KHALSA COLLEGE AMRITSAR

(An Autonomous College)

P.G. Department of Zoology
Session-2021-22
B.Sc. Medical
Scheme of Course - Zoology

(To be offered along with other compulsory subjects- Chemistry, Botany, English & Panjabi/PHC)

Semester (Course code)	Paper	Paper Code	Title	Cr. Hr./ wk.	Periods /week	Marks	Total
ZOO-I	Theory	ZOO-IA	Cell Biology	3	4	25	100
		ZOO-IB	Biodiversity-I	3	4	25	
	Practical-I (Related to Zoo-IA and Zoo-IB)			4.5	6	25	
			Internal Assessment		---	25	
ZOO-II	Theory	ZOO-IIA	Ecology	3	4	25	100
		ZOO-IIB	Biodiversity-II (Arthropoda to Hemichordata)	3	4	25	
	Practical-II (Related to Zoo-IIA and Zoo-IIB)			4.5	6	25	
			Internal Assessment		---	25	
ZOO-III	Theory	ZOO-IIIA	Evolution	3	4	25	100
		ZOO-IIIB	Biodiversity–III (Chordates)	3	4	25	
	Practical-III (Related to Zoo-IIIA and Zoo-IIIB)			4.5	6	25	
			Internal Assessment		---	25	
ZOO- IV	Theory	ZOO-IVA	Biochemistry	3	4	25	100
		ZOO-IVB	Animal Physiology	3	4	25	
	Practical-IV (Related to Zoo-IVA and Zoo-IVB)			4.5	6	25	
			Internal Assessment		----	25	
ZOO-V	Theory	ZOO-VA	Developmental Biology	3	4	25	100
		ZOO-VB	Genetics	3	4	25	
	Practical-V (Related to Zoo-VA and Zoo-VB)			4.5	6	25	
			Internal Assessment		----	25	
ZOO-VI	Theory	ZOO-VIA	Option (i)- Medical Zoology	3	4	25	100
			Option (ii)- Economic Entomology I				
			Option (iii)- Inland Fisheries-I				
		ZOO-VIB	Option (i)- Medical Laboratory Technology	3	4	25	
			Option (ii)- Economic Entomology II				
			Option (iii)- Inland Fisheries-II				
	Practical-VI (Related to Zoo-VIA and Zoo-VIB)			4.5	6	25	
			Internal Assessment		----	25	

PROGRAM SPECIFIC OUTCOMES (PSOs):

PSO-1	To acquire knowledge in the subjects of Botany, Zoology, Chemistry and Biochemistry.
PSO-2	To enable students to define and explain major concepts of biological sciences.
PSO-3	To gain knowledge to correctly use biological and chemical instrumentation and proper laboratory techniques.
PSO-4	To become efficient to communicate biological and chemical knowledge in oral and written form.
PSO-5	To gain knowledge to recognize the relationship between structure and function at molecular and cellular levels.

KHALSA COLLEGE AMRITSAR

(An Autonomous College)

P.G. Department of Zoology
Session-2021-22

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

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

Instructions for the Paper Setters:

1) There will be a total of 9 questions of which 5 are to be attempted.
2) Question 1 is compulsory and having 5 short answer type questions (1 mark each).
3) The remaining 8 questions (5 marks each) shall include 2 questions from each unit. Candidates shall be required to attempt 4 questions, one from each unit. 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.

Course Objectives: The paper aims to:

1	Understand the structures and purposes of basic components of prokaryotic and eukaryotic cells, especially macromolecules, membranes, and organelles
2	Understand how these cellular components are used to generate and utilize energy in cells
3	Understand the cellular components underlying mitotic cell division.
4	Apply their knowledge of cell biology to selected examples of changes or losses in cell function like responses to environmental or physiological changes, or mutation.

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.

Suggested Readings

1. Alberts, B., Bray, D., Lewis, J., Raff, M. Roberts, K., Watson J.D.(1998), Molecular Biology of the Cell, Garland Publ. Inc., New York.
2. Chandra Roy, S and DE Kumar, K. (2001), Cell Biology, New Central Book Agency (P) Ltd. Kolkata.
3. Cooper, G. M. (2004), The cell, A Molecular Approach, ASM press, Washington, D. C.
4. De Robertis, E.D.P. De Robertis, E.M.F.(1995) Cell Biology and Molecular Biology (Eighth Edition), W.B. Saunders Co., Philadelphia.
5. Karp, G. (1984). Cell Biology (4th ed), McGraw Hill, New York. 6. Pawar, C.B (1999), Cell Biology, Himalaya Publishing House, Bombay

Course Outcomes

Sr. No.	On completing the course, the students will be able to:
CO-1.	Understand the cell theory and cell principle.
CO-2.	Understand properties of cell like cell size, shape, number, life span and death
CO-3.	Know the structure and importance of prokaryotic (Mycoplasma, Bacteria, Cyanobacteria) and eukaryotic cell.
CO-4.	Study the theories of evolution of eukaryotic cell from prokaryotic cell.
CO-5.	Study the structure and functions of the cell organelles like Golgi complex, Endoplasmic reticulum, Mitochondrion, Ribosomes, Peroxysomes and glyoxysomes.
CO-6	Develop understanding about various cell surface modifications: Glycocalyx, Microvilli and Caveolae
CO-7	Study the cytoskeleton including microtubules, actin, myosin, intermediate filaments and their role in muscle contraction
CO-8	Understand the phases of cell cycle including Mitosis and Meiosis.

