B. Sc. Medical

Scheme of course-Zoology

(To be offered along with other compulsory subject Chemistry, Botany, English and Panjabi)

Semester	Paper	Paper Code	Title	Periods /week	Marks	Total
I	Theory	Zoo-IA:	Cell Biology	**4**	**25**	**75+25= 100**
		Zoo-IB:	Biodiversity-I	**4**	**25**	
	Practical-I (Related to Zoo-IA and Zoo-IB)			**6**	**25**	
			Internal Assessment	**---**	**25**	
II	Theory	Zoo-IIA	Ecology	**4**	**25**	**75+25 =100**
		Zoo-IIB	Biodiversity-II (Arthropoda to Hemichordata)	**4**	**25**	
	Practical-II (Related to Zoo-IIA and Zoo-IIB)			**6**	**25**	
			Internal Assessment	**---**	**25**	
III	Theory	Zoo-III A	Evolution	**4**	**25**	**75+25 =100**
		Zoo-III B	Biodiversity–III (Chordates)	**4**	**25**	
	Practical-III (Related to Zoo-IIIA and Zoo-IIIB)			**6**	**25**	
			Internal Assessment	**---**	**25**	
IV	Theory	Zoo -IVA	Biochemistry	**4**	**25**	**75+25 =100**
		Zoo -IVB	Animal Physiology	**4**	**25**	
	Practical-IV (Related to Zoo-IVA and Zoo-IVB)			**6**	**25**	
			Internal Assessment	**----**	**25**	
V	Theory	Zoo -V A	Developmental Biology	**4**	**25**	**75+25 =100**
		Zoo -V B	Genetics	**4**	**25**	
	Practical-V (Related to Zoo-VA and Zoo-VB)			**6**	**25**	
			Internal Assessment	**----**	**25**	
VI	Theory	Zoo -VI A	Option (i)- Medical Zoology	**4**	**25**	**75+25 =100**
			Option (ii)- Economic Entomology I		**25**	
			Option (iii)- Inland Fisheries-I		**25**	
		Zoo -VI B	Option (i)- Medical Laboratory Technology	**4**	**25**	
			Option (ii)- Economic Entomology II		**25**	
			Option (iii)- Inland Fisheries-II		**25**	
	Practical-VI (Related to Zoo-VIA and Zoo-VIB)			**6**	**25**	
			Internal Assessment	**----**	**25**	

B. Sc. Medical Semester–I
ZOOLOGY

Theory Paper A: 25
Theory Paper B: 25
Practical: 25
Internal assessment: 25
Total Marks: 100

Theory
Zoo–IA: CELL BIOLOGY

Time: 3 Hrs. **Marks: 25**
Periods/week: 4

Instructions for the Paper Setters:

1) There will be a total of 9 questions of which five are to be attempted.
2) Question 1 will be compulsory and will be of 5 short answer type (one mark each).
3) The remaining 8 questions shall include two questions from each unit. Candidates shall be required to attempt 4 questions, one from each unit. Each question carries 5 marks. Preferably, the question should not be split into any sub-parts. In case of any splitting, it should not have more than two sub-parts.

UNIT–I

- Methods in Cell Biology:
  (a) Principles of light and phase contrast microscopy
  (b) Electron microscopy (TEM and SEM): Principle and construction
  (c) Fixation and fixatives
  (d) Staining techniques

UNIT–II

- Organization of Cell: Extra nuclear and nuclear, ultrastructure and functions of cell organelles
  (a) Plasma Membrane: Structure, osmosis, active & passive transport, endocytosis & exocytosis
  (b) Endoplasmic reticulum: Structure, types and associated enzymes
  (c) Mitochondria: Structure, mitochondrial enzymes and role of mitochondria in respiration and mitochondrial DNA

UNIT–III

- Organization of Cell:
  (a) Golgi complex: Structure and functions
  (b) Ribosomes: Types of ribosomes, their structure and functions
  (c) Lysosomes: Polymorphism and their function
  (d) Centrosome: Structure and functions

UNIT–IV

- Nucleus: Structure and functions of nuclear membrane, nucleolus and chromosomes
- An elementary idea of cell transformation in cancer: causes, symptoms and characteristics of cancer cells.
- An elementary idea of cellular basis of immunity: Types of immunity, B cell, T cell, Structure of antibody

B. Sc. Medical Semester–I
ZOOLOGY
Theory
Zoo–IB: BIODIVERSITY-I
(PROTOZOA TO ANNELIDA)

Time: 3 Hrs. **Marks: 25**

Periods/week: 4

Instructions for the Paper Setters:

1) There will be a total of 9 questions of which five are to be attempted.
2) Question 1 will be compulsory and will be of 5 short answer type (one mark each).
3) The remaining 8 questions shall include two questions from each unit. Candidates shall be required to attempt 4 questions, one from each unit. Each question carries 5 marks. Preferably, the question should not be split into any sub-parts. In case of any splitting, it should not have more than two sub-parts.

Detailed Type study of the following animals

UNIT–I

- Protozoa:
  - *Amoeba proteus*
  - *Paramecium caudatum* (with special reference to Kappa particles in *P. aurelia*)
  - *Plasmodium vivax*
- Introduction to Parasitic Protozoans

UNIT–II

- Parazoa (Porifera):
  - *Sycon*
- Cnidaria (Coelentrata):
  - *Obelia*

UNIT–III

- Platyhelminthes:
  - *Fasciola hepatica*
  - *Taenia solium*
- Larvae of *Fasciola hepatica* and *Taenia solium*

UNIT–IV

- Aschelminthes:
  - *Ascaris*
- Parasitic adaptations in Helminthes
- Annelida:
  - *Pheretima posthuma* (Earthworm)

B. Sc. Medical Semester–I
ZOOLOGY
PRACTICAL–I (RELATED TO Zoo-IA and Zoo-IB)

Time: 3 Hrs **Marks: 25**

Important Note for Practical:

1. Candidates will be required to submit their original note books containing record of their laboratory work.
2. Wherever possible, students must be taken out for excursion to the field (Zoological gardens, sea shores, ponds and hill stations etc) to study habitat and ecology of the animals.
3. As per the latest UGC guidelines the dissections may please be avoided In no case an animal falling under the categories of wildlife protection act 1972 should be caught or dissected The rules of the Prevention of cruelty to Animals act 1960 should be familiar to all who are teaching the zoology courses.

1	**Classification up to orders with ecological notes and economic importance (if any) of the following animals (Through Specimens or slides):**	
	Protozoa:	*Amoeba, Euglena, Trypanosoma, Noctiluca, Eimeria, Monocystis, Paramecium, Opalina, Vorticella, Balantidium, Nyctotherus, Polystomella*
	Parazoa:	*Sycon, Grantia, Euplectella, Hyalonema, Spongilla, Euspongia*
	Cnidaria:	*Porpita, Velella, Physalia, Aurelia, Rhizostoma, Metridium, Millipora, Alcyonium, Tubipora, Zoanthus, Madrepora, Favia, Fungia and Astrangia Hydra* (WM), *Hydra* with buds, *Obelia* (colony and medusa), *Sertularia, Plumularia, Tubularia, Bougainvillea* and *Aurelia*
	Platyhelminthes:	*Dugesia, Fasciola, Taenia, Echinococcus*
	Aschelminthes:	*Ascaris* (male and female), *Trichinella, Ancylostoma*
	Annelida:	*Pheretima, Nereis, Heteronereis, Polynoe, Eunice, Aphrodite, Chaetopterus, Arenicola, Tubifex, Pontobdella*
2	**Study of the permanent stained preparations**:	LS and TS *Sycon*, gemmules, spicules and spongin fibers of a sponge
		TS *Hydra* (Testis and ovary region)
		TS *Fasciola* (Different regions) Miracidium, Sporocyst, Redia, Cercaria larvae of *Fasciola* Scolex and proglottids of *Taenia* (mature and gravid)
		TS *Ascaris* (Male and Female)
		TS *Pheretima* (pharyngeal and typhlosolar regions), setae, septal nephridia, spermathecae and ovary of *Pheretima* (Earthworm)
3	**Temporary Preparation:**	Freshwater Protozoan culture; slide preparation
4	**Demonstration of**	digestive, reproductive and nervous systems of earthworm **with the help of charts/ videos/ models**
5	**Cell Biology:**	Paper chromatography
		Thin layers chromatography
		Gel electrophoresis through photographs or through research laboratories
		Familiarity with TEM & SEM
		Study of different ultra-structures of cell organelles through photographs
6	Students must be taken out to study vermicomposting unit and submission of report.	

