZOH101	Paper I	Life and Diversity of Non-Chordata I	54	21	75
ZOH102	Paper II	Cell & Molecular Biology	54	21	75
ZOH103	Paper III	Fundamental of Genetics	54	21	75
Total Marks					**225**
ZOHP101	Practical	Practical Based on Theory papers	90	60	150

II Semester (CBCS)
Max. Marks (Theory): 225
Max. Marks (Practical): 150

Paper Code	Paper No	Nomenclature	External / Theories	Internal / Theories	Total Max Marks
ZOH201	Paper I	Life and Diversity of Non-Chordata II	54	21	75
ZOH202	Paper II	Genetics & Evolutionary Biology	54	21	75
ZOH203	Paper III	Biology of Parasitism	54	21	75
Total Marks					**225**
ZOHP201	Practical	Practical Based on Theory papers	90	60	150

III Semester (CBCS)
Max. Marks (Theory): 225
Max. Marks (Practical): 150

Paper Code	Paper No	Nomenclature	External / Theories	Internal / Theories	Total Max Marks
ZOH301	Paper I	Life and Diversity of Chordate	54	21	75
ZOH302	Paper II	Physiology & Biochemistry	54	21	75
ZOH303	Paper III	Basics of Radiation and Cancer Biology	54	21	75
Total Marks					**225**
ZOHP301	Practical	Practical Based on Theory papers	90	60	150

IV Semester (CBCS)
Max. Marks (Theory): 225
Max. Marks (Practical): 150

Paper Code	Paper No	Nomenclature	External / Theories	Internal / Theories	Total Max Marks
ZOH401	Paper I	Developmental Biology	54	21	75
ZOH402	Paper II	Ecology & Ethology	54	21	75
ZOH403	Paper III	Medical Entomology	54	21	75
Total Marks					**225**
ZOHP401	Practical	Practical Based on Theory papers	90	60	150

V Semester (CBCS)
Max. Marks (Theory): 225
Max. Marks (Practical): 150

Paper Code	Paper No	Nomenclature	External / Theories	Internal / Theories	Total Max Marks
ZOH501	Paper I	Research Methodology and Biostatistics	54	21	75
ZOH502	Paper II	Applied & Economic Zoology	54	21	75
ZOH503	Paper III	Microbiology & Immunology	54	21	75
Total Marks					**225**
ZOHP501	Practical	Practical Based on Theory papers	90	60	150

VI Semester (CBCS)
Max. Marks (Theory): 225
Max. Marks (Practical): 150

Paper Code	Paper No	Nomenclature	External / Theories	Internal / Theories	Total Max Marks
ZOH601	Paper I	Bioinstrumentation & Bio-techniques	54	21	75
ZOH602	Paper II	Environmental Toxicology	54	21	75
ZOH603	Paper III	Basics of Medical Diagnosis and Public Health	54	21	75
Total Marks					**225**
ZOHP601	Practical	Practical Based on Theory papers	90	60	150

Scheme for Choice Based Credit System in B.Sc. (Hons.) Zoology

S.No.	Subject Code	Course Title	Course Category	Credit	Contact Hours per Week	ESE Duration (Hrs.)
				L	T	P
SEMESTER-I						
1.	ZOH101	Life and Diversity of Non-Chordata I	DSC	3	3	-
	ZOH102	Cell & Molecular Biology	DSC	3	3	-
	ZOH103	Fundamental of Genetics	DSC	3	3	-
	ZOHP101	Practical Based on Theory papers	DSCP	6	-	12
SEMESTER-II						
2.	ZOH201	Life and Diversity of Non-Chordata II	DSC	3	3	-
	ZOH202	Genetics & Evolutionary Biology	DSC	3	3	-
	ZOH203	Biology of Parasitism	DSC	3	3	-
	ZOHP201	Practical Based on Theory papers	DSCP	6	-	12

Examination Scheme for Theory Paper

Part A

- Question 1 is compulsory and comprises seven very short questions from all units.
- Each question carries **2 marks**.
- Calculation: 7 × 2 marks each = **14 Marks**

Part B

- Comprises 4 questions (1 question from each unit with internal choice).
- Each question carries **10 marks**.
- Calculation: 4 × 10 marks each = **40 Marks**

Total of End Semester Exam (Duration of exam: 3 hours) = **54 Marks**
Internal Assessment = 21 Marks

Examination Scheme for Practical Paper

- **Max. Practical Marks = 150 Marks**
- **Internal Practical Examination = 60 Marks**
- **External Practical Exam** (Duration: 4 hrs.) = **90 Marks**

Distribution of Marks:

- Four practicals, one from each group = **15 Marks each = 60 Marks**
- Practical Record = **15 Marks**
- Viva-voce = **15 Marks**

Note:

1. Each candidate has to prepare his/her practical record.
2. Each candidate has to pass in Practical and Theory examination separately.

SEMESTER-I THEORY

PaperI-ZOO-101
[Life and Diversity of Non Chordata-I]

Max.Marks:75

Paper I (ZOO-101)

Life and Diversity of Non-Chordata I
Max Marks: 75
Credits: 3

Scheme of Examination:

Part A: Seven short answer questions of 7 marks (1 mark each).
Part B: Eight questions; four to be attempted with internal choice (7 marks each).

Unit I: Principles of Taxonomy

1. Nomenclature system: Binomial nomenclature, Trinomial nomenclature, Rules of nomenclature.
2. Five Kingdom Concept, Levels of Organization, Basis of classification (Number of cells, Symmetry, Coelom, Embryogeny, Segmentation).

Phylum Protozoa

1. Salient features and classification up to Class.
2. Type study – *Paramecium* (Salient Features, Locomotion, Nutrition, Reproduction).

Unit II

Phylum Porifera

1. Salient features and classification up to Class.
2. Type study – *Sycon* (Salient Features, Nutrition, Reproduction).
3. Canal system of sponges.

Phylum Coelenterata

1. Salient features and classification up to Class.
2. Type study – *Obelia* (Salient Features, Nutrition, Reproduction, Metagenesis).

Unit III

Phylum Ctenophora

1. *Beroe* (General features).

Phylum Platyhelminthes

1. Salient features and classification up to Class.
2. Type study – *Taenia* (External features and life cycle).
3. Type study – *Fasciola* (External features and life cycle).

Unit IV

Phylum Nemathelminthes

1. Salient features and classification up to Class.
2. *Ascaris* (External features and life cycle).
3. Parasitic adaptations in Helminths.

Phylum Annelida

1. General characters and outline classification up to classes with examples.
2. Type study – *Nereis* (External characters, Morphology, Digestive, Excretory, Nervous System, Development & Trochophore Larva).

Paper II (ZOO-102)

Cell & Molecular Biology

Max Marks: 75
Credits: 3

Scheme of Examination:

Part A: Seven short answer questions of 7 marks.
Part B: Eight questions; four to be attempted with internal choice (7 marks each).