KHALSA COLLEGE AMRITSAR

(An Autonomous College)

P.G. Department of Zoology

Session-2021-22

Theory

BIODIVERSITY-I

(PROTOZOA TO ANNELIDA)

Periods/week: 4

Time: 3 Hrs. Marks: 25

Instructions for the Paper Setters:

1) There will be a total of 9 questions of which 5 are to be attempted.
2) Question 1 is compulsory and having 5 short answer type questions (1 mark each).
3) The remaining 8 questions (5 marks each) shall include 2 questions from each unit. Candidates shall be required to attempt 4 questions, one from each unit. 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.

Course Objectives: The paper aims to

1.	Understand the animal kingdom.
2.	Understand the taxonomic position of protozoa to Annelida.
3.	Understand the general characteristics of animals belonging to protozoa to Annelida.
4.	Understand the body organization of phylum from protozoa to Annelida.
5.	Understand the origin and evolutionary relationship of different phylum from protozoa to Annelida.

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 (Coelenterata):
  - *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)

Suggested Readings:-

1. Barnes, R.D. (1999), Invertebrate Zoology. W.B. Saunder, Philadelphia.
2. Dhami, P.S. & Dhami, J. K(2001), Invertebrates, R. Chand & Co., New Delhi.
3. Barth, R. H. and Broshears, R. E (1982), The Invertebrate world. Holt Saunder, Japan.
4. Brusca, R. C. and Brusca, G. J. (2003), Invertebrates (2nd ed). Sinauer Associates, Inc. Publishers, Sunderland, Massachusetts.
5. Engemann, J. G. and Hegner, R. W. (1981), Invertebrate Zoology (3rd ed.) Macmillan, New York.
6. Gardiner, M. S. (1972), The Biology of Invertebrates, McGraw Hill, New York.
7. Meglitsch, P. A. and Schran, F. R. (1991), Invertebrate Zoology (3rd ed). Oxford University Press, New York.
8. Pechenik, A. Jan. (2000), Biology of the invertebrates, (4th ed), McGraw Hill Book Co. Singapore.

Course Outcomes

Sr. No.	On completing the course, the students will be able to:
CO-1.	Know about the structural aspects of different animals
CO-2.	Gain knowledge about the taxonomies and evolutionary aspects of Zoology.
CO-3.	Study faunal diversity and learn to implement conservation measures to save biodiversity

KHALSA COLLEGE AMRITSAR

(An Autonomous College)

P.G. Department of Zoology
Session-2021-22

Practical
Related to ZOO-IA and ZOO-IB

Periods/week: 6
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.

Course Objectives: The paper aims to:

1.	Understand the structure of invertebrates and classify them.
2.	Understand various techniques like SEM, TEM and Chromatography.
3.	Understand the structure and function of digestive, reproductive and nervous system of earthworm.
4.	Understand the preparation of temporary slides.

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 submit the report.	

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/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

Course Outcomes

Sr. No.	**On completing the course, the students will be able to:**
CO-1.	Have knowledge about all the different phyla of invertebrates
CO-2.	Understand the comparative structure of invertebrates
CO-3.	Have an insight on the microscopic life
CO-4.	Differentiate invertebrates on the basis of morphological characteristics

KHALSA COLLEGE AMRITSAR

(An Autonomous College)

P.G. Department of Zoology

Session-2021-22

B.Sc. Medical Semester II

ZOOLOGY

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

Theory
ZOO-IIA: ECOLOGY

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

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.

Course Objectives: The paper aims to

1.	Describe the interaction between organisms and environment.
2.	Describe the ecological adaptations in animals in different habitats.
3.	Understand ecological niche and succession.
4.	Understand the exchange of nutrients within the ecosystem.
5.	Describe the population dynamics.

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 non-renewable natural resources and their conservation
- Environmental Issues: Causes, impact and control of environmental pollution

Suggested Readings:-

1. Anderwartha, H.G. and Birch, L. C. (1970), The distribution and abundance of animals, University of Chicago Press, Chicago London.
2. Beeby, A. (1992), Applying Ecology, Chapman and Hall Madras.
3. Begon, M., Harper J. L. and Townsend, C. R. (1995), Ecology – Individuals, populations and communities, Blackwell Science, Cambridge UK.
4. Brewer, R. (1994), The science of Ecology, Saunders College of Publishing, New York.
5. Chapman, J. L. and Resis, M. J. (1995), Ecology- Principles and applications, Cambridge University Press, Cambridge UK.
6. Kaeighs, S. C. (1974), Ecology with special references to animal and Man, Prentice Hall Inc.
7. Kormondy, E.J. (1975), Concept of Ecology, Englewood Cliffs, N.J. Prentice Hall Inc.
8. Kreb C.J. (1982), Ecology, Harper & Row, New York. 9. Putmann, R. J. and Wratten, S. D. (1984), Principles of Ecology, Crown Helm, London.

Course Outcomes

Sr. No.	On completing the course, the students will be able to:
CO-1.	Have knowledge about the biodiversity
CO-2.	Study the effects of human activities on biosphere
CO-3.	Pursue various courses like M.Sc. Environmental studies etc. in future and opt for carrier in academics.

KHALSA COLLEGE AMRITSAR

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P.G. Department of Zoology

Session-2021-22

Theory

BIODIVERSITY-II

(ARTHROPODA TO HEMICHORDATA)

Periods/week: 4

Time: 3 Hrs. Marks: 25

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.