Guideslines for conduct of practical Examination: -

1.	Identify and classify the specimens up to order. Write a note on their habit, habitat, special features and economic importance.	6
2.	Identify the slides/models and give two reasons for identification.	6
3.	Identify the adaptive feature/nest.	3
4.	Mark the distribution of animals of a realm on the map.	4
5.	Project/ Assignment report	2
6.	Viva-voce & Practical file.	4

B.Sc. Medical Semester–II
ZOOLOGY

Theory Paper A: 25
Theory Paper B: 25
Practical: 25
Internal assessment: 25
Total Marks: 100

Theory

Zoo–II A: ECOLOGY

Time: 3 Hrs. **Marks: 25**

Periods/week: 4

Instructions for the Paper Setters:

1) There will be a total of 9 questions of which five are to be attempted.
2) Question 1 will be compulsory and will be of 5 short answer type (one mark each).
3) The remaining 8 questions shall include two questions from each unit. Candidates shall be required to attempt 4 questions, one from each unit. Each question carries 5 marks. Preferably, the question should not be split into any sub-parts. In case of any splitting, it should not have more than two sub-parts.

UNIT–I

- **Ecology:** Definition, subdivisions and scope of ecology
- **Ecosystem:** Components, ecological energetics, food web, major ecosystems of the world
- **Ecological factors:** Temperature, light and soil as ecological factors

UNIT–II

- **Nutrients:** Biogeochemical cycles and concept of limiting factors
- **Ecological Adaptations:** Morphological, physiological and behavioural adaptations in animals in different habitats

UNIT–III

- **Population**: Characteristics and regulations of population
- **Inter and Intra Specific relationship:** Competition, predation, parasitism, commensalism and mutualism
- **Biotic community:** Characteristics, ecological succession, ecological niche

UNIT–IV

- **Natural resources:** Renewable and nonrenewable natural resources and their conservation
- **Environmental Issues:** Causes, impact and control of environmental pollution

B.Sc. Medical Semester–II
ZOOLOGY
Theory
Zoo–II B: BIODIVERSITY-II
(ARTHROPODA TO HEMICHORDATA)

Time: 3 Hrs. **Marks: 25**

Periods/week: 4

Instructions for the Paper Setters:

1) There will be a total of 9 questions of which five are to be attempted.
2) Question 1 will be compulsory and will be of 5 short answer type (one mark each).
3) The remaining 8 questions shall include two questions from each unit. Candidates shall be required to attempt 4 questions, one from each unit. Each question carries 5 marks. Preferably, the question should not be split into any sub-parts. In case of any splitting, it should not have more than two sub-parts.

UNIT–I

- **Arthropoda-** Type study**:**
  - *Periplaneta americana* (Cockroach)
- Social organizations in insects (Honey bee and Termite)

UNIT–II

- **Mollusca-** Type study**:**
  - *Pila globosa*
- Torsion, Pearl formation

UNIT–III

- **Echinodermata-** Type study**:**
  - *Asterias* (Star fish)
- Study of Echinoderm larvae

UNIT–IV

- **Hemichordata:** *Balanoglossus* (External characters only)
- Affinities of Hemichordates with Non-Chordates and Chordates

B.Sc. Medical Semester–II
ZOOLOGY
PRACTICAL–II (RELATED TO Zoo-II A and Zoo-II B)

Time: 3hrs. **Marks: 25**

Important Note for Practical:

1) Candidates are required to submit their original note books containing record of their laboratory work.

2) Wherever possible, students must be taken out for excursion to the field (Zoological gardens, sea shores, ponds and hill stations etc.) to study habitat and ecology of the animals.

As per the latest UGC guidelines (D.O.No. F. 14-6/2014(CPP-II) dated 01-08-2014) the dissections should not be conducted. The guidelines on this issue are available on the UGC website: www.ugc.ac.in

1.	Classification up to orders with ecological notes and economic importance (if any) of the following animals:	
	Arthropoda :	*Peripatus, Palaemon, Lobster, Cancer, Sacculina, Eupagurus, Lepas, Balanus, Cyclops, Daphnia, Lepisma, Periplaneta, Schistocerca, Mantis, Poecilocerus, Gryllus, Cicada, Forficula*, Dragonfly, Termite queen, *Apis*, Bug, Moth, Beetles, *Polistes, Bombyx, Pediculus, Scolopendra, Julus, Palamnaeus, Aranea , Limulus*
	Mollusca:	*Anodonta, Mytilus, Ostrea, Cardium, Pholas, Solen, Pecten, Haliotis, Patella, Aplysia, Doris, Limax, Loligo, Sepia, Octopus, Nautilus* shell (Complete and T.S.), *Chiton, Dentalium*
	Echinodermata:	*Asterias, Echinus Ophiothrix, Antedon*
	Hemichordata:	*Balanoglossus*
2.	Study of permanent stained preparations:	Insect trachea
		Radula and osphradium of *Pila*
		T.S. Star fish (Arm)
3.	Study of	Mouth parts of *Periplaneta*
4.	Demonstration using charts/models/software	Digestive and nervous system of *Periplaneta*
5.	**Ecology:**	Study of animal adaptations with the help of specimens, charts & models
		Study of abiotic and biotic components of an ecosystem
		Study of different types of nests in birds
		Study and preparation of charts Zoogeographical realms
6.	**Assignment**	

Guidelines for conduct of practical Examination: -

1.	Identify and classify the specimens up to order. Write a note on their habit, habitat, special features and economic importance.	6
2.	Identify the slides/models and give two reasons for identification.	6
3.	Identify the adaptive feature of animals/nest.	4
4.	Mark the distribution of animals of a realm on the map.	3
5.	Project/ Assignment report	2
6.	Viva-voce & Practical file.	4

B.Sc. Medical Semester–III
ZOOLOGY

Theory Paper A: 25
Theory Paper B: 25
Practical: 25
Internal assessment: 25
Total Marks: 100

Theory

Zoo–III A: EVOLUTION

Time: 3 Hrs. **Marks: 25**

Periods/week: 4

Instructions for the Paper Setters:

1) There will be a total of 9 questions of which five are to be attempted.
2) Question 1 will be compulsory and will be of 5 short answer type (one mark each).
3) The remaining 8 questions shall include two questions from each unit. Candidates shall be required to attempt 4 questions, one from each unit. Each question carries 5 marks. Preferably, the question should not be split into any sub-parts. In case of any splitting, it should not have more than two sub-parts.

UNIT–I

- Introduction to evolution.
- Evidences of organic evolution
- Theories of organic evolution.