Unit I

1. Introduction to Cell, Cell Theory, Prokaryotic and Eukaryotic Cells
2. Plasma Membrane: Various Models of Plasma Membrane Structure and Functions
3. Transport Across Membranes: Active and Passive Transport
4. Structure and Functions: Endoplasmic Reticulum, Golgi Apparatus, Lysosomes, Peroxisomes

Unit II

1. Mitochondria: Structure, Function and Biogenesis
2. Structure and Functions: Cilia and Flagella
3. Cell Cycle, Mitosis, Meiosis

Unit III

1. Structure of Nucleus: Nuclear Envelope, Nuclear Pore Complex, Nucleolus, Chromatin – Euchromatin and Heterochromatin, and Packaging (Nucleosome)
2. Salient Features of DNA and RNA, Watson and Crick Model of DNA
3. DNA Replication in Prokaryotes and Eukaryotes

Unit IV

1. Genetic Code
2. Transcription in Prokaryotes and Eukaryotes
3. Protein Synthesis in Prokaryotes and Eukaryotes

Paper III (ZOO-103)

Fundamentals of Genetics

Max Marks: 75
Credits: 3

Scheme of Examination:

Part A: Seven short answer questions of 7 marks (1 mark each).
Part B: Eight questions; four to be attempted with internal choice (7 marks each).

Unit I – The Gene

1. Brief idea of Mendelian Genetics.
2. Multiple Allelism: Inheritance of Blood group and Rh factor.
3. Sex Determination in man.
4. Sex-Linked, Sex-Influenced, and Sex-Limited Inheritance Patterns in man.

Unit II – Chromosomal Anomalies

1. Mutation: Gene Mutation.
2. Chromosomal Mutation:
   a. Numerical Changes (Polyploidy, Aneuploidy) and associated disorders in man.
   b. Structural Changes (deletion, duplication, translocation, inversion) and associated disorders in man.
3. Pedigree Analysis.

Unit III – Genetic Disorders

1. Classification of genetic disorders.
2. Single gene Disorders: Cystic Fibrosis, Thalassemia, Haemophilia, Albinism, Sickle cell anaemia.
3. Multifactorial Disorders: Alzheimer's disease, Diabetes, Spina bifida.
4. Chromosomal Disorders: Down's syndrome, Klinefelter syndrome, Turner syndrome, Patau syndrome (trisomy 13), Edwards syndrome (trisomy 18), Cri-du-chat syndrome.

Unit IV – Genetic Counselling

1. Principles of genetic counselling.
2. Causes and factors for seeking counselling.
3. Ethical and legal issues in genetic counselling.

Schemes for Genetic Disorders in India:

- National Policy for Rare Diseases 2021.
- Rashtriya Bal Swasthya Karyakram (RBSK).
- Thalassemia Control Program.
- Public-Private Partnerships (PPPs).

Semester I Practical
Paper – Practical (ZOO-P1)

Maximum Practical Marks: 150

- Internal Marks: 60 Marks
- External Marks: 90 Marks

Section A – Life and Diversity of Animals (Non-Chordata – I)

1. Microscopic Techniques:
a. Organisation and working of optical microscopes: Dissecting and Compound Microscope.
b. General methods of microscopical permanent preparations:

- Fixatives and Preservatives: Formalin, Bouin's Fluid.
- Stains: Borax carmine, Acetocarmine, Acetoorcein, Haematoxylin, Eosin.
- Common reagents: Normal saline, Ringer's solution, Acid water, Acid alcohol, Mayer's egg albumin.

2. Study of Museum Specimens (Classification of animals up to orders):

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

3. Study of Permanent Slides:

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

4. External Features and Anatomy through Audio-Visual Presentation:

- Earthworm: External features, Digestive, Nervous, and Reproductive System.
- Leech: External features, Digestive, Nervous, and Reproductive System.

5. Mounting:

- *Paramecium, Euglena.*
- Spicules, spongin fibers, and Gemmules of Sponge.
- Obelia colony.

6. Cell and Molecular Biology:

- Study of pictures of ultrastructure of prokaryotic cell & eukaryotic cell.
- Demonstration of mitotic cell division in onion root tips by squash method.
- Demonstration of meiosis through audio-visual presentation.
- Study of mitochondria in Buccal Epithelium.
- Demonstration of salivary gland chromosome in *Chironomous* larva.
- Use of colchicine in arresting anaphase movement (onion root tips).
- Study of cell permeability using mammalian RBCs.

7. Fundamentals of Genetics:

- Study of Chromosomal Aberrations.
- Study of human karyotype (Normal and Abnormal).
- In vitro study of DNA damage.
- Preparation of Polytene Chromosomes from salivary gland of *Drosophila*.
- A project report on various programs run by Government organization / NGOs.

SEMESTER II
THEORY

Paper I (ZOO-201)

Life & Diversity of Non-Chordata – II

Max Marks: 75
Credits: 3

Scheme of Examination:

Part A: Seven short answer questions of 7 marks (1 mark each).
Part B: Eight questions; four to be attempted with internal choice (7 marks each).

Unit I – Arthropoda

1. General characters and outline classification up to classes with examples.
2. Type Study: *Prawn* — External characters, Morphology, Skeletal, Digestive, Respiration, Nervous, Excretion & Reproductive systems.

Unit II – Mollusca

1. General characters and outline classification up to classes with examples.
2. Type Study:
    - *Pila* — External characters, Skeletal, Digestive, Respiration, Nervous, Excretion.

Unit III – Echinodermata

1. General characters and outline classification up to classes with examples.
2. Type Study: *Asterias* — External characters, Water Vascular System, Digestive, Nervous, Excretion & Reproductive systems.

Unit IV – Hemichordata

1. General characters and outline classification up to classes with examples.
2. Salient features of *Balanoglossus*.

Paper II (ZOO-202)

Genetics and Evolutionary Biology

Max Marks: 75
Credits: 3

Scheme of Examination:

Part A: Seven short answer questions of 7 marks (1 mark each).
Part B: Eight questions; four to be attempted with internal choice (7 marks each).

Unit I

1. Brief history of Genetics.
2. Mendelism and Neo-mendelism:
   a. Mendelian Laws (significance and current status).
3. Genetic Interactions:
   a. Duplicate, Epistasis, Inhibitory, Supplementary, Complementary Genes.
   b. Multiple Allelic interactions (Blood group & Rh factor).
   c. Linkage and crossing over (concept, types, and theories).

Unit II

1. Mutation: Chromosomal Mutation.
2. Cytoplasmic inheritance (kappa particles in *Paramecium*, Shell Coiling in Snail).
3. Genetic disorders: Turner syndrome, Klinefelter's Syndrome, Down's syndrome.

Unit III

1. Basics and origin of life: Definition, Pre-Darwinian theories of evolution; Oparin-Haldane Concept of origin of life; Miller-Urey experiment of Chemical Evolution.
2. Micro-evolution: Lamarckism; Darwinism; Neo-Darwinism.
3. Product of Evolutionary Process: Speciation, concept of species, sub species, modes of speciation (allopatric, sympatric, peripatric).

Unit IV

1. Macro-evolution: Geological time scale, Continental Drift.
2. Genetic basis of evolution: Hardy-Weinberg law, Gene Frequency, genetic drift, Factors affecting Hardy-Weinberg law, Sewall-Wright effect.
3. Variation, Adaptations and Isolation, Mimicry, Fossils.

Paper III (ZOO-203)

Biology of Parasitism

Max Marks: 75
Credits: 3

Scheme of Examination:

Part A: Seven short answer questions of 7 marks (1 mark each).
Part B: Eight questions; four to be attempted with internal choice (7 marks each).

Unit I – Introduction to Parasitism

1. Brief introduction of Parasitism.
2. Host-parasite relationship (Commensalism, Symbiosis, Predatorism, and Mutualism).
3. Parasite, Parasitoid, and Vectors.