Course Objectives: The paper aims to:

1.	Understand the animal kingdom.
2.	Understand the taxonomic position of arthropods to hemichordates.
3.	Understand the general characteristics of animals belonging to arthropods up to hemichordates.
4.	Understand the body organization of phylum from arthropods to hemichordates.
5.	Understand the origin and evolutionary relationship of different phylum from arthropods to hemichordates.

UNIT–I

- Arthropoda- Type study:
  - Prawn
  - *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

Suggested Readings:-

1. Barnes, R.D. (1999), Invertebrate Zoology. W.B. Saunder, Philadelphia.

2. Dhami, P.S. & Dhami, J. K., Invertebrates, R. Chand & Co., New Delhi, 2001.
3. Barth, R. H. and Broshears, R. E (1982), The Invertebrate world. Holt Saunder, Japan.
4. Brusca, R. C. and Brusca, G. J. (2003), Invertebrates (2nd ed), Sinauer Associates, Inc. Publishers, Sunderland, Massachusetts.
5. Engemann, J. G. and Hegner, R. W. (1981), Invertebrate Zoology (3rd ed), Macmillan, New York.
6. Gardiner, M. S. (1972), The Biology of Invertebrates, McGraw Hill, New York.
7. Meglitsch, P. A. and Schran, F. R. (1991), Invertebrate Zoology (3rd ed), Oxford University Press, New York.
8. Pechenik, A. Jan. (2000), Biology of the invertebrates, (4th ed), McGraw Hill Book Co. Singapore.

Course Outcomes

Sr. No.	On completing the course, the students will be able to:
CO-1.	Know about the structural aspects of different animals.
CO-2.	Gain knowledge about the taxonomies and evolutionary aspects of Zoology.
CO-3.	Study faunal diversity and learn to implement conservation measures to save biodiversity
CO-4.	Get in depth knowledge about various animal phyla (Arthropoda to Hemichordata)
CO-5.	Do detailed type studies of representative organisms of each phyla.
CO-6.	Get detailed knowledge about evolutionary relationships between Non-Chordates, Hemichordates & Chordates.

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P.G. Department of Zoology
Session-2021-22

Practical
Related to ZOO-IIA and ZOO-IIB

Periods/week: 6
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

Course Objectives: The paper aims to

1.	Classify the organisms up to orders with their ecological notes and economic importance.
2.	Understand the permanent stained slides of insects and mollusk.
3.	Understand digestive and nervous system of Periplaneta.
4.	Study abiotic and biotic components of an ecosystem.
5.	Study and prepare the charts related to Zoogeographical realms.

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* (Centipede), *Julus* (Millipede), *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:	Trachea and mouth parts of insects
		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	6

	features and economic importance.	
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

Course Outcomes

Sr. No.	On completing the course, the students will be able to:
CO-1.	Differentiate invertebrates on the basis of morphological characteristics
CO-2.	Understand the comparative structure of invertebrates
CO-3.	Have an insight into the internal systems of different invertebrates
CO-4.	Have a knowledge about different phyla of invertebrates

KHALSA COLLEGE AMRITSAR

(An Autonomous College)

P.G. Department of Zoology

Session-2021-22

B.Sc. Medical Semester III

ZOOLOGY

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

Theory

ZOO-IIIA: EVOLUTION

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

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.

Course Objectives: The paper aims to

1.	Describe the theory of natural selection.
2.	Understand how species evolve.
3.	Describe evolutionary history of man.
4.	Describe origin of species on earth.

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
- Poison apparatus in snakes
- Flight adaptation & Bird migration
- Adaptive radiation and Dentition in Mammals

Suggested Readings:-

1. Avers, C. J.(1989). Evolution Process and Pattern in Evolution, Oxford University, Press, New York, Oxfor.
2. Ayala, F. J. and Valentine J. W. (1979). Evolving the theory and Process of Organic Evolution, Benjamin Cumming.
3. Bhamarah, H.S.(1993), Juneka K., Cytogenetics & Evolution, Anmol Publication Pvt. Ltd.
4. Brookfield, A. P. (1986). Modern aspects of Evolution. Hutchinson London, Melbourne.
5. Colbert. E.H.(1989), Evolution of Vertebrates, (2nd ed), Wiley Eastern Ltd.
6. Dobzhansky, Ayala, Stebbins & Valentine(1952), Evolution W.H. Freeman.
7. Gallow, P. (1983). Evolutionary principles. Chapman and Hall.
8. Freeman, S. and Herron, Jon C. (2007). Evolutionary analysis, Pearson Prentice Hall, New Jersey.
9. Futuyma, D. J. (1998), Evolutionary Biology, Sinauer Assoc. Inc. Pub. USA.
10. Meglitsch, P. A. (1991), Invertebrate Zoology (3rd ed), Oxford University Press.
11. Minkoff, E. C. (1983), Evolutionary Biology, Addison Wesley Pub. Co., London.
12. Wen-Hsiung Li (1997), Molecular Evolution, Sinauer associates Inc.Pub. USA.

Course Outcomes

Sr. No.	On completing the course, the students will be able to:
CO-1.	Develop an understanding about the concept of evolution & different proposed theories of evolution
CO-2.	Develop understanding about the origin of life and concept of species and speciation
CO-3.	Become familiarized with topics related to fossils, reptile origin & extinction, origin of man
CO-4.	Get knowledge about poisonous and non-poisonous snakes & poison apparatus in snakes
CO-5.	Develop basic knowledge of migratory and parental investment in fishes

Theory
ZOO-IIIB: BIODIVERSITY–III (CHORDATES)

Periods/week: 4

Time: 3 Hrs. Marks: 25

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.