UNIT–II

- Origin of life.
- Concept of micro, macro and mega-evolution.
- Concept of Species
- Speciation

UNIT–III

- Fossils, its types and significance
- Evolutionary rate
- Origin & Extinction of reptiles
- Evolution of man (in Brief)

UNIT–IV

- Migration & Parental Care in Pisces
- Scales & fins in fish
- General features of Poisonous and Non-Poisonous Snakes
- Poison apparatus in snakes
- Flight adaptation & Bird migration,
- Adaptive radiation and Dentition in Mammals

B.Sc. Medical Semester–III
ZOOLOGY

Theory
Zoo–III B: BIODIVERSITY–III (CHORDATES)

Time: 3 Hrs. **Marks: 25**

Periods/week: 4

Instructions for the Paper Setters:

1) There will be a total of 9 questions of which five are to be attempted.
2) Question 1 will be compulsory and will be of 5 short answer type (one mark each).
3) The remaining 8 questions shall include two questions from each unit. Candidates shall be required to attempt 4 questions, one from each unit. Each question carries 5 marks. Preferably, the question should not be split into any sub-parts. In case of any splitting, it should not have more than two sub-parts.

UNIT–I

- **Urochordata-** External features and affinities of Herdmania
- **Cephalochordata**-Type study:
  - *Amphioxus*

UNIT–II

- **Cyclostomata:** External Characters of *Petromyzon*
- Affinities of Cyclostomata
- **Pisces**-Type study:
  - *Labeo*

UNIT–III

- **Amphibia**-Type study:
  - Frog
- **Reptilia**-Type study:
  - *Uromastix,*

UNIT–IV

- **Aves**-Type study:
  - Pigeon
- **Mammals**-Type study:
  - Rat

B.Sc. Medical Semester–III
ZOOLOGY
PRACTICAL-III (RELATED TO Zoo-IIIA and Zoo-IIIB)

Time: 3 Hrs. **Marks: 25**

Important Note for Practical:

1) Candidates are required to submit their original note books containing record of their laboratory work.
2) Wherever possible, students must be taken out for excursion to the field (Zoological gardens, sea shores, ponds and hill stations etc.) to study habitat and ecology of the animals.
3) As per the latest UGC guidelines (D. O. No. F. 14-6/2014(CPP-II) dated 01-08-2014) the dissections should not be conducted. The guidelines on this issue are available on the UGC website: www.ugc.ac.in

I.	**Classification up to order level, except in case of Pisces and Aves where classification up to subclass level, habits, habitat, external characters and economic importance (if any) of the following animals is required :**	
	Urochordata:	*Herdmania, Molgula, Pyrosoma, Doliolum, Salpa & Oikopleura*
	Cephalochordata:	*Amphioxus*
	Cyclostomata:	*Myxine, Petromyzon & Ammocoetes* Larva.
	Chondrichthyes:	*Zygaena, Pristis, Narcine, Trygon, Rhinobatus and Chimaera*
	Actinoptergii:	*Polypterus, Acipenser, Lepidosteus, Muraena, Mystus, Catla, Hippocampus,*
		Syngnathus, Exocoetus, Anabas, Diodon, Tetradon, Echeneis and Solea.
	Dipneusti :	*Protopterus* (african lung fish)
	Amphibia:	*Uraeotyphlus, Necturus, Amphiuma, Amblystoma* and its Axolotl Larva,
		Triton, Salamandra, Hyla, Rhycophorus
	Reptilia:	*Hemidactylus, Calotes, Draco, Varanus, Phrynosoma, Chamaeleon,*
		Typhlops, Python, Eryx, Ptyas, Bungarus, Naja, Hydrus, Vipera,
		Crocodilus, Gavialis, Chelone (turtle) and *Testudo* (tortoise),
		Differences in nonpoisonous and poisonous snakes.
	Aves:	*Casuarius, Ardea, Anas, Milvus, Pavo, Eudynamics, Tyto* and *Alcedo.*
	Mammalia:	*Ornithorynchus, Echidna, Didelphis, Macropus, Loris, Macaca, Manis,*
		Hystrix, Funambulus, Panthera, Canis, Herpestes, Capra, Pteropus.
II.	Study of the following systems with the help of charts/models/videos:	
	Herdmania	General anatomy
	Labeo	Digestive and reproductive systems, heart, afferent and branchial arteries, cranial nerves and internal ear.
	Chick	Digestive, arterial, venous and urino-genital systems.
	White Rat	Digestive, arterial, venous and urino-genital systems
III.	Study of permanent slides	whole mount of Pharynx of *Herdmania*
		T.S. *Amphioxus* through various regions, Pharynx of *Amphioxus*
		Cycloid scales of *Labeo*
		Blood smear of mammal
		Histology of rat/rabbit (compound tissues)
IV	Demonstration of evolutionary phenomena: homology, analogy, mimicry, crypsis.	
V	Study of evolution	horse/elephant/man
VI	Study of fossils.	
VII.	Assignment	

Guidelines for conduct of Practical Examination:

1.	Identify and classify the given specimen.	6
2.	Identify the given system of the animal from chart/model. Draw a well labeled diagram.	6
3.	Identify the given slide stating two reasons for its identification.	4
4.	Identify evolutionary phenomenon and give its significance.	3
5.	Project/ Assignment report	2
6.	Viva-voce & Practical file.	4

B.Sc. Medical Semester–IV
ZOOLOGY

Theory Paper A: 25
Theory Paper B: 25
Practical: 25
Internal assessment: 25
Total Marks: 100

Theory
Zoo–IVA: BIOCHEMISTRY

Time: 3 Hrs. **Marks: 25**
Periods/week: 4

Instructions for the Paper Setters:

1) There will be a total of 9 questions of which five are to be attempted.
2) Question 1 will be compulsory and will be of 5 short answer type (one mark each).
3) The remaining 8 questions shall include two questions from each unit. Candidates shall be required to attempt 4 questions, one from each unit. Each question carries 5 marks. Preferably, the question should not be split into any sub-parts. In case of any splitting, it should not have more than two sub-parts.

UNIT–I

- **Biochemistry and its scope;**
- **Classification and functions of:**
  - Carbohydrate
  - Proteins
  - Lipids
  - Nucleic acids

UNIT–II

- **Enzymes:**
  - Nature and their classification
  - Coenzymes
- **Lipid Metabolism:**
  - β-Oxidation of fatty acid
  - Ketosis

UNIT –III

- **Carbohydrate Metabolism:**
  - Glycolysis (The Embden Meyerhoff Parnas Pathway)
  - Tricarboxylic acid cycle
  - Hexose monophosphate shunt
  - Glycogenesis
  - Glycogenolysis
  - Gluconeogenesis
  - Oxidative Phosphorylation

UNIT –IV

- **Protein Metabolism:**
  - Metabolism of amino acids
  - Oxidative deamination
  - Transamination
  - Decarboxylation,
  - Hydrolysis of proteins
  - Ornithine cycle

B.Sc. Medical Semester–IV
ZOOLOGY
Theory
Zoo–IVB: ANIMAL PHYSIOLOGY

Time: 3 Hrs. **Marks: 25**

Periods/week: 4

Instructions for the Paper Setters:

1) There will be a total of 9 questions of which five are to be attempted.
2) Question 1 will be compulsory and will be of 5 short answer type (one mark each).
3) The remaining 8 questions shall include two questions from each unit. Candidates shall be required to attempt 4 questions, one from each unit. Each question carries 5 marks. Preferably, the question should not be split into any sub-parts. In case of any splitting, it should not have more than two sub-parts.