Unit II – Parasitic Protists

1. Study of Morphology, Life Cycle, Prevalence, Epidemiology, Pathogenicity, Diagnosis, Prophylaxis and Treatment of *Plasmodium vivax*.

Parasitic Platyhelminthes

1. Study of Morphology, Life Cycle, Prevalence, Epidemiology, Pathogenicity, Diagnosis, Prophylaxis and Treatment of *Schistosoma haematobium*.

Unit III – Parasitic Nematodes

1. Study of Morphology, Life Cycle, Prevalence, Epidemiology, Pathogenicity, Diagnosis, Prophylaxis and Treatment of *Wuchereria bancrofti*, *Ancylostoma duodenale*.

Unit IV – Parasitic Arthropods

1. Biology, importance and control of *Pediculus humanus* (head and body louse), *Xenopsylla cheopis* (Oriental rat flea).

Parasitic Vertebrates

1. A brief account of parasitic vertebrates.

SEMESTER II PRACTICAL

Paper – Practical (ZOO-PII)

Maximum Practical Marks: 150
Internal Marks: 60
External Marks: 90

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

1. Study of Museum Specimens (Classification of Animals up to Orders)

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.*

Mollusca: *Chiton, Dentalium, Cyprea, Pila, Aplysia, Mytilus, Pinctada, Loligo, Sepia, Octopus, Nautilus.*

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

Hemichordata: *Balanoglossus.*

2. Study of Permanent Slides

Arthropoda: Crustacean Larvae — Nauplius, Zoea, Metazoea, Megalopa, Mysis.

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

Echinodermata: T.S. of arm of starfish.

Hemichordata: *Balanoglossus* through collar and proboscis.

3. Audiovisual Demonstration

- **Prawn:** Appendages, Digestive, Nervous, and Reproductive System, Statocyst, Hastate Plate.
- **Pila:** Nervous System, Osphradium, Gills, Radula.

4. Mounting – Study via Chart/Model/Figures

- Daphnia
- Hastate Plate
- Statocyst of Prawn
- Gill lamella, Osphradium, and Radula of *Pila*.

Section B: Genetics and Evolutionary Biology

1. Life cycle of *Drosophila*, identification of male and female *Drosophila*, study of mutant forms in *Drosophila*.
    - Bareye, whiteeye, yellowbody, sepiaeye, curledwing, vestigialwing.
2. Identification of blood groups & Rh factor.
3. Study of fossils from models/pictures.
4. Study and verification of Hardy-Weinberg Law by chi-square analysis.

Section C: Biology of Parasitism (Permanent Slides / Microphotographs)

1. *Entamoeba histolytica, Giardia intestinalis, Trypanosoma gambiense, Leishmania donovani, Plasmodium vivax.*
2. *Fasciolopsis buski, Schistosoma haematobium, Taenia solium, Hymenolepis nana.*
3. *Ascaris lumbricoides, Ancylostoma duodenale, Wuchereria bancrofti, Trichinella spiralis.*
4. Study of plant parasitic root knot nematode (*Meloidogyne*) from soil sample.
5. Study of *Pediculus humanus* (Head louse and Body louse), *Xenopsylla cheopis*, *Cimex lectularius*.
6. Study of monogenea from the gills of fresh/marine fish (gills can be procured from fish market).
7. Study of nematode/cestode parasites.
8. Submission of a brief report on parasitic vertebrates.

Scheme of Practical Examination and Distribution of Marks

Exercise	Max Marks
1. General Anatomy	16
2. Permanent Preparation	12
3. Exercise in Cell Biology	12
4. Exercise in Genetics	12
5. Identification & Comments on spots (1–6)	18
6. Viva-Voce	10
7. Class Record	10
Total	**90**

Suggested Readings – Practical

1. Verma, P.S., *A Manual of Practical Zoology: Invertebrates*.
2. Lal, S.S., *Practical Zoology: Invertebrates* (9th Edition).
3. Barnes, R., *Invertebrate Zoology*.
4. Barrington, E.W.J., *Invertebrate Structure and Function*.
5. Jordan, E.L. & Verma, P.S., *Invertebrate Zoology*.
6. Kotpal, R.L., Agrawal, & Khetrapal, *Modern Text Book of Zoology – Invertebrates*.
7. Puranik, P.G. & Thakur, R.S., *Invertebrate Zoology*.
8. Dhami, P.S. & Dhami, J.K., *Invertebrate Zoology*.

SEMESTER III
THEORY

Paper–I (ZOO- 301)
Life and diversity of Chordates

Max.Marks:75
Credits:3

Scheme of Examination: There will be two parts in end semester theorypaper. Part A of the paper shall contain seven short answer questions of 7 marks. Each question will carry one mark forcorrect answer. Part B of the paper will contain eight questions, out of which four questions are to be attempted from each unit with internal choice. Each question will carry 7 marks.

UNIT-I

1. General characters of Urochordata and Cephalochordata; Retrogressive metamorphosis
2. **Cyclostomata:** Peteromyzon,Ammocoete larva
3. Pisces: General characters of Chondrichthyes and Osteichthyes and their classification up to order

UNIT-II

1. **Amphibia:** Generalcharacters and classification up to order
2. **Reptilia:** General characters and classification up to order;
3. **Aves:** General characters and classification of Aves up to order; Flightad aptations; Archaeopteryx.

UNIT-III

4. **Mammals:** Generalcharacters and classification up to order
5. Comparative anatomy: Integument. Alimentary canal. Respiratory organs.

UNIT–IV

1. Comparative anatomy :Heart, Brain and cranialnerves
2. Comparative structure of urinogenital system

Paper–II (ZOO- 302)
Physiology and Biochemistry

Max.Marks:75
Credits: 3

Scheme of Examination: There will be two parts in end semester theorypaper. Part A of the paper shall contain seven short answer questions of 7 marks. Each question will carry one mark forcorrect answer. Part B of the paper will contain eight questions, out of which four questions are to be attempted from each unit with internal choice. Each question will carry 7 marks

UNIT– I (Physiology)

I. Digestion: Digestion of Carbohydrate, Protein and Lipid; Absorption of Lipid
II. Respiration: Respiratory pigments; Mechanism of Breathing, Transport of O_2 and CO_2, Bohr's Effect, Chloride Shift
III. Renal Physiology: Structure of Mammalian Kidney, Mechanism of urine formation; Counter Current Mechanism of Urine Formation

UNIT–II

I. Circulatory system: Mechanism of Blood Clotting, Structure and function of Mammalian heart, Cardiac Cycle
II. Nervous System: Structure and types of Neurons, Physiology of Transmission of nerve impulse, Synaptic transmission; Reflex action
III. Muscle: Structure and types of Muscle Fibers, Mechanism of Skeletal Muscle contraction

UNIT–III
I. Reproductive System: Histology and Physiology of male and female reproductive system
II. Endocrine System: Hypothalamus and Pituitary, Thyroid, Adrenal, Parathyroid, Ovary, and Testes

UNIT–IV
I. Carbohydrate Metabolism: Glycolysis, TCA, Glycogenesis, Glycogenolysis, Gluconeogenesis
II. Lipid Metabolism: Beta oxidation of Lipid
III. Protein Metabolism: Transamination, Decarboxylation, Deamination, Urea Cycle/Ornithine Cycle

Paper – III (ZOOH - 303)
Basics of Radiation and Cancer Biology

Max. Marks: 75
Credits: 3

UNIT – I

- Types of radiation
- Ionization and excitation
- Linear energy transfer
- Direct and indirect effects of radiation
- Interaction of radiation with matter
- Radiation chemistry of water
- Biological effects of radiation