Course Objectives: The paper aims to

1.	Understand what the chordates are.
2.	Understand different categories of chordates.
3.	Understand the general characters of chordates.
4.	Understands the level of organization in chordate subphylum.

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

Suggested Reading:-

1. Dhami, P.S. & Dhami J.K. (1998), Vertebrates, R. Chand & Co., New Delhi.
2. Goodrich, E. S. (1958), Structure and Development of Vertebrates, Vol. I and II. D. E. Publication, New York.
3. Hildebrand, M. and Goslow. Jr. G.E. (2001), Analysis of Vertebrates Structure, John Wiley, N. Y.
4. Jollie, M. (1968), Chordate Morphology, Reinhold, New York.

5. Kardong, K. V. (1995), Vertebrates – Comparative Anatomy, Function, Evolution. W.B.C. Pub. , Oxford.
6. Kent, G. C. and Carr, R. K. (2001), Comparative Anatomy of the Vertebrates (9th ed), McGraw Hill Higher Education, New York.
7. Linzey, D. (2001), Vertebrate Biology, McGraw Hill Publishing Company, New York.
8. Pough, F. H., Heiser, J. B. and McFarland, W. N. (1990), Vertebrate Life (3rd ed), Macmillan Pub. Co., New York.
9. Young, J. Z. (1982), The Life of Vertebrates, New York.
10. Parker, T.J. and Haswell, W.A (1981) Text Book of Zoology, Vol. II (Vertebrates), ELBS and Macmillian Press Ltd.

Course Outcomes

Sr. No.	On completing the course, the students will be able to:
CO-1.	Understand the internal system of chordates
CO-2.	Understand of interrelationships of chordates; their characteristics and affinities
CO-3.	Understand the basis of their relationship to other animals by body structure, external characters
CO-4.	Get knowledge of all anatomical features and working of various body organs
CO-5.	Understand the underlying principles of classification of animals
CO-6.	Understand the differences and similarities in the various aspects of anatomical features of chordates
CO-7.	Understand Protochordates- Urochordates and cephalochordates

KHALSA COLLEGE AMRITSAR

(An Autonomous College)

P.G. Department of Zoology
Session-2021-22

Practical
Related to ZOO-IIIA and ZOO-IIIB

Periods/week: 6
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

Course Objectives: The paper aims to

1.	Classify vertebrates up to order level.
2.	Understand habits and habitats of vertebrates and their morphological characters along with their economic importance.
3.	Study digestive, circulatory, nervous and urino-genital system of Herdmania, Labeo, Chick and rat.
4.	Understand evolutionary phenomena: homology and analogy.
5.	Study fossils and evolution in Horse, Elephant and Man.

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, Chameleon,*
		Typhlops, Python, Eryx, Ptyas, Bungarus, Naja, Hydrus, Vipera,
		Crocodilus, Gavialis, Chelone (turtle) and *Testudo* (tortoise),
		Differences in non-poisonous 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* and *Amphioxus*
		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.	3
4.	Identify evolutionary phenomenon and give its significance.	3
5.	Project/ Assignment report	3
6.	Viva-voce & Practical file.	4

Course Outcomes

Sr. No.	**On completing the course, the students will be able to:**
CO-1.	Understand the use of various levels of classification of animals and significance of effective use the six levels of classification
CO-2.	Classify animals on the basis of their relation to other animals by body structure, external characters
CO-3.	Get In-depth knowledge of museology- placement and arrangement of animals depicting their classification and interrelationships
CO-4.	Understand various concepts relevant to classification
CO-5.	Understand the anatomy of vertebrates
CO-6.	Gain knowledge to identify various animals based on morphological features
CO-7.	Gain knowledge to distinguish between poisonous and non-poisonous snakes
CO-8.	Describe the morphology, habit and habitat, Systematic position and various systems
CO-9.	Identify the taxonomic status of the entire chordates and discuss the evolutionary model of the group.

KHALSA COLLEGE AMRITSAR

(An Autonomous College)

P.G. Department of Zoology
Session-2021-22
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

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

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.

Course Objectives: The paper aims to

1.	Understand the difference between micromolecules and macromolecules.
2.	Understand structure and function of carbohydrates, proteins, lipids and nucleic acids
3.	Understand the nature of enzymes and how to classify them.
4.	Understand the metabolism of lipid, carbohydrate and proteins.

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 Meyerhof 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

Suggested Reading:-

1. Conn, E.E., Stump. P.K. Bruening, S. and Doi R.H. (1987), Outlines of Biochemistry (5th ed), John Wiley and Sons Inc., New York.
2. Fischer, J. and Arriold, J.R.P. (2001). Instant notes in Chemistry for Biologists, Viva Books Pvt. Ltd.
3. Harper, H.A. (2000): Harper's Biochemistry (25th ed).
4. Holde, K.E.V., Johnson, W.C. and Shing, P. (1998). Principles of Physical Biochemistry Prentice Hall, Inc., USA.
5. Lehninger, A (2000). Principles of Biochemistry, (3rd ed).
6. Morris, H. Best, L.R., Pattison, S., Arerna, S. (2001). Introduction to General Organic Biochemistry, (7th ed), Wadsworth Group.
7. Rawn, J.D. (1989), Biochemistry, Niel Patterson Publication U.S.A. North Carolina.
8. Robert, K., Murray, Mayes Daryl, K. Granner, Victor, W., Woodwell (1990), Harper's Biochemistry, 22nd Edition, Prentice Hall International Inc.
9. Sheehon, D (2000). Physical Biochemistry: Principles and Applications – John Wiley & Sons Ltd., England.
10. Stryer, L. (1988). Biochemistry (3rd ed), San Francisco W.H. Freeman.