UNIT–I

- **Digestion:**
  - Digestion of dietary constituents
  - Regulation of digestive processes and absorption
  - Extra and intra cellular digestion
  - Enzymatic digestion and symbiotic digestion.
- **Respiration:**
  - Transport of O_2 and CO_2
  - Oxygen dissociation curve of haemoglobin
  - Bohr effect, Chloride shift and Haldane effect
  - Control of breathing

UNIT –II

- **Heart:**
  - Origin and regulation of heart beat
  - Cardiac cycle and Cardiac output
  - Electrocardiogram
  - Blood pressure and micro-circulation
- **Blood:**
  - Composition and functions of blood and lymph
  - Blood clotting
  - Blood groups including Rh factor
  - Haemopoiesis and haemostasis
- **Excretion:**
  - Urine formation
  - Osmoregulation

UNIT –III

- **Muscles:**
  - Ultrastructure of skeletal muscle
  - Chemical and physiological basis of skeletal muscle contraction
- **Neural Integration:**
  - Structure of neuron
  - Resting membrane potential
  - Origin and propagation of impulse along the axon, synapse and myoneural junction

UNIT –IV

- **Physiology of Behavior:**
  - Taxes and reflexes
  - Instinctive and motivative learning and reasoning
- **Endocrine:**
  - Structure and physiology of thyroid, parathyroid, adrenal, hypothalamus, pituitary, pancreas and gonads

Suggested Readings:

1. Bhamarah, H.S., Juneka K., Cytogenetics & Evolution, Anmol Publication Pvt. Ltd., 1993.
2. Colbert. E.H., Evolution of Vertebrates, II Edition, Wiley Eastern Ltd., 1989.
3. Dobzhansky, Ayala, Stebbins & Valentine, Evolution W.H. Freeman, 1952.
4. Dhami, P.S. & Dhami J.K., Vertebrates, R. Chand & Co., New Delhi, 1998.
5. Guyton, A.S., Text Book of Medical Physiology, 7th Edition, W.B. Saunders Company, 1994.
6. Lehninger, A., Principles of Biochemistry, Worth Publishers, Inc., USA, 2000.
7. Parker, T.J. and Haswell, W.A, Text Book of Zoology, Vol. II (Vertebrates), ELBS and Macmillian Press Ltd., 1981.
8. Robert, K., Murray, Mayes Daryl, K. Granner, Victor, W., Woodwell, Harper's Biochemistry, 22nd Edition, Prentice Hall International Inc., 1990.
9. Taneja, S.K., Biochemistry & Animal Physiology, Trueman Book Co., 1997.

B.Sc. Medical Semester–IV

ZOOLOGY

PRACTICAL–IV (RELATED TO Zoo-IVA and Zoo-IVB)

Time: 3 Hrs. **Marks: 25**

Important Note for Practical:

1. Candidates are required to submit their original note books containing record of their laboratory work.
2. Wherever possible, students must be taken out for excursion to the field (Zoological gardens, sea shores, ponds and hill stations etc.) to study habitat and ecology of the animals. As per the latest UGC guidelines (D.O.No. F. 14-6/2014(CPP-II) dated 01-08-2014) the dissections should not be conducted. The guidelines on this issue are available on the UGC website: www.ugc.ac.in

1.	Study of the skeleton	*Rana*, *Scoliodon*, *Varanus*, *Gallus* and *Oryctolagus*
2.	Identification of food stuffs in solution	starch, glucose, proteins and fats
3.	Demonstration	osmosis and diffusion
4.	Demonstrate the presence of amylase in:	Saliva and its denaturation by pH and temperature.
5.	Determination	coagulation and bleeding time of blood in man/rat/rabbit
		blood groups of human blood sample
		haemoglobin content of human blood
6.	Recording	blood pressure of man
7.	Urine Analysis	for urea, chloride, glucose and uric acid
8.	Field study: Visit to a fossil Park/Lab.	
9.	Familiarity with the local vertebrate fauna	

Note: Some changes can be made in the practicals depending on the availability of material.

Guidelines for conduct of Practical Examination:

1.	Identify the given bones. Make labeled sketches of their respective–views.	8
2.	Write down the procedure and determine the constituent in the given sample.	6
3.	Write the procedure and perform the given physiology experiment.	5
4.	Report on visit to fossil park/study of local vertebrate fauna.	2
5.	Viva-voce & Practical file.	4

B.Sc. Medical Semester–V
ZOOLOGY

Theory Paper A: 25
Theory Paper B: 25
Practical: 25
Internal assessment: 25
Total Marks: 100

THEORY
Zoo-VA: DEVELOPMENTAL BIOLOGY

Time: 3 Hrs. **Marks: 25**
Periods/week: 4

Instructions for the Paper Setters:

1) There will be a total of 9 questions of which five are to be attempted.
2) Question 1 will be compulsory and will be of 5 short answer type (one mark each).
3) The remaining 8 questions shall include two questions from each unit. Candidates shall be required to attempt 4 questions, one from each unit. Each question carries 5 marks. Preferably, the question should not be split into any sub-parts. In case of any splitting, it should not have more than two sub-parts.

Unit-I

- Gametogenesis with particular reference to differentiation of spermatozoa, Vitellogenesis; role of follicle/sub-testicular cells in Gametogenesis
- Egg maturation; egg membranes; polarity of egg
- Parthenogenesis

Unit-II

- Fertilization
- Cleavage and its patterns
- Gastrulation
- Determination and differentiation
- Development upto three germinal layers and their fate in *Herdmania, Amphioxus*
- Tissue interactions, basic concepts of organizers and inductors and their role

Unit-III

- Development upto three germinal layers and their fate in frog, chick and rabbit
  Fate maps of chick and frog embryos
- Metamorphosis in *Herdmania* and *Rana* (frog)

Unit-IV

- Foetal membranes, their formation and role
- Mammalian placenta–its formation, types and functions
- Regeneration, Ageing and Death

Suggested Readings:

1. Balinsky, B.I. (1981), An Introduction to Embryology, Saunders, Philadelphia.
2. Bellairs, R. (1971), Development Processes in Higher Vertebrates, University of Miami Press, Miami.
3. Berrill. N.J. (1971), Developmental Biology. McGraw Hill, New Delhi.
4. Ebert, J.D. & Sussex, IM. (1970), Interacting Systems in Development, Holt, Rinehart and Winston, New York
5. Gilbert, F. (2000), Developmental Biology, Sinaur.
6. Goel, S.C. (1984), Principles and Animal Developmental Biology, Himalaya, Bombay.
7. Grant, P. (1978), Biology of Developing System.
8. Karp. G. & Berrill, M.J. (1981), Development. McGraw Hill, New Delhi.
9. Loomis, W.F. (1986), Developmental Biology Macmillan, New York.
10. Miller, W.A. (1997), Developmental Biology Springer Verlag, New York.
11. Oppenheimer, J.M. and Willer, B.H. (1964), Foundation of Experimental Embryology, Prentice-Hall, New Delhi.
12. Pritchard, D.J. (1986), Foundation of Development Genetics, Taylor and Francis, London.
13. Saunders, J.W. (1982), Developmental Biology, Patterns, Principles, Problems, MacMillan, New York.
14. Spratt, N.T. Jn. (1971), Developmental Biology, Wordsworth, Belmont, Co.
15. Waddigton CH. (1966), Principles of Development and Differentiation, MacMillan, New York.