UNIT – II

- Chromosomal aberration
- Survival curves
- Concept of Radiosensitivity and Radioresistance
- Radiation carcinogenesis
- Concept of radiotherapy of cancer

Health Physics:

- Radiation detection & instrumentation
- Exposure to radiation
- Dosimetry
- Concept of radiation protection and shielding
- Medical imaging and radiation protection
- Concept of waste disposal:
    - Radioactive waste disposal
    - Bio-medical waste disposal
    - Incineration

UNIT – III: Cancer Epidemiology

1. Definition and global aspect of cancer
2. General properties of cancer
3. Benign and malignant tumors
4. Sarcoma and carcinoma

5. Leukaemia and lymphoma
6. Epithelial and nonepithelial tumors
7. Teratocarcinoma (Specialized tumor)

UNIT – IV: Causation, Diagnosis and Treatment of Cancer

1. Chemical carcinogenesis
2. Radiation carcinogenesis
3. Viral carcinogenesis
4. Hormone and cancer
5. Tumor markers, Histological and Cytological methods, Modern aids in tumor diagnosis
6. Surgery, Radiation therapy, Chemotherapy, Hormone therapy, Immune therapy

SEMESTER III
PRACTICAL

PAPER–PRACTICAL (ZOO-PIII)

Maximum practical Marks = 150 marks
Internal marks = 60 Marks
External marks = 90 Marks

I. Life and Diversity of Chordates

A. Study of Specimen
a) Protochordata: Herdmania, Ciona, Salpa, Doliolum, Amphioxus
b) Lower Chordates: Petromyzon, Myxine/Bdellostoma, Ammocoete larva
c) Pisces: Sphyrna, Trygon (Stingray), Pristis (Saw Fish), Raja (Skate), Torpedo, Chimaera (Rat Fish), Acipenser, Amia, Lepidosteus, Notopterus, Labeo, Clarius, Anguilla (eel), Exocoetus, Hippocampus, Echenesis (Sucker Fish), Protopterus
d) Amphibia: Ichthyophis, Cryptobranchus, Ambystoma (Tiger Salamander), Axolotl Larva, Salamandra, Proteus, Siren, Alytes, Pipa, Hyla, Rhacophorous (Flying Frog)
e) Reptilia: Testudo, Chelone, Sphenodon, Calotes fiemidactylus, Phrynosoma, Draco, Varanus, Hydrophis
f) Aves: Archaeopteryx, Taylor Bird, Indian Keel, Junglefowl, Pavo
g) Mammals: Ornithorhynchus, Echidna, Macropus, Loris, Bat

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, Placoid 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

E. Biochemistry
i. Biochemical detection of carbohydrates, proteins, and lipids in a given sample
ii. Colorimetric estimation of glucose/Protein in a given solution

F. Physiology *(Through study of Permanent Slides)*

i. Histological Slides: Bone, Cartilage, Striated Muscle Fibre

ii. Endocrine Glands: Pituitary, Thyroid, Parathyroid, Thymus, Adrenal cortex, Adrenal Medulla, Ovary, Testis

iii. To study the knee jerk reflex in man

iv. Demonstration of ptyalin enzyme activity

v. Estimation of hemoglobin content; RBC Counting, WBC Counting; Hematocrit value, and ESR of a given blood sample

vi. Histological Slides of mammalian T.S. of spinal Cord, stomach, duodenum, ileum, liver, lung, kidney

G. Radiation and Cancer Biology

1. Knowledge and use of the various instruments: Geiger-Muller counter, Scintillation counters, Survey meter, Single-channel gamma spectrometer, Cobalt camera
2. Finding out the operating voltage of the G-M tube
3. Calculation of Inverse Square Law
4. Determination of the resolving time of the G-M tube
5. Absorption of beta and gamma rays
6. Determination of Backscattering factors
7. Histopathological, histochemical and biochemical studies of various tissues after external irradiation
8. Histopathological study of various cancerous tissues (Oral cancer, Prostate cancer, Breast cancer)

SEMESTER III
SCHEMEOFEXAMINATION:

Time: 4hrs.	EXCERSISE	Max.Marks:90
1.	Anatomy	16
2.	PermanentPreparation	12
3.	ExerciseinBiochemistry/Physiology	12
4.	Exercisein Basics ofRadiation and Cancer Biology	12
5.	Identification& Commentsonspots(1to6)	18
6.	Viva-Voce	10
7.	Class Record	10
Total		**90**

SuggestedReadings:

Chordates:

1. Colbert'sEvolution oftheVertebrates;Colbert, E.H; JohnWiley&Sons
2. TextbookofChordate Zoologyvol.II; Sandhu,G.S.and Sandhu,G.S;Campus Books.
3. ModerntextbookofZoology-Vertebrates;Kotpal,RastogiPublication.
4. VertebrateZoology;Rastogi,V.B.;Ramnath& Kedarnath.
5. Young,O.Z.:TheLifeofVertebrates,Oxford UniversityPress, Oxford.
6. Young,J.Z:Thelifeofvertebrates.OxfordUniversityPressLondon1962(LowPricedText Reprint English Language Book Society London, 1962).
7. Barrington,E.J.W.:TheBiologyHemichordata&Protochordata,Oliver&Boyd,London, 1965
8. YoungJ. Z:Thelifeof mammals, Oxford UniversityPressLondon 1963

Biochemistry:

1. Stryer, I.(1988). BiochemistryII. FreemanandCo.
2. Plummer,L.(1989).Practicalbiochemistry.TataMcGraw.
3. Murray,R.K.etal (1995).Harper'sbiochemistry, 24thed.Prentice Hall.
4. Lewin,B.(2000).Gene.JohnWiley& sons.
5. Strikburger,M.W.(1994).Genetics.MacmillanPubl.Co.

6. Russel,P.J.(1998). Genetics.TheBenjaminCumminsPublishingCo.
7. Lehninger(2004).Principles ofbiochemistry4th ed.
8. Gilbert,F.(2000).Basicconceptsinbiochemistry:Astudent'ssurvivalguide.2nded. McGrawHill

Physiology:

1. Ganong:ReviewofMedicalPhysiology(22nded.2005,Lange Medical)
2. Guytonand Hall:A textbookofMedicalPhysiology(11thed.2006, Saunders).
3. Keele&Neil:SamsonWright'sAppliedPhysiology(13thed.1989,Oxford)
4. K.V.Shastri:Physiology
5. WilliamS.Hoar,1976.GeneralandComparativePhysiology,Prentice

SuggestedReadings:

1. Biologyof CancerbyRobertAWeinberg
2. Principlesof CancerBiologybyKleinsmith
3. Cancer Biology"byRaymondWRuddon
4. Biologyof Cancer (Pearson Special Topicsin Biology)"byPALLADINOand PHILLIS
5. "TheBiologyof Cancer:A NewApproach"byPRBurch

SEMESTER IV
THEORY

Paper–I (ZOO-401)
Developmental Biology

Max.Marks:75
Credits:3

Scheme of Examination: There will be two parts in end semester theorypaper. Part A of the paper shall contain seven short answer questions of 7 marks. Each question will carry one mark forcorrect answer. Part B of the paper will contain eight questions, out of which four questions are to be attempted from each unit with internal choice. Each question will carry 7 marks

