FACULTY OF SCIENCES

SYLLABUS FOR THE BATCH FROM 2023 TO 2026

Programme Code: BSMD

Programme Name: B.Sc. Medical

(Semester I