B.Sc. Medical Semester–V
ZOOLOGY
THEORY
Zoo-V B: Genetics

Time: 3 Hrs. **Marks: 25**

Periods/week: 4

Instructions for the Paper Setters:

1) There will be a total of 9 questions of which five are to be attempted.
2) Question 1 will be compulsory and will be of 5 short answer type (one mark each).
3) The remaining 8 questions shall include two questions from each unit. Candidates shall be required to attempt 4 questions, one from each unit. Each question carries 5 marks. Preferably, the question should not be split into any sub-parts. In case of any splitting, it should not have more than two sub-parts.

Unit-I

- **Modification of Mendelian Ratios:** Non-allelic gene interaction, Modified F2 ratios. (9:7; 9:3; 12:3:1; 13:3; 15:1; 9:6:1), Gene modifications due to incomplete dominance; lethal factors(2:1); Pleiotropic genes.
- **Multiple Alleles:** Blood group inheritance, eye colour in *Drosophila,* pseudoallelism.
- **Multiple Factors:** Qualitative and quantitative characters, inheritance of quantitative traits (skin colour in man)
- **Linkage:** Linkage, sex-linked characters
- **Crossing Over and Recombination:** crossing over, frequency of crossing over, cytological basis of crossing over, synaptonemal complex. Recombination in Fungi (Tetrad analysis)

Unit-II

- **Gene and Genetic Code:** Structure of nucleic acids **(DNA & RNA).**
- **Replication & transcription of DNA**
- **Expression of gene** (Protein synthesis in Prokaryotes and Eukaryotes).
- **Genetic code:** Properties of genetic code, codon assignment, wobble hypothesis, split and over-lapping genes

Unit-III

- **Mutations:** Spontaneous and induced mutations, physical and chemical mutagen. Detection of mutations in Maize and *Drosophila.* Inborn errors of metabolism in man (Phenylketonuria, Alcaptonuria, Albinism). Somatic mutations and carcinogenesis.
- **Regulation of gene expressions** in prokaryotes (Operon model) in eukaryotes.
- **Extranuclear inheritance:** Chloroplast with special reference to *Mirabilis jalapa* and kappa particles in *Paramecium*

Unit-IV

- **Population genetics:** Equilibrium of gene frequencies and Hardy-Weinberg law.
- **Genetic recombination** in bacteria (conjugation, transduction and transformation) and in plasmids.
- **Applied Genetics:** Recombination DNA, Genetic cloning and its applications in medicine and agriculture, DNA finger printing.
- **Evolution of genes**

Suggested readings:

1. Ayala, F.J. & Kiger, Jr. J.A. (1980), Modern Genetics. The Benjamin Cummings Publishing Co. Inc.
2. Brown T.A. (1992), Genetics- A Molecular Approach, (2^{nd} ed), Van Nostrand Rainhold
3. Gardener, E.J., Simmons, M.T.J. & Sunstad, D.P. (1999), Principles of Genetics, (8^{th} ed), John Wiley & Sons, New York.
4. Miglani, G.S. (2000), Basic Genetics, Narosa Publishing House, New Delhi.
5. Satson, J.D. et. al. (1987), Molecular Biology of Gene (4^{th} ed. vol. I & II), The Benjamin /Cummings Publishing Co., Inc.
6. Weaver, R.F. and Hedrick, P.W. (1992), Genetics, Wm. C. Brown Publishers Dubuque.
7. Winter, P.C., Hickey, G.I. and Fletcher, H.L. (1999), Instant notes in Genetics, New Delhi.
8. Zubay. U.G. (1987), Genetics, The Cummings Publishing Co., Inc.

B.Sc. Medical Semester–V
ZOOLOGY
Practical-V (Related to Zoo-V A and Zoo-V B)

Time: 3hrs. **Marks: 25**

Important Note for Practical:

1. Candidates are required to submit their original note books containing record of their laboratory work.
2. Wherever possible, students must be taken out for excursion to the field (Zoological gardens, sea shores, ponds and hill stations etc.) to study habitat and ecology of the animals.
3. As per the latest UGC guidelines the dissections may please be avoided. In no case an animal falling under the categories of wildlife protection act 1972 should be caught or dissected. The rules of the Prevention of cruelty to Animals act 1960 should be familiar to all who are teaching the zoology courses. The guidelines on this issue are also available on the UGC website: www.ugc.ac.in

1.	Demonstration of	Law of segregation and Independent assortment (use of coloured beads capsules etc.)
		Segregation in preserved material (Maize)
		Cytoplasmic inheritance in snails
2.	Numerical	Segregation Independent assortment Epistasis
3.	Inheritance	Inheritance of human characteristics (ability to taste PTC, thio urea)
4.	Variance	Comparison of Pod length and number of seeds/pods
5.	Calculation	Gene frequencies Random mating (coloured beads, capsules)
6.	Pedigree analysis	
7.	Preparation	Polytene Chromosomes of *Chironomus*
		Dermatoglyphics: Palm print and fingertip patterns
8.	Study of the permanent slides	Stages of gametogenesis, structure of egg and sperm of a mammal
		Larva of *Herdmania*
		Developmental stages of freshwater snail *(Limnaea)*, Frog upto tadpole, Chick upto 96 hrs
		Preparation of charts showing various life stages of any vertebrate

Note: - Some changes can be made in the practicals depending on the availability of material.

Guidelines for conduct of Practical Examination:

1.	Two Numerical based on Mendel/Hardy Weinberg Law.	8
2.	Perform the experiment for Dermatoglyphic/ Random mating/ Variance.	6
3.	Identification of given spots.	4
4.	Make a pedigree chart from the given data.	3
5.	Viva-voce and practical file.	4

B.Sc. Medical Semester–VI
ZOOLOGY

Options:-

(i) Medical Zoology & Medical Laboratory Technology
(ii) Economic Entomology I & II
(iii) Inland Fisheries (Aquaculture) I & II

Theory Paper A: 25
Theory Paper B: 25
Practical: 25
Internal assessment: 25
Total Marks: 100

THEORY

Zoo-VI A: Option (i): Medical Zoology

Time: 3 Hrs. **Marks: 25**

Periods/week: 4

Instructions for the Paper Setters:

1) There will be a total of 9 questions of which five are to be attempted.
2) Question 1 will be compulsory and will be of 5 short answer type (one mark each).
3) The remaining 8 questions shall include two questions from each unit. Candidates shall be required to attempt 4 questions, one from each unit. Each question carries 5 marks. Preferably, the question should not be split into any sub-parts. In case of any splitting, it should not have more than two sub-parts.

UNIT–I

- Introduction of Parasitology (pertaining to various terminologies in use).
- Brief introduction to pathogenic Microbes, Viruses, Ricketsiae, Spirochaetes and Bacteria.
- Brief accounts of life history, mode of infection and pathogenicity of the following pathogens with reference to man; prophylaxis and treatment:
  - Pathogenic protozoans: *Entamoeba, Trypanosoma*, *Leishmania, Giardia, Trichomonas* and *Plasmodium.*
  - Pathogenic helminthes: *Fasciolopsis, Schistosoma, Echinococcus, Ancylostoma, Trichinella, Wuchereria, Dracunculus* and *Oxyuris.*

UNIT–II

- Life cycle and control measures of arthropod vectors of human disease: Malaria *(Anopheles stephens, A. culicifaces* Yellow fever and Dengue haemorrhagic fever, Chicken gunea, *(Aedes aegypti A. Albopicuts)*; Filariasis *(Culex pipien satigeans) Mansonia* sp. Japanes Encephalitis *(C. trinanelorhynchus);* Plague *(Stenophalide cheopis)* and Epidemic Typhus *(Pediculus spp).*
- Epidemic disease, such as Typhoid, Cholera, Small pox; their occurrence and eradication programmes.