UNIT-I

1. HistoricalreviewandScopeofembryology
2. Gametogenesis:Spermatogenesis,Structureofsperm,Oogenesis,Structureofegg, Types of Egg.
3. Fertilization,Parthenogenesis

UNIT-II

1. Planes and Patterns of Cleavage, Blastulation, Gastrulation, Morphogenetic Movements, Fate Map
2. Conceptofembryonicinduction;Primaryorganizers,differentiationandcompetence.
3. ExtraembryonicmembranesPlacentationinMammals

UNIT-III

1. Structureofhen'segg,Developmentof chickupto96hrsstage.
2. Metamorphosisinamphibiansand insects
3. Regeneration

UNIT-IV

1. Stemcells:Sources,typesandtheiruseinhuman welfare;Cloning
2. ElementaryIdeaofTeratogenesis,andAgeing
3. ElementaryIdeaofArtificialinsemination,cryopreservation,amniocentesis,IVF, GIFT, ZIFT

Paper–II (ZOO- 402)
Ecology and Ethology

Max.Marks:75
Credits:3

Scheme of Examination: There will be two parts in end semester theory paper. Part A of the paper shall contain seven short answer questions of 7 marks. Each question will carry one mark for correct answer. Part B of the paper will contain eight questions, out of which four questions are to be attempted from each unit with internal choice. Each question will carry 7 marks

Unit I

- Basicconceptsinecology,itsmeaning,andhistory.Conceptsoflimitingfactors.
- Ecosystem:Bioticandabioticfactors.
- Conceptsoffoodchain,foodweb,trophicstructure,ecological pyramids.
- Ecosystem:Homeostasis.Functionalaspects.Productivityconceptsanditsdetermination, Ecotone, Edge Effects, Niche.
- PopulationEcology:Density,Natality,Mortality,Agedistribution,Growth,Dispersion,and Biotic Potential.

Unit II

- Community Ecology: Interspecific interactions – Negative (Antibiosis, Competition, Parasitism,andPredatism)andPositive(Commensalism,Proto-Cooperation,andMutualism).
- Pollution:Elementaryideaofair, water,soil, and noise pollution.
- CurrentEnvironmentalIssues:Introduction,Impact,andMitigation/control measures
  a) Greenhouseeffect b)Globalwarming-Ozonelayer depletion

UnitIII-ETHOLOGY(ANIMALBEHAVIOUR)

- Introductionand historyofEthology.
- Conceptsandpatternsofbehavior:FAP,SignStimulus,InnateReleasingMechanism(IRM), Action Specific Energy (ASE), Concept of motivation.
- Learning:Learnedbehaviorandtypesoflearning;Imprinting.

Unit IV

- Methods of studying Brain Behavior: Laboratory Techniques (Neuroanatomical, Physiological,andNeurochemicalTechnique);FieldStudyTechniques(AdLibitum,Focus Sampling, Scan Sampling, One-Zero, and All Occurrence Sampling).
- ElementaryideaofPheromones.

Socialbehavior:

- SocialbehaviorinInsects– HoneyBeesandTermites.
- SocialsysteminPrimates:Monkeys.
- Parentalcare: Fishesand Amphibians.

Paper–III(ZOO-403)
Medical Entomology

Max.Marks:75
Credits: 3

Scheme of Examination: There will be two parts in end semester theory paper. Part A of the papershall contain seven short answer questions of 7 marks. Each question will carry one mark for correct answer.PartBofthepaperwillcontaineightquestions,outofwhichfourquestionsaretobe attempted from each unit with internal choice. Each question will carry 7 marks

UNITI

Introduction to medicalentomology; Classification of Arthropodborne diseases; Hematophagy,disease transmission and epidemiology; flies (Diptera) of medical Importance; moth flies: Leishmaniasis and Bartonellosis; biting midges (Ceratapogonidae).

UNITII

Mosquito taxonomy, biology, and behaviour; mosquito viruses: Yellow fever,mosquito surveillance; malaria; black flies of medical Importance; filariasis: mansonellosis, onchocerciasis.

UNITIII

Lice of medical importance; rickettsial diseases: epidemic typhus. mites: rickettsial pox; mites and acariasis: mange,scabies,chiggers; spiders andscorpions; fleas(Siphonaptera) ofmedicalimportance; plague and murine typhus.

UNITIV

Ticks of medical importance; lyme disease, rocky mountain spotted fever, tularemia; true bugs (Hemiptera):kissingbugsandbedbugs;chagasdisease;tsetseflies;LepidopteraandHymenopteraof medical importance.

SEMESTERIV PRACTICAL

Paper–Practical (ZOO–PIV)

Maximum practical Marks = 150 marks
Internal marks = 60 Marks
External marks = 90 Marks

Developmental Biology

1. Study of Development of Chick
   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 eggshell

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 monkeys through visual aids
3. Antennal Grooming in Cockroach

Ecology

1. Determination of population density in a terrestrial community or hypothetical community by quadrate method
2. Study of life table and fecundity table, plotting of the three types of survivorship curves from hypothetical data
3. Estimation of Soil Parameters – pH, chlorides, and water vapor quantity
4. Estimation of Water Parameters – Dissolved oxygen, Salinity, pH, free CO_2 in water samples
5. Plankton Study in Freshwater
6. Study of Natural Ecosystem and Field Report

Visit to a National park and Sanctuary (candidates are required to submit the report of the visit).

Practical

7. Identification of Arthropod Classes, Orders, and Families of Medical Importance
8. Collection, Segregation, Curing Insect and Arachnid Specimens, Their Preservation
9. Management of Insect and Mite Pests of Medical Importance
10. Study of Practical Aspects in Forensic Entomology

SEMESTER IV
SCHEMEOFPRACTICALEXAMINATION

SchemeofPracticalExaminationandDistributionofMarks

Time: 4hrs.	**EXCERSISE**	**Max.Marks:90**
1.	ExerciseInDevelopmental Biology	16
2.	PermanentPreparation	12
3.	Exercise in EthologyAndEcology	12
4.	ExerciseinMedicalEntomology	12
5.	Identification&CommentsonSpots(1to6)	18
6.	Vivavoce	10
7.	Class record	10
Total		**90**

DevelopmentalBiology:

1. Gilbert,S.T.(2000).DevelopmentalBiology,6thed.Sinauer, Sunderland.
2. Hoar,W.S.(1983).GeneralandComparativePhysiology.PrenticeHall.
3. Balinsky,B.I.(1976).AnIntroductiontoEmbryology,6thed.W.B.Saunders&Co.
4. Prosser,C.L.ComparativeAnimal Physiology.
5. Saunders,J.W.DevelopmentalBiology:Patterns/Principles/Problems.MacMillanPubl.
6. Wilson,J.A.PrinciplesofAnimalPhysiology.CollinsMacMillanPubl.
7. Sandhu,T.B.PrinciplesofEmbryology.
8. Armugam,T.B.PrinciplesofEmbryology.
9. Pattern.EarlyEmbryologyofChick.
10. Verma&Agrawal.ChordateEmbryology.
11. Tomar.ChordateEmbryology.

Ecology:

1. Odum,E.P.(1996).Ecology:ABridgeBetweenScienceandSociety.SinauerAssociatesInc.
2. Chapman, J. L., & Reiss, M. J. (1992). Ecology, Principles and Applications. Cambridge UniversityPress.
3. Verma, P. S., & Agarwal, V. K. (1983). Environmental Biology (Principles of Ecology). S. Chand &Co.
4. Singh,J.H.etal.(2006).Ecology,EnvironmentandResourceConservation.AnamayaPubl.N.Delhi.