Course Outcomes

Sr. No.	On completing the course, the students will be able to:
CO-1.	Understand the mechanisms that work to keep the animal alive and functioning
CO-2.	Knowledge of basic terms in biochemistry and define basic terminologies of metabolic pathways.
CO-3.	Get biochemical understanding through scientific enquiry into the nature of mechanical physical, and biochemical functions of animals
CO-4.	Understand and have in-depth knowledge of intermediate biochemical pathways and cycles
CO-5.	Comprehend interactions and interdependence of biochemical processes
CO-6.	Comprehend the energy source, chemical bonds and the principles of thermodynamic
CO-7.	Understand macromolecule such as carbohydrates, protein and fat, their types and significance, draw the structures of various carbohydrates, lipids and amino acids.
CO-8.	Classify enzymes with examples
CO-9.	Understand mechanism of enzyme action and factors affecting the enzyme activity
CO-10.	Understand the oxidation of fatty acids and its significance
CO-11.	Illustrate the electron transport chain and oxidative phosphorylation
CO-12.	Illustrate the reactions, energetics and regulation of glycolysis, glycogen biosynthesis, TCA cycle etc.

KHALSA COLLEGE AMRITSAR

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P.G. Department of Zoology

Session-2021-22

Theory

ZOO-IVB: ANIMAL PHYSIOLOGY

Periods/week: 4

Time: 3 Hrs. Marks: 25

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.

Course Objectives: The course aims to

1.	Understand the metabolic activities in the body of animals.
2.	Understand the various biomolecules in body.
3.	Understand the structural chemistry of endocrine system.
4.	Understand the structure and function of blood.
5.	Understand the process of digestion.
6.	Understand the types of mechanism of working of nerve cells.
7.	Understand the gaseous transport and the structure involved in gaseous transport.

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 O2 and CO2
  - 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 Behaviour:
  - Taxes and reflexes
  - Instinctive and motivative learning and reasoning
- Endocrine:
  - Structure and physiology of thyroid, parathyroid, adrenal, hypothalamus, pituitary, pancreas and gonads

Suggested Readings:

Bhamarah, H.S., Juneka K., Cytogenetics & Evolution, Anmol Publication Pvt. Ltd., 1993.

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

Course Outcomes

Sr. No.	On completing the course, the students will be able to:
CO-1.	Develop understanding of the various fundamental concepts related to physiology of digestion & absorption
CO-2.	Develop understanding of circulatory system and blood components
CO-3.	Get familiar with topics related to nervous and muscular system and their working
CO-4.	Study various aspects of respiratory system and exchange of respiratory gases
CO-5.	Develop basic knowledge of innate and acquired behaviours
CO-6.	Develop an understanding of endocrine glands, their functioning and associated disorders

KHALSA COLLEGE AMRITSAR

(An Autonomous College)

P.G. Department of Zoology

Session-2021-22

Practical
Related to ZOO-IVA and ZOO-IVB

Periods/week: 6

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

Course Objectives: The course aims to

1.	Study the skeleton of vertebrates.
2.	Study various macromolecules present in food stuffs.
3.	Demonstrate the presence of amylase in saliva.
4.	Demonstrate various blood tests in Man.
5.	Analyze urine for urea, chloride, glucose and uric acid.

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/Science city and submit a report.	
9.	Familiarity with the local vertebrate fauna	

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

Guidelines for conduct of Practical Examination:

1.	Identify the given bones. Make labelled sketches of their respective–views.	6
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.	4
5.	Viva-voce & Practical file.	4

Course Outcomes

Sr. No.	**On completing the course, the students will be able to:**

CO-1	Analyse vertebrate skeletal system
CO-2	Compare and contrast the skeletons of fish, frog, lizard, bird and a mammal
CO-3	Develop skill for the observation of blood cells and haemitin crystals.
CO-4	Attain knowledge of qualitative analysis of macromolecules, excretory products, blood glucose and cholesterol
CO-5	Illustrate the enzyme activity from suitable material.
CO-6	Demonstrate the effect of various physical and chemical factors on enzyme activity
CO-7	Get basic understanding of the experimental methods and designs that can be used for further study and research.

KHALSA COLLEGE AMRITSAR

(An Autonomous College)

P.G. Department of Zoology

Session-2021-22

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

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

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.

Course Objectives: The course aims to

1.	Understand how organisms maintain gametic population.
2.	Understand fertilization process.
3.	Understand way of cleavage and different patterns to form zygote.
4.	Understand the fundamental embryonic development.
5.	Understand the complete process of formation of germ layers.

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
- Fertilization

UNIT-II

- Cleavage and its patterns
- Gastrulation
- Determination and differentiation
- Embryonic development of *Herdmania*
- Tissue interactions, basic concepts of organizers and inductors and their role

UNIT-III

- Development upto three germinal layers and their fate in frog and chick
- Fate maps of chick and frog embryos
- Metamorphosis in Frog

UNIT-IV

- Embryonic development of rabbit
- 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.