UNIT–III

- Brief introduction to human defense mechanisms.
- Humoral and cell mediated immune response. Physical & chemical properties of antigens. Antibodies structure and function of immunoglobulins M, G, A, E and D.

UNIT–IV

- Antigens and antibody interactions-Serodiagonstic assays (Precipitation, agglutination immunodiffusion, ELISA, RIA).
- Vaccines

Suggested Readings:

1. Baker, F.J. and Silverton, R.E. (1985) Introduction to Medical Laboratory Technology,(6th ed), Butlerworth and Co. Ltd.
2. Chatterjee, K.D.(1995), Parasitology, Protozoology and Helminthology (12th ed).
3. Cheesborough, M.(1987), Medical Laboratory Technology for Tropical countries (2nd ed), Butlerworth and Co., Ltd.
4. Garcia, L.S.(2001), Diagnostic Medical Parasitology, (4th ed), ASM Press Washington.
5. Kimball, J.W. (1986), Introduction of Immunology, MacMillian Publishing Co., New York.
6. Kuby, J.(2000), Immunology, W.H. Freeman & Co., USA.
7. Roitt, I. (1984), Essential Immunology, Blackwell Scientific Publications, Oxford.
8. Talib, V.H.(1999), Essential Laboratory Manual, Mehta Publishers, New Delhi.

B.Sc. Medical Semester–VI
ZOOLOGY
THEORY
Zoo-VI B: Option (i): Medical Laboratory Technology

Time: 3 Hrs. **Marks: 25**

Periods/week: 4

Instructions for the Paper Setters:

1) There will be a total of 9 questions of which five are to be attempted.
2) Question 1 will be compulsory and will be of 5 short answer type (one mark each).
3) The remaining 8 questions shall include two questions from each unit. Candidates shall be required to attempt 4 questions, one from each unit. Each question carries 5 marks. Preferably, the question should not be split into any sub-parts. In case of any splitting, it should not have more than two sub-parts.

UNIT–I

- Laboratory safety rules, hazards and precautions during sample collections and laboratory investigations.
- Laboratory Techniques: Colorimetry, Microscopy, Autoclaving, Centrifugation and Spectrophotometry

UNIT–II

- Collection, transportation and preservation of different clinical samples.
- Haematology, collection of blood (venous and capillary) anticoagulants (merits and demerits),
- Romanowsky's stains, total RBC count, erythrocyte sedimentation rate, TLC, DLC, eosinophil count, platelet count, reticulocyte count

UNIT–III

- Bacteriology, sterilization (dry heat, moist heat, autoclave, filteration), disinfection, staining techniques, (gram stain, AFB stain, etc), culture media (defined and synthetic media & routine laboratory media), bacterial culture (aerobic and anerobic) and antibiotic sensitivity.

UNIT–IV

- Biochemistry, protein estimation, estimation of blood urea, sugar and cholesterol, serum creatinine and uric acid, urine analysis, estimation of proteins, sugar, bile salts, bile pigments, ketone bodies, enzyme studies (serum transaminase, phosphatase, amylase and lipase), liver function test.
- Histopathology: Common fixatives and staining techniques, histochemistry, principle and methods: staining of carbohydrates, proteins and fats with Bromophenol Blue, Periodic acid Schiff, Sudan Black Blue and Feulgen reagents

Suggested Readings:

1. Baker, F.J. and Silverton, R.E. (1985) Introduction to Medical Laboratory Technology, (6^{th} ed), Butlerworth and Co. Ltd.
2. Chatterjee, K.D.(1995), Parasitology, Protozoology and Helminthology (12^{th} ed).
3. Cheesborough, M.(1987), Medical Laboratory Technology for Tropical countries (2^{nd}ed), Butlerworth and Co., Ltd.
4. Garcia, L.S.(2001), Diagnostic Medical Parasitology, (4^{th} ed), ASM Press Washington.
5. Kimball, J.W. (1986), Introduction of Immunology, MacMillian Publishing Co., New York.
6. Kuby, J.(2000), Immunology, W.H. Freeman & Co., USA.
7. Roitt, I. (1984), Essential Immunology, Blackwell Scientific Publications, Oxford.
8. Talib, V.H.(1999), Essential Laboratory Manual, Mehta Publishers, New Delhi.

B.Sc. Medical Semester–VI
ZOOLOGY
Practical-VI (Related to (Option-i) Zoo-VI A and Zoo-VI B)

Time: 3hrs. **Max. Marks: 25**

Important Note for Practical:

A. Candidates will be required to submit their original note books containing record of their laboratory work.

B. Wherever possible, students must be taken out for excursion to the field (Zoological gardens, sea shores, ponds and hill stations etc.) to study habitat and ecology of the animals.

C. As per the latest UGC guidelines the dissections may please be avoided. In no case an animal falling under the categories of wildlife protection act 1972 should be caught or dissected. The rules of the Prevention of cruelty to Animals act 1960 should be familiar to all who are teaching the zoology courses. The guidelines on this issue are also available on the UGC website: www.ugc.ac.in

1.	Demonstration of	Safety rules in laboratory like proper handling of patients, specimens and disposal of syringes, needles etc.
		Use of autoclave, centrifuge and spectrophotometer.
		Parts of microscope, its functioning and care.
2.	Cleaning and sterilization of	Glass ware, using hot air oven, autoclave etc.
3.	Estimation of	Haemoglobin using Sahli's Haemometer.
		ESR, haematocrit, bleeding time, coagulation time, prothrombin time
		Blood sugar, serum urea, protein and cholesterol.
4.	Physico-chemical examination of urine.	
5.	Preparation of thick and thin blood films for malarial parasite.	
6.	Counting of WBC, RBC and DLC.	
7.	Examination of stools for demonstration of intestinal parasites.	
8.	Analysis of blood groups, A, B, AB, O and Rh.	
9.	Study of permanent slides and specimens	Parasitic protozoans, helminthes and arthropods mentioned in the theory syllabus.
10.	Fixation, embedding, cutting of tissue sections, and their staining (routine haemotoxylin and eosin and special staining with BPB, PAS, SBB and Fuelgen reagents).	

Visit to a pathology Lab and preparation of report.

Note: - Some changes can be made in the practicals depending on the availability of material

Guidelines for conduct of Practical Examination:

1.	Write down the principle and working of the given equipment.	6
2.	Write down the procedure, precautions and perform the experiment for physico-chemical examination of urine.	6
3.	Perform an experiment on Haematology.	3
4.	Identification, pathogenicity and host of parasitic organism.	3
5.	Estimation of blood sugar/urea/cholesterol/ protein in the given sample.	3
6.	Viva-voce and practical file.	4

B.Sc. Medical Semester–VI
ZOOLOGY
Theory
Zoo-VI A: Option (ii): Economic Entomology-1

Time: 3 Hrs. **Marks: 25**

Periods/week: 4

Instructions for the Paper Setters:

1) There will be a total of 9 questions of which five are to be attempted.
2) Question 1 will be compulsory and will be of 5 short answer type (one mark each).
3) The remaining 8 questions shall include two questions from each unit. Candidates shall be required to attempt 4 questions, one from each unit. Each question carries 5 marks. Preferably, the question should not be split into any sub-parts. In case of any splitting, it should not have more than two sub-parts.