MedicalEntomology:

1. David BV and Ramamurthy VV. (2011). Elements of Economic Entomology, 6th Edition. Namrutha Publications, Chennai.
2. GullanPJandCranstonPS.(2010).TheInsects:AnOutlineofEntomology,4thEdition. WileyBlackwell, West Sussex, UK & New Jersey, US.
3. MullenGandDurdenL.(2018).MedicalandVeterinaryEntomology,3rdEdition.AcademicPress.

SEMESTER V
THEORY-ELECTIVE

Paper–I (ZOO-501)
Research Methodology and Biostatistics

Scheme of Examination:

Max.Marks:75
Credits:3

There will be two parts in end semester theory paper. Part A of the paper shall contain seven short answer questions of 7 marks. Each question will carry one mark for correct answer. Part B of the paper will contain eight questions, out of which four questions are to be attempted from each unit with internal choice. Each question will carry 7 marks.

UNIT I

1. Meaning, Objectives, Motivation: Research Methods vs Methodology
2. Types of Research
    - Analytical vs Descriptive
    - Quantitative vs Qualitative
    - Basic vs Applied
3. Need for Research Design
    - Features of good design
    - Important concepts related to good design
    - Observation and Facts
    - Prediction and Explanation

UNIT II

1. Observation and Collection of Data
    - Methods of data collection
    - Sample and sampling
2. Concept of Research Articles, Research Papers, Reviews, Scientific Popular Articles, Technical Reports, and Thesis Writing
    - Preparation of Tables and Bibliography
3. Ethical Issues
    - Intellectual Property Rights
    - Commercialization

- Copyright, Royalty, Patent Law
- Plagiarism
- Citation
- Acknowledgment

UNIT III

1. Introduction, Definition, and Scope of Biostatistics
2. Concepts of Descriptive and Inferential Statistics
3. Data: Types, Presentation of Data
    - Tabular (Frequency Distribution Table; Continuous and Discontinuous Series)
    - Diagrammatical (Line, Bar, Ogive, and Pie Diagram)
    - Graphical (Histogram, Frequency Polygon, Frequency Curve)

UNIT IV

1. Measures of Central Tendency
    - Mean, Median, and Mode and their Significance
2. Measures of Dispersion
    - Mean Deviation & Standard Deviation
    - Standard Error
3. Test of Hypothesis
    - t-test
    - Null and Alternate Hypothesis

THEORY-ELECTIVE

Paper–III (ZOO-502)
Applied and Economic Zoology

Max.Marks:75
Credits:3

Scheme of Examination: There will be two parts in end semester theory paper. Part A of the paper shall contain seven short answer questions of 7 marks. Each question will carry one mark for correct answer. Part B of the paper will contain eight questions, out of which four questions are to be attempted from each unit with internal choice. Each question will carry 7 marks.

UNIT I: Economic Entomology – Insects of Economic Importance

- **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
- **Apiculture:**
  - Types of honeybees
  - Life cycle and culture
  - Bee product and its economic importance
- **Lac culture:**
  - Lac insect, *Laccifer lacca*
  - Life cycle
  - Lac processing
  - Lac products and economic importance

UNIT II: Economic Entomology

- **Chemical Control of Insecticides:**
  - Pyrethroids, Carbamate, and HCN (mode of action, merits, and demerits)
- **Biological Control of Pests:**
  - Biological agents (predators and parasites; merits and demerits)
- **Crop Pests:**
  - Life cycle, damage, and control of Cotton spotted bollworm – *Earias vitella*
- **Stored Grain Pests:**
  - Rice Weevil, *Sitophilus oryzae*
- **Animal Pests:**

- Life cycle, damage, and control of Housefly – *Musca nebulo*
- Stable fly – *Stomoxys calcitrans*

UNIT III: Aquaculture (Economic Importance)

- **Pisciculture:**
  - Techniques of induced breeding
  - Edible fishes
  - By-products of fishing and its commercial values
- **Prawn Culture:**
  - Culture techniques of freshwater prawn (*Macrobrachium rosembergii*) & marine water prawn (*Penaeus monodon*)
- **Pearl Culture:**
  - Formation and nature of pearls
  - Commercial importance of pearl culture in India

UNIT IV: Economic Importance of Other Animals

- **Vector-Borne Diseases:**
  - A brief account of insect vectors affecting the health of man and domestic animals
- **Animal Husbandry:**
  - Introduction to common dairy animals
  - Techniques of dairy management
- **Vermiculture:**
  - Vermitechnology, bio-fertilizers
- **Future Strategies for Livestock Development:**
  - Transgenic animal technology
  - Genetic improvement for best breeds
  - Economic importance of dairy, leather, wool, fur

THEORY-ELECTIVE

Paper–II (ZOO-502)
Microbiology and Immunology

Max.Marks:75
Credits:3

Scheme of Examination

There will be two parts in end semester theory paper. Part A of the paper shall contain seven short answer questions of 7 marks. Each question will carry one mark for correct answer. Part B of the paper will contain eight questions, out of which four questions are to be attempted from each unitwith internal choice. each question will carry 7 marks.

UNIT–I

1. **Microbiology:**The scope of Microbiology: Characterization, Classification andidentification
2. **Microorganisms;** History and landmark events in Microbiology: Working of A.V. Leeuwenhoek, Louis Pasteur, Robert Koch, Germ Theory of diseases.
3. **General Morphology of Protozoa Parasitic Protozoans**: life cycle, pathogenesis anddisease caused by Entamoeba; Plasmodium, Trypanosome, Leishmania,fungi – Molds and Yeasts

UNIT-II

1. Bacteria; The World of Bacteria – Morphology of Bacteria; Difference between Gram-positive and Gram-negative Bacteria
2. Growth and nutrition: Microbial Nutrition, Growth and Control: Nutritional requirements (macro&; micronutrients),Factors affecting growth ofbacterial culture; Basic ideaofCulture: Types of culture media, uptake of nutrients, Maintenance of pure cultures.
3. Growth; Reproduction: Bacterial division, growth curve,generation time, measurement of growth. Asepsis, sterilization with physical and chemicalagents; Reproduction- Asexual and sexual

UNIT-III

1. Virus:Structure,Classification; LifeCycle-LyticandLysogeny;A Bacteriophage
2. Hepatitis:Structureandtypesofcausativeagent,Precaution,PreventionandControl
3. HIV and AIDS: Epidemiology, prevention, control andtreatment. Applied Microbiology: Fermented Food production (DairyProducts, Alcoholic Beverages);Microbial spoilage and techniques of Food Preservation

UNIT-IV

1. Immunity: Types and Mechanism of Innate and Adaptive Immunity;Antigens; Immunogens, Adjuvants and haptens, epitopes
2. Immunoglobulin;Structureandfunctionsofdifferentclassesof immunoglobulins
3. Antigen antibodyinteractions,Immunoassays(ELISAandRIA)
4. StructureandfunctionsofMHCmolecules,Complement System

SEMESTERV
PRACTICAL

Paper – Practical (ZOO–PV)

Maximum Practical Marks: 150 marks
Internal Marks: 60 Marks
External Marks: 90 Marks