Course Outcomes

Sr. No.	On completing the course, the students will be able to:
CO-1.	Learn the concepts of developmental biology
CO-2.	Understand gametogenesis process, process of differentiation of eggs and sperms before fertilization and vitellogenesis
CO-3.	Understand the events that led up to and comprise the process of fertilization
CO-4.	Know about the cleavage, gastrulation and differentiation
CO-5.	know about the macro-, meso- and micromeres which form into specific cells in the embryo
CO-6.	Understand the significance of regeneration and metamorphosis
CO-7.	Know about the embryonic development of *Herdmania*, frog, chick and rabbit
CO-8.	Know about mammalian placenta, its formation, types and function
CO-9.	Understand the process of regeneration, ageing and finally death

Theory
ZOO-VB: GENETICS

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

Course Objectives: The course aims to

1.	Understand how the behaviour of chromosomes during meiosis can explain mendel's law.
2.	Understand how inheritance patterns are affected by position on chromosomes.
3.	Understand the similarities and differences between how genetic information is passed on in prokaryotes and eukaryotes.
4.	Understand gene interactions.
5.	Understand the chemical nature of heredity.

UNIT-I

- Modification of Mendelian Ratios: Non-allelic gene interaction, Modified F2 ratios. (9:7; 9:3:4; 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, Alkaptonuria, Albinism). Somatic mutations and carcinogenesis.
- Regulation of gene expressions in prokaryotes (Operon model) in eukaryotes.
- Extra nuclear 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.

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, (2nd ed), Van Nostrand Rainhold
3. Gardener, E.J., Simmons, M.T.J. & Sunstad, D.P. (1999), Principles of Genetics, (8th 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 (4th 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.

Course Outcomes

Sr. No.	On completing the course, the students will be able to:
CO-1.	Acquire a broad understanding of Genetics including the physical and chemical basis of heredity.
CO-2.	Understand the basic organization and chemical composition of prokaryotic and eukaryotic genomes.
CO-3.	Understand genetic phenomenon like linkage, crossing over and chromosomal mapping
CO-4.	Understand gene expression and regulation mechanisms among prokaryotes and eukaryotes & basic aspects of flow of genetic information from DNA to Protein
CO-5.	Distinguish between maternal effect, sex-linked, and extra nuclear modes of inheritance.
CO-6.	Have a better understanding of bacterial genetics and means of genetic recombination
CO-7.	Understand the role of genetic technologies in industry related to pharmaceuticals, biotechnology, and diagnostic clinics.

KHALSA COLLEGE AMRITSAR

(An Autonomous College)

P.G. Department of Zoology

Session-2021-22

Practical

Related to ZOO-VA and ZOO-VB

Periods/week: 6

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 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

Course Objectives: The course aims to

1.	Demonstrate the law of segregation and independent assortment and solve numerical problems related to them, Epistasis and blood group inheritance.
2.	Demonstration of segregation in preserved Maize and cytoplasmic inheritance in snail.
3.	Study permanent slide of polytene chromosome and Barr body.
4.	Study different developmental stages of fresh water snail, frog and chick.
5.	Understand and calculate gene frequencies and random mating analysis.
6.	Demonstrate palm print and fingertip patterns.

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
		Barr body from cheek cells
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

		Preparation of slide for Barr body from cheek cells

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.	5
3.	Identification of given spots.	4
4.	Make a pedigree chart from the given data.	4
5.	Viva-voce and practical file.	4

Course Outcomes

Sr. No.	**On completing the course, the students will be able to:**
CO-1.	Understand the law of segregation and independent assortment and solve numerical problems related to them.
CO-2.	Solve numerical problems related to Epistasis and blood group inheritance
CO-3	Demonstrate the segregation in preserved material: Maize
CO-4.	Understand cytoplasmic inheritance in snail.
CO-5.	Prepare permanent slide of polytene chromosome and Barr body.
CO-6.	Identify different developmental stages of fresh water snail, frog and chick.
CO-6.	Understand and calculate gene frequencies and random mating analysis
CO-7	Analyze variance in pea pod

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ZOOLOGY

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

This course offers 3 options and student can opt for any one

Options	ZOO-VIA	ZOO-VIB
(i)	Medical Zoology	Medical Laboratory Technology
(ii)	Economic Entomology I	Economic Entomology II
(iii)	Inland Fisheries (Aquaculture)-I	Inland Fisheries (Aquaculture)-II

Theory
ZOO-VIA: OPTION (i) MEDICAL ZOOLOGY

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

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.

Course Objectives: The paper aims to

1.	Understand various pathogenic microbes and diseases caused by them, their occurrence and eradication programmes.
2.	Understand the life history, mode of infection and pathogenicity of pathogenic protozoans and helminthes.
3.	Study the life cycle and control measures of arthropod vectors of human disease.
4.	Understand human defense mechanisms and study the structure and function of antibodies.

UNIT–I

1. Introduction of Parasitology (pertaining to various terminologies in use).
2. Brief introduction to pathogenic Microbes, Viruses, Ricketsiae, Spirochaetes and Bacteria.
3. Epidemic disease, such as Typhoid, Cholera, Small pox; their occurrence and eradication programmes.

UNIT–II

4. Brief accounts of life history, mode of infection and pathogenicity of the following pathogens with reference to man; prophylaxis and treatment:
    a. Pathogenic protozoans: *Entamoeba, Trypanosoma, Leishmania, Giardia, Trichomonas* and *Plasmodium*.
    b. Pathogenic helminthes: *Fasciolopsis, Schistosoma, Echinococcus, Ancylostoma, Trichinella, Wuchereria, Dracunculus* and *Oxyuris*.

UNIT–III

5. Life cycle and control measures of arthropod vectors of human disease: Malaria (*Anopheles stephens, A. culicifaces* Yellow fever, Dengue 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*).

UNIT–IV

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

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.

Course Outcomes

Sr. No.	On completing the course, the students will be able to:
CO-1.	Learn about human defense mechanism, Humoral & Cell mediated immune responses.
CO-2.	Study of Pathogenic protozoans, helminthes, their pathogenicity, prophylaxis & treatment.
CO-3.	Learn about Pathogenic viruses, Ricketsiae, Spirochaetes, Bacteria etc.
CO-4.	Have insight into physiology, biochemistry, reproduction and control measures of insect vectors.
CO-5.	Know about epidemic diseases like influenza, chickenpox, small pox etc. their prevention and control measures

Theory

ZOO-VIB OPTION (i): MEDICAL LABORATORY TECHNOLOGY

Periods/week: 4

Time: 3 Hrs. Marks: 25

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.

Course Objectives: The paper aims to

1.	Study the interaction between antigens and antibody.
2.	Study various laboratory techniques.
3.	Understand various blood test and preservation of different clinical samples.
4.	Understand various parameters related to bacteriology.
5.	Understand principle and significance of techniques related to histopathology and biochemistry.

UNIT–I

1. Antigens and antibody interactions- Sero-diagonstic assays (Precipitation, agglutination immunodiffusion, ELISA, RIA).
2. Vaccines
3. Laboratory Techniques: Colorimetry, Microscopy, Autoclaving, Centrifugation and Spectrophotometry

UNIT–II

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

UNIT–III

7. 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

8. Histopathology: Common fixatives and staining techniques
9. Biochemistry: Principle/ theory and significance of estimation of urea, sugar and cholesterol, creatinine, enzymes (serum transaminase, phosphatase, amylase and lipase), uric acid in blood; estimation of proteins, sugar, bile salts, ketone bodies in urine and liver function test.

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 (2nded), 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.

Course Outcomes

Sr. No.	**On completing the course, the students will be able to:**
CO-1.	Know the techniques involved in the detection of various diseases and its associated pathology.
CO-2.	Have practical skills of conducting basic clinical lab experiments.
CO-3.	Apply knowledge of clinical science and pathology to day to day life.
CO-4.	Understand the impact of diseases and endo-parasites on human health
CO-5.	Learn about Physiology of Human Immune response.

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Practical

Related to Option (i)- ZOO-VIA and ZOO-VIB

Periods/week: 6

Time: 3 Hrs. 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.

Course Objectives: The paper aims to

1.	Demonstrate various safety rules in laboratory.
2.	Understand cleaning and sterilization of glass ware.
3.	Examine physicochemical properties of urine.
4.	Study permanent slides of parasitic protozoans, helminthes and arthropods.
5.	Study various blood tests.

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.
2.	Cleaning and sterilization of	Glass ware using hot air oven autoclave etc.
3.	Estimation of	ESR and hematocrit,
		Blood sugar and protein.
4.	Physico-chemical examination of urine.	
5.	Preparation of thick and thin blood smears.	
6.	Counting of WBC, RBC and DLC.	
7.	Analysis of blood groups, A, B, AB, O and Rh.	
8.	Study of permanent slides and specimens	Parasitic Protozoans, helminthes and arthropods mentioned in the theory syllabus.
9.	Demonstration of	Fixation, embedding, cutting of tissue sections, and their staining (routine haemotoxylin and eosin)

Visit to a pathology Lab and preparation of report.

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

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

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-	6

	chemical examination of urine.	
3.	Perform an experiment on Hematology.	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

Course Outcomes

Sr. No.	**On completing the course, the students will be able to:**
CO-1.	Know about laboratory safety rules like proper handling of patients, specimens, needles etc.
CO-2.	Get technical know how regarding estimation of Heamoglobin level, ESR, blood sugar, protein, cholesterol etc.
CO-3.	Prepare thick and thin blood films and counting of WBC, RBC and DLC
CO-4.	Study the protozoans, parasitic helminthes , arthropods vectors of various diseases through permanent slides
CO-5.	Perform physic-chemical examination of urine
CO-5.	Examine stool for intestinal parasite

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ZOOLOGY

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

Theory
ZOO-VIA OPTION (ii): ECONOMIC ENTOMOLOGY-I

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

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.

Course Objectives: The paper aims to

1.	Study Systematic position, habits and nature of damage of sugarcane, cotton, paddy, wheat and vegetables.
2.	Study Systematic position, habits and nature of damage of pests of stored grains.
3.	Study principle of sericulture, apiculture and lac culture.

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 varicornis*)
   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

E. 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*)

F. 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:

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.

Course Outcomes

Sr. No.	On completing the course, the students will be able to:
CO-1.	Acquaint themselves with the common pests of major crops and the damage caused.
CO-2.	Study the attack of various insect pests on stored grain and their control.
CO-3.	Learn how insects become pests.
CO-4.	Learn various methods to control the pests and acquire skills to control them.
CO-5.	Learn the importance of apiculture, sericulture and Lac culture.
CO-6.	Gain knowledge to define the concepts of the applied subjects like Apiculture, Sericulture and lac culture.
CO-7.	Understand the important pests of apiculture, sericulture and lac culture.

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ZOOLOGY

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

Theory
ZOO-VIB: OPTION (ii): ECONOMIC ENTOMOLOGY-II

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

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.

Course Objectives: The paper aims to

1.	Study Systematic position, disease caused and control of the pests of Medical and Veterinary importance.
2.	Study mouth parts of the disease causing insects.
3.	Understand the concept of biological, chemical and integrated pest control.

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) 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.

Course Outcomes

Sr. No.	On completing the course, the students will be able to:
CO-1.	Get themselves acquainted with the common pests of medical and veterinary importance and the damage caused by them.
CO-2.	Learn various methods to control the pests and acquire skills to control them.
CO-3.	Learn about different types of the mouth parts of insects
CO-4.	Learn about Insect pest-Management strategies and tools of biological control and other recent methods of insect control
CO-5.	Understand the underlying concepts of Integrated pest management and its importance
CO-6.	Learn about the most commonly used insect control method i.e., chemical control.
CO-7.	Know about the principle, categories and important pesticide of each category
CO-8.	Get acquainted with various repellents and attractants used to control pest.

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ZOOLOGY

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

Practical Related to Option (ii)- ZOO-VIA and ZOO-VIB

Periods/week: 6
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

Course Objectives: The paper aims to

1.	Study feeding apparatus of insects.
2.	Study different types of larvae and pupae of insects.
3.	Study external morphology of pest of stored grains and of medical/veterinary important insects.
4.	Study of life stages of silkworm and honeybees.
5.	Demonstrate various techniques and equipments for the preservation and storage of insects.
6.	Study structure and function of hand compression and Knap sack sprayer.

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

Course Outcomes

Sr. No.	**On completing the course, the students will be able to:**
CO-1.	Identify the feeding apparatus (mouth parts) and its modifications
CO-2.	Identify and differentiate between different larvae and pupae of insects
CO-3.	Morphologically identify important insect-pests of various crops, stored grains and of medical and veterinary importance
CO-4.	Observe life stages of silkworm and honey bee
CO-5.	Understand techniques and equipment for collection and preservation of insects.
CO-6.	Use and understand the working commonly used sprayers

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ZOOLOGY

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

Theory
ZOO-VIA: OPTION (iii): INLAND FISHERIES-I

Periods/week: 4

Time: 3 Hrs. Marks: 25

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.

Course Objectives: The course aims to

1.	Give the students the necessary basic information about fishery and aquaculture.
2.	Discuss morphological characters of a typical fish.
3.	Study the identification and classification of important fishes.
4.	Discuss the techniques of induced breeding.
5.	Discuss the control of aquatic weeds.

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.

Course Outcomes

Sr. No.	On completing the course, the students will be able to:
CO-1.	Observe various tools, crafts and gears used in Fishery.
CO-2.	Describe the morphology, habit and habitat, systematic position and various systems of fishes of Punjab, Haryana and Himachal.
CO-3.	Understand external features and economic importance of fresh water and marine water fishes and other aqua culture organisms
CO-4.	Differentiate between different structure of mouth related to feeding habits
CO-5.	Get insight on exotic fishes
CO-6.	Understand induced breeding techniques and their impact on fish culture
CO-7.	Construct and maintain different types of ponds for fish culture
CO-8.	Understand the role of aquatic weeds and their control

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ZOOLOGY

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

Theory
ZOO-VIB: OPTION (iii): INLAND FISHERIES-II

Periods/week: 4

Time: 3 Hrs. Marks: 25

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.

Course Objectives: The paper aims to

1.	Discuss various reservoir fisheries/dams.
2.	Discuss the concept of integration of fish farming.
3.	Study diseases of fish and their control measures.
4.	Study various by-products of fish and fish marketing procedure.

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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.
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

Course Outcomes

Sr. No.	On completing the course, the students will be able to:
CO-1.	Understand riverine fisheries of Sutlej and Beas
CO-2.	Get insight on reservoir fisheries
CO-3.	Understand various fish culture systems and integrate fish farming along with sewage fed fisheries
CO-4.	Have Know-how of cold water fisheries like Mhaseer and trout
CO-5.	Have In-depth knowledge about fish diseases and their control
CO-6.	Study the marketing of fish and fish by-products

KHALSA COLLEGE AMRITSAR

(An Autonomous College)

P.G. Department of Zoology

Session 2017-18

B.Sc. Medical Semester VI

ZOOLOGY

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

Practical
Related to Option (iii)- ZOO-VIA and ZOO-VIB

Periods/week: 6

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

Course Objectives: The paper aims to

1.	Study the morphology, Morphometric and meristic characters of a typical fish.
2.	Study the identification of fishes using key.
3.	Determine food and feeding habits of locally available fishes.
4.	Study permanent stained slides of phytoplankton and zooplankton.
5.	Study physicochemical parameters of pond water.

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.	8
2.	Estimation of physico-chemical parameters of pond water.	4
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

Course Outcomes

Sr. No.	**On completing the course, the students will be able to:**
CO-1.	Identify fishes based on the morphological characters
CO-2.	Analyze morphometric and meristic character of typical fish using identification keys
CO-3.	Determine food and feeding habits of fishes and their maturity stages
CO-4.	Identify and differentiate between important phytoplanktons and zooplanktons using permanent slides
CO-5.	Estimate chemical parameters of pond waters