UNIT–I

- Systematic position, habits and nature of damage of the following pests of crops and vegetables :

A. Sugarcane:

1) Sugarcane leaf hopper *(Pyrilla perpusilla)*
2) Sugarcane top borer *(Scirpophaga nivella)*
3) Sugarcane stem borer *(Chilotrea infuscatellus)*
4) Along with life cycle and control of *Pyrilla perpusilla* (Sugarcane leaf hopper).

B. Cotton:

1) Pink bollworm *(Pectinophora gossypiella)*
2) Red cotton bug *(Dysdercus cingulatus)*
3) Cotton grey weevil *(Myllocerus maculosus)*
4) Surface grasshopper *(Chrotogonus trachypterus)*
5) Cotton jassid *(Empoasca devastans)*
6) Along with life cycle and control of Pink boll worm *(Pectinophora gossypiella)*

UNIT–II

C. Paddy:

1) Rice gundhy Bug *(Leptocorisa varicorni)*
2) Rice grasshopper *(Heiroglyphus banian)*
3) Rice Hispa *(Dicladispa armigera)*
4) Along with life cycle and control of gundhy bug *(Leptocorisa varicornis)*.

D. Wheat:

1) Wheat stem borer *(Sesamia inferens)*.
2) Termites
3) Wheat Aphid and Jassid
4) Life cycle and control of Wheat stem borer *(Sesamia inferens)*.

UNIT–III

- **Vegetables:**
  1) Red pumpkin beetle *(Aulacophora foveicollis)*
  2) Pumpkin fruit fly *(Dacus cucurbitae)*
  3) Hadda beetle *(Epilachna vigintioctopunctata)*
  4) Life cycle and control of pumpkin fruit fly *(Dacus cucurbitae)*

- **Pests of stored grains: Systematic position, habits and nature of damage of the following pests of stored grains:**
    1. Pulse Beetle *(Callosobruchus maculatus)*
    2. Rice weevil *(Sitophilus oryzae)*
    3. Khapra beetle *(Trogoderma granarium)*
    4. Rust red flour beetle *(Tribolium castaneum)*
    5. Rice moth *(Corcyra cephalonica)*
    6. Lesser grain borer *(Rhizopertha dominica)*
    7. Along with life cycle and control of Pulse Beetle *(Callosobruchus maculatus)*

UNIT–IV

- **Useful Insects**: Principles of following industries-
    1. Sericulture
    2. Apiculture
    3. Lac culture industries

Suggested Reading Material:

1. Alford, D.V. (1999), A text book of Agricultural Entomology. Blackwell Science Publishers, Cambridge, U.K.
2. Atwal, A.S. and Dhaliwal, G.S. (1997), Agricultural pest of South Asia and their management, Kalyani Publishers, New Delhi.
3. Dhaliwal, G.S. and Arora, R. (1996), Principles of insect management, Globe offset Press, New Delhi.
4. Hill, D.S. (1993), Agricultural insect pests of the Tropics and their control (2nd Ed), Cambridge University Press, Cambridge, New York.

B.Sc. Medical Semester–VI
ZOOLOGY
THEORY
ZOO-VI B: Option (ii): Economic Entomology-1

Time: 3 Hrs. **Marks: 25**

Periods/week: 4

Instructions for the Paper Setters:

1) There will be a total of 9 questions of which five are to be attempted.
2) Question 1 will be compulsory and will be of 5 short answer type (one mark each).
3) The remaining 8 questions shall include two questions from each unit. Candidates shall be required to attempt 4 questions, one from each unit. Each question carries 5 marks. Preferably, the question should not be split into any sub-parts. In case of any splitting, it should not have more than two sub-parts.

UNIT–I

- Systematic position, disease caused and control of the following pests of Medical and Veterinary importance:
    1) Mosquitoes
    2) Sand fly *(Phlebotomus minutus)*
    3) House fly *(Musca domestica)*
    4) Horse fly *(Tabanus striatus)*
    5) Blow fly (*Calliphora erythrocephala)*
    6) Warble fly *(Hypoderma lineatum)*
    7) Fleas

UNIT–II

- Systematic position, disease caused and control of the following pests of Medical and Veterinary importance
    1) Lice Poultry louse *(Menopon gallinae)*
    2) Sucking louse *(Haematopinus eurysternus)*
- Mouth parts of:
    1) Red cotton bug
    2) Grasshopper
    3) Cockroach
    4) Mosquito
    5) Honey bee

UNIT–III

- Biological control of insect pests.
    - Principles and history
    - Modern status
    - Recent methods of pest suppression:
        - Sterile insect release methods
        - Behavioral control involving the use of pheromones
- Integrated pest control.

UNIT–IV

- Chemical Control:
    - History
    - Principle of chemical control
    - Categories of pesticides
    - Important pesticides of each category
    - Insect repellents
    - Attractants.

Suggested Reading Material:

1. Alford, D.V. (1999), A text book of Agricultural Entomology. Blackwell Science Publishers, Cambridge, U.K.
2. Atwal, A.S. and Dhaliwal, G.S. (1997), Agricutural pest of South Asia and their management, Kalyani Publishers, New Delhi.
3. Dhaliwal, G.S. and Arora, R. (1996), Principles of insect management, Globe offset Press, New Delhi.
4. Hill, D.S. (1993), Agricultural insect pests of the Tropics and their control, (2nd Ed), Cambridge University Press, Cambridge, New York.

B.Sc. Medical Semester–VI
ZOOLOGY
Practical–VI (Related to (Option-ii) ZOO-VI A and ZOO-VI B)

Time: 3 Hrs. **Marks: 25**

Important Note for Practical:

1. Candidates will be required to submit their original note books containing record of their laboratory work.
2. Wherever possible, students must be taken out for excursion to the field (Zoological gardens, sea shores, ponds and hill stations etc.) to study habitat and ecology of the animals.
3. As per the latest UGC guidelines the dissections may please be avoided. In no case an animal falling under the categories of wildlife protection act 1972 should be caught or dissected. The rules of the Prevention of cruelty to Animals act 1960 should be familiar to all who are teaching the zoology courses. The guidelines on this issue are also available on the UGC website: www.ugc.ac.in

1.	Feeding Apparatus (Mouth parts): preparation of permanent mounts	honey bee, butterfly and red cotton bug
2.	A study of different types of larvae and pupae of insects.	
3.	External morphology and identification marks of the pests:	*Pyrilla perpusilla*, *Pectinophora gossypiella*, *Leptocorisa varicornis, Heiroglyphus banian, Dacus cucurbitae*
		Sitophilus oryzae, *Tribolium castaneum*, *Rhizopertha dominica*, *Trogoderma granarium, Callosobruchus maculatus*.
		Insects of Medical/Veterinary importance–Mosquitoes *(Culex, Anopheles* and *Aedes),* house fly, blow fly, warble fly and horse fly.
4.	Study of life stages	silkworm and honeybees
5.	Demonstration	different techniques and equipments for collection, storage and preservation of insects
6.	Structure and working	of common sprayers: hand compression and Knap sack sprayer
7.	Visit to apiary and go-downs for study of infestation.	
8.	Assignment on local insect fauna	

Guidelines for conduct of Practical Examination:

1.	Identify of given spots, give two points for identification .	8
2.	Draw & write a note on the life cycle of given specimen.	5
3.	Identify the instrument and write down its working and application.	5
4.	Project report on apiary/godowns/granary.	3
5.	Viva-voce and practical file.	4

B.Sc. Medical Semester–VI
ZOOLOGY
THEORY
ZOO-VI A: Option-iii: Inland Fisheries-I

Time: 3 Hrs. **Marks: 25**

Periods/week: 4

Instructions for the Paper Setters:

1) There will be a total of 9 questions of which five are to be attempted.
2) Question 1 will be compulsory and will be of 5 short answer type (one mark each).
3) The remaining 8 questions shall include two questions from each unit. Candidates shall be required to attempt 4 questions, one from each unit. Each question carries 5 marks. Preferably, the question should not be split into any sub-parts. In case of any splitting, it should not have more than two sub-parts.