Practicals for Elective I – Research Methodology and Biostatistics

1. **Education and Research Resources on Net:**
   - Encyclopedia, Wikipedia
   - Online Tutorials and Lectures
   - Virtual Labs, Open Course-wares
   - Electronic Journals, E-Books, Digital Libraries
   - Searching research information
2. **Professional Written Communication:**
   - Students prepare E-mails, Letters, Memos, Proposals, Formal and Informal Reports
3. **Report Writing and Presentation:**
   - Research Report: Types and Significance
   - Structure of research report
   - Ethical issues in research
   - Presentation of the report
4. **Construction of Frequency Table, Histograms, Polygons, Pie Charts**
5. **Exercise on Mean, Mode, Median, Std. Deviation, Std. Error, Probability**

Practicals for Elective II – Microbiology & Immunology

1. Preparation and Use of Culture Media for Microbes
2. Study of Microbes in Food Material (milk, curd, etc.)
3. **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)
4. **Identification of Helminth Parasites and Larvae from Permanent Slides**
5. Study of Histological Slides of Organs of Immune System:
   - Thymus, Lymph nodes, and Spleen

Practicals for Elective III – Applied & Economic Zoology

1. **Study of 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:**
   - Preparation of the life cycle of these pests

SEMESTERV

SCHEMEOFPRACTICALEXAMINATION

SchemeofPracticalExaminationandDistributionof Marks

Time:4hrs.	**EXCERSISE**	**Max.Marks:90**
1.	ExercisefromElectiveI- Major	12
2.	ExercisefromElectiveI- MINOR	05
3.	ExercisefromElectiveII	10
4.	ExercisefromElectiveIII	10
5.	Identification & Comments on spots(1to6)	18
6.	StudentProjectwork	15
7.	VivaVoce	10
8.	Class Record	10
Total		**90**

Suggested Readings of Books:

ResearchandMethodology:

1. BusinessResearchMethods–DonaldCooper&PamelaSchindler,TMGH,9thedition
2. BusinessResearchMethods–AlanBryman&EmmaBell,OxfordUniversityPress.
3. ResearchMethodology–C.R.Kothari

Microbiology:

1. Mani,A.,Selvaraj,A.M.,Narayanan,L.M.&Arumugam,N.(1996).

- *Microbiology*.SarasPublications,Nagercoil,India.

2. Sharma,P.D.(1998).
   - *Microbiology*.RastogiPublications,Meerut,India.
3. SubbaRao,N.S.(1999).
   - *SoilMicrobiology*.OxfordIBHCo.,NewDelhi,India.
4. Sullia,S.B.&Santharam,S.(2004).
   - *GeneralMicrobiology*.OxfordIBH,India.
5. Meenakumari,S.(n.d.).
   - *MicrobialPhysiology*.MJPPublications,Chennai,India.
6. PurushotamKaushik(2005).
   - *Microbiology*.S.Chand&Co.,NewDelhi,India.
7. VijayaRamesh(2005).
   - *EnvironmentalMicrobiology*.MJPPublications,Chennai,India.

8. VijayaRamesh(2007).
   - *FoodMicrobiology.*MJPPublications,Chennai,India.
9. Rajan,S.(2007).
   - *MedicalMicrobiology.*MJPPublications,Chennai,India.
10. Purohit,S.S.(2007).
   - *Microbiology.*AgrobiosPublications,India.
11. Trivedi,P.C.(2008).
   - *AppliedMicrobiology.*AgrobiosPublications,India.
12. Prescott(2009).
   - *IndustrialMicrobiology.*AgrobiosPublications,India.
13. Parihar,L.(2008).
   - *AdvancesinAppliedMicrobiology.*AgrobiosPublications,India.
14. Agarwal,A.K.(2008).
   - *IndustrialMicrobiology.*AgrobiosPublications,India.
15. Bohra,A.(2006).
   - *FoodMicrobiology.*AgrobiosPublications,India.

EconomicZoology

1. ShuklaandUpadhyaya(1999-2000).
   - *EconomicZoology.*RastogiPublishers.
2. Shrivastava(1991).
   - *TextbookofAppliedEntomology,Vol.I&II.*KalyaniPublishers.
3. Mani(2006).
   - *Insects.*NBT,India.
4. Jabde(2005).
   - *TextbookofAppliedZoology:Vermiculture,Apiculture,Sericulture,Lacculture,AgriculturalPestsand their Control.* Vedams eBooks (P) Ltd. New Delhi.

WildlifeConservationandManagement

1. Caughley,G.,andSinclair,A.R.E.(1994).
   - *WildlifeEcologyandManagement.*BlackwellScience.
2. WoodroffeR.,Thirgood,S.andRabinowitz,A.(2005).
   - *PeopleandWildlife,ConflictorCoexistence?*CambridgeUniversity.
3. Bookhout,T.A.(1996).
   - *ResearchandManagementTechniquesforWildlifeandHabitats,5thedition.* TheWildlifeSociety, Allen Press.
4. Sutherland,W.J.(2000).
   - *TheConservationHandbook:Research,Management,andPolicy.*BlackwellSciences.
5. HunterM.L.,Gibbs,J.B.andSterling,E.J.(2008).
   - *Problem-SolvinginConservationBiologyandWildlifeManagement:ExercisesforClass,Field,and Laboratory.* Blackwell Publishing.

SEMESTER –VI
THEORY-ELECTIVE

Paper–I(ZOO-601)
Bioinstrumentation and Biotechniques

Max.Marks75
Credit:3

Scheme of Examination

There will be two parts in end semester theory paper. Part A of the paper shall contain seven short answer questions of 7 marks. Each question will carry one mark for correct answer. Part B of the paper will contain eight questions, out of which four questions are to be attempted from each unitwith internal choice. Each question will carry 7 marks.

UNIT-I

1. Concepts of sterilization: Filtration, autoclaving, dry heat sterilization, wet sterilization and radiation
2. Separation of biomolecules: Centrifugation (Sedimentation, density gradient)
3. Chromatography (Elementary idea of Paper – ascending and Circular, thin layer, gel filtration and ion exchange – Principles and applications)
4. Electrophoresis: Agarose Gel Electrophoresis, SDS-PAGE

UNIT-II

1. Fixation, dehydration, clearing, embedding & section cutting
2. Difficulties encountered during section cutting (causes and remedies)
3. Double staining with Haematoxylin and Eosin
4. Histochemical staining techniques for carbohydrates (Periodic acid schiff), proteins (Mercury-bromophenol blue) and lipids (Sudan Black-B)

UNIT-III

1. Microscope: Principle of Microscopy and types
2. Principles of colorimeter
3. Principles of spectrophotometers

UNIT-IV

1. Bioinformatics: Definition, Scope, Basic concepts in bioinformatics, importance and role of bioinformatics in life sciences
2. Bioinformatics databases – introduction, types of databases
3. Nucleotide sequence databases, Elementary idea of protein databases
4. BLASTA, FASTA, PHYLOGENY TREE Analysis

THEORY-ELECTIVE

Paper–II (ZOO-602)
Environmental Toxicology

Max.Marks75
Credit: 3.

Scheme of Examination: There will be two parts in end semester theory paper.PartA of the paper shall contain seven short answer questions of 7 marks. Each question will carry one mark for correct answer. Part B of the paper will contain eight questions, out of which four questions are to be attempted from each unit with internal choice. Each question will carry 7 marks.

UNIT–I

- Definition, history, scope & sub-divisions of toxicology
- Principles of Environmental Toxicology and the Dose-Response Relationship
- Classification of toxic agents: natural toxins, animal toxins, plant toxins, food toxins, genetic poisons and chemical toxins

UNIT–II

- Ecotoxicology – Examples of ecotoxicology, Scientific approach to ecotoxicology
- Entry, movement, and fate of pollutants in ecosystems
- Biomarkers and Biomonitoring

UNIT–III

- Environmental pollution I: General outline and various types of pollution of water, air and soil

UNIT–IV

- Environmental pollution II: Sources and remedies for noise, radiation, industrial chemicals, agrochemicals, insecticides and pesticides and household pollutants

THEORY-ELECTIVE

Paper–III (ZOO-603)
Medical Diagnostics, Public Health & Hygiene

Max.Marks75
Credit: 3

Scheme of Examination
There will be two parts in the end semester theory paper.
Part A of the paper shall contain seven short answer questions of 7 marks. Each question will carry one mark for correct answer.
Part B of the paper will contain eight questions, out of which four questions are to be attempted, selecting at least one question from each unit with internal choice. Each question will carry 7 marks.

UNIT-I
Diagnostics Methods Used forAnalysis ofBlood Blood composition, Preparation ofblood smearand Differential Leucocyte Count (D.L.C) using Leishman's stain, Platelet count using haemocytometer, Erythrocyte Sedimentary Rate (E.S.R), Packed Cell Volume (P.C.V.)

UNIT-II
Diagnostic Methods Used for Urine Analysis Urine Analysis: Physical characteristics; Abnormal constituents

UNIT-III
Non-infectious Diseases Causes, types, symptoms, complications, diagnosis and prevention of Diabetes(Type IandTypeII),Hypertension(Primaryandsecondary),Testingofbloodglucoseusing Glucometer/Kit

UNIT-IV
Infectious Diseases Causes, types, symptoms, diagnosis and prevention of Tuberculosis and Hepatitis TumoursTypes(Benign/Malignant),Detectionandmetastasis;Medicalimaging:X-RayofBone fracture, PET, MRI and CTScan (using photographs).

SEMESTERVI
PRACTICAL

Project Work (Elective)

Maximum Practical Marks = 150 marks
Internal Marks = 60 Marks
External Marks = 90 Marks

Practicals for Elective I – Bioinstrumentation and 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 Equipment:
    - 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 Office, BLASTA, FASTA

Practicals for Elective II – Environmental Toxicology

1. Determination of Alkalinity and Acidity of Water
2. Determination of Dissolved Oxygen in Water
3. Determination of Chloride in Water
4. pH Estimation of Water
5. Estimation of Nitrogen and Phosphorus in Water Sample
6. Determination of Total Dissolved Solids in Waste Water Sample
7. Determination of Chemical Oxygen Demand in Waste Water Sample
8. Analysis of Total Hardness of Waste Water Sample
9. Analysis of Waste Water/Sludge for Heavy Metals

Practicals for Basics of Medical Diagnosis and Public Health

1. **Microbiology – Basic Aseptic Techniques and Media Preparation**
    - Spread Plate, Streak Plate
    - Gram Staining

- Microbial Growth Curve
- Culture
- Antibiotic Susceptibility Testing

2. **Haematological Methods**
   - Blood Grouping
   - TBC, WBC, RBC Count
3. **Biochemistry**
   - Glucose Estimation
   - Liver Function Tests
4. Estimation of Haemoglobin
5. **Immunology**
   - Ouchterlony Double Diffusion
   - ELISA
6. **Molecular Biology**
   - Protein Estimation by Biuret, Bradford, and Folin's Lowry Method
7. **Environmental Measures**: Water Quality Testing

Practicals for Neuroendocrinology

1. **Neurochemical Studies**
   - TLC, Silica Gel Chromatography, DBH Analysis
   - Isolation of Neurotransmitters
   - Analysis of Neurotransmitters by Fluorometry, HPLC
2. **Study of Permanent Slides**
   - Histological Slides: Bone, Cartilage, Striated Muscle Fiber
3. **Endocrine Glands**
   - Pituitary, Thyroid, Parathyroid, Thymus, Adrenal Cortex, Adrenal Medulla, Ovary, Testis
4. To Study the Knee Jerk Reflex in Man

SEMESTER VI
SCHEMEOFEXAMINATION:

SchemeofPracticalExaminationandDistributionofMarks

Time:4hrs.	**EXCERSISE**	**Max.Marks:90**
1.	ExercisefromElectiveI- Major	12
2.	ExercisefromElectiveI- MINOR	05
3.	ExercisefromElectiveII	10
4.	ExercisefromElectiveIII	10

5.	Identification & Comments on spots(1to6)	18
6.	StudentProjectwork	15
7.	VivaVoce	10
8.	Class Record	10
Total		**90**

SuggestedReadings:

BiotechniquesandMicrotechnique

1. AnimalTissueTechnique–Humason
2. HistologicalTechnique–Devenport
3. Microtechnique–Jiwaji&Patki
4. Microtechnique–Wankhede
5. BiophysicalChemistry–Upadhyay,Upadhyay,and Nath
6. TechniquesinLifeSciences –D.B.Tembhare
7. Pearse:Histochemistry-TheoreticalandApplied,VolumeI-III(1980-1993,ChurchillLivingstones)
8. Plummer:AnIntroductiontoPracticalBiochemistry(1989,McGrawHill)
9. Wilson&Walker:ExperimentalBiochemistry(2006,Cambridge)

Bioinformatics

1. MountW.(2004).BioinformaticsandSequenceGenomeAnalysis,2ndEdition.CBSPub.,New Delhi.
2. Bergman, N.H. (2007). Comparative Genomics. Humana Press Inc., Part of Springer Science+Business Media.
3. Baxevanis, A.D., Ouellette, 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. OxfordUniversity Press.
6. RashidiH.H.andBuehler(2002).BioinformaticsBasics:ApplicationsinBiologicalScienceand Medicine. CRC Press, London.
7. Gibas Cynthia and Jambeck P. (2001). Developing Bioinformatics Computer Skills. Shroff Publishers and Distributors Pvt. Ltd. (O'Reilly), Mumbai.

BasicsofMedicalDiagnosisandPublicHealth

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2. Avena,V.:IonizingRadiationandLife.Mosby,S1.Lonis.1971orLaterEdition.
3. Baverstock,K.ofStaltar,J.:LowDoseRadiationBiologicalBasesofRiskAssessment.Taylorof

Francis, 1989.

4. Broil,A.B.:LowlevelRadiationEffects.AfactBook.SocietyofNuclearMedicine,USA,1982.
5. Bulokav EB., V. Naiitel, and J.B. Reitan.: Radiobiological Consequences of Nuclear AccidentsContamination Radioecology, Radiobiology, and Health.
6. Chase,GD.andRobinowitz,J.L.:RadioisotopeMethodology.BurgessPublishingCo.rdMinneapolis, Minn, USA. 3 Edition, 1967 or Later.
7. Coggle,J.E.:BiologicalEffectsofRadiation.TaylorandfrancisLtd.,London,1988orLaterEdition.
8. Dalrymple,G.V.,Ganldev,M.E.,Kollmorgen,G.M.,andVogel,H.J.:MedicalRadiationBiology. Saunders. Philadelphia, 1973 or Later Edition.
9. Duncan, R.C., Knapp., R.G., and Miller III, M.C.: Introductory Biostatistics for the Health Sciences. John Wiley and Sons. Inc., New York, 1977 or Later Editon.
10. Fobrikant,J.I.:Radiobiology.Yearbookmed.,Chicago,1972orLater Edition.