UNIT–I

- History of inland fisheries in India.
- Morphology of a typical fish (carp, cat-fish, freshwater eel, perch).
- Structure of mouth of different fishes in relation to feeding habits.

UNIT–II

- Identification and classification of important fishes of Punjab, Haryana and Himachal Pradesh.
- Bionomics of *Labeo rohita, Cirrhinus mrigala* and *Wallago attu.*

UNIT–III

- Exotic fishes: History, their introduction, morphology, their role in fish culture, impact on native fish fauna.
- Induced Breeding: History, Technique, Chemicals involved in induced breeding and Impact on fish culture.

UNIT–IV

- Pond culture: Construction of pond, Types of pond, Fertilization of pond and Maintenance of pond
- Aquatic weeds and their control- Both biological and chemical

Suggested Readings:

1. Aggarwal S.C. & Johal M.S., Fishery Development, Narendra Publishing House, Delhi.
2. Jayaram, K.C. (1981), the freshwater fishes of India, Pakistan, Bangladesh, Burma and Sri Lanka- A Hand Book of Zoological Survey of India, Kolkatta.
3. Jhingran V.G. (1991), Fish and Fisheries of India, Hindustan Publishing Corporation of India, Delhi.
4. Johal M.S. & Tandon K.K. (1979,1980), Monograph on the Fishes of reorganized Punjab, (Vol. I & II), Punjab.
5. Johal M.S. & Tandon K.K. (1981), Fisheries of Punjab, Res. Bull, Punjab University, Vol. 32, pp. 143-154.
6. Legler Karl F. (1962), Freshwater Fishery Biology, Wm. C-Brown Co. Dublingus IOWA, USA.
7. Munshi, J.S.D and Datta, H.M. (1996), Fish Morphology- Horizons of New Research, Oxford and IBH Publishing Co. Pvt. Ltd., New Delhi.
8. Rath R.K. (1993), Freshwater Aquaculture, Scientific Publishers, Jodhpur.
9. Tandon K.K. and Johal M.S. (1996), Age and Growth of freshwater fishes in India, Narendra Publishing House, New Delhi.

B.Sc. Medical Semester–VI
ZOOLOGY
THEORY
ZOO-VI B: Option (iii): Inland Fisheries-II

Time: 3 Hrs. **Marks: 25**

Periods/week: 4

Instructions for the Paper Setters:

1) There will be a total of 9 questions of which five are to be attempted.
2) Question 1 will be compulsory and will be of 5 short answer type (one mark each).
3) The remaining 8 questions shall include two questions from each unit. Candidates shall be required to attempt 4 questions, one from each unit. Each question carries 5 marks. Preferably, the question should not be split into any sub-parts. In case of any splitting, it should not have more than two sub-parts.

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UNIT–I

- Riverine fisheries of river Sutlej and Beas.
- Reservoir Fisheries: Gobindsagar, Pong Dam

UNIT–II

- Culture Systems: Conventional, Extensive, Intensive, Monoculture and Polyculture.
- Integration of fish farming with duckry, poultry, piggery and dairy.
- Sewage fed fisheries.

UNIT–III

- Cold water fisheries: Mhaseer fisheries and Trout fisheries.
- Fish Disease and their control: Viral, Bacterial, Fungal, Helminths, Crustacean.
- Disease due to unhygienic conditions during transportation.

UNIT–IV

- Fish by-products.
- Marketing of Fish: Fresh Water fish, Preservation of fish.

Suggested Readings:

1. Aggarwal S.C. & Johal M.S., Fishery Development, Narendra Publishing House, Delhi.
2. Jayaram, K.C. (1981), the freshwater fishes of India, Pakistan, Bangladesh, Burma and Sri Lanka-A Hand Book of Zoological Survey of India, Kolkatta.
3. Jhingran V.G. (1991), Fish and Fisheries of India, Hindustan Publishing Corporation of India, Delhi.
4. Johal M.S. & Tandon K.K. (1979, 1980), Monograph on the Fishes of reorganized Punjab, (Vol. I & II), Punjab.
5. Johal M.S. & Tandon K.K.(1981),Fisheries of Punjab, Res. Bull, Panjab University, Vol. 32, pp. 143-154.
6. Legler Karl F(1962), Freshwater Fishery Biology, Wm. C-Brown Co. Dublingus IOWA, USA.
7. Munshi, J.S.D and Datta, H.M. (1996), Fish Morphology- Horizons of New Research, Oxford and IBH Publishing Co. Pvt. Ltd., New Delhi.
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B.Sc. Medical Semester–VI
ZOOLOGY
Practical–VI (Related to Option (iii)- ZOO-VI A and ZOO-VI B)

Time: 3hrs. **Marks: 25**

Important Note for Practical:

1. Candidates will be required to submit their original note books containing record of their laboratory work.
2. Wherever possible, students must be taken out for excursion to the field (Zoological gardens, sea shores, ponds and hill stations etc.) to study habitat and ecology of the animals.
3. As per the latest UGC guidelines the dissections may please be avoided. In no case an animal falling under the categories of wildlife protection act 1972 should be caught or dissected. The rules of the Prevention of cruelty to Animals act 1960 should be familiar to all who are teaching the zoology courses. The guidelines on this issue are also available on the UGC website: www.ugc.ac.in

1.	Morphology of	Carp, Cat fish and Perch
2.	Morphometric and meristic characters of typical fish	
3.	Identification of the following fishes using key For the identification of these fishes, the candidate can use already prepared keys or they can prepare their own keys	*Notopterus* spp.; *Labeo rohita, L. bata, Cirrhinus mrigala, Catla catla, Puntius sarana, Tor putitora, Schizothorex, Aorichthys seenghala, Wallago attu, Callichrous padda, Bagarius bagarius, Heteropneustus fossilis, Channa marulius, C. striatus, Xenetodon cancila, Cyprinus carpio, Hypophthalmichthys molitrix, Ctenopharyngodon idella, Colisa fasciata* and *Mastacembelus armatus*
4.	Determination of food and feeding habits	of locally available fishes on the basis of stomach analysis adopting the following methods : a. Frequency occurrence method b. Feeding intensity c. Point method
5.	Determination of maturity stages	Of both male and female of any commercial fish (Preserved specimens).
6.	Preparation of permanent slides	Phytoplankton and zooplanktons which constitute the food of commercial fishes. Their identification and study of important characters.
7.	Identification of aquatic weeds of a fish pond.	
8.	Estimation of following chemical parameters of pond water	a. Temperature b. pH c. Dissolved oxygen d. Phosphates e. Total Dissolved solids f. Nitrates g. Hardness h. Examination of diseased fishes
9.	Visit of various fish ponds and fish market.	

Note: - Some changes can be made in the practicals depending on the availability of material.

Guidelines for conduct of Practical Examination:

1.	Give salient features of the given fish/ Identification of Fish using keys.	6
2.	Estimation of physico-chemical parameters of pond water.	6
3.	Identification of Zoo/ Phytoplankton and their important characteristics.	4
4.	Write morphometric/meristic characters of a fish species.	3
5.	Project report.	2
6.	Viva-voce and practical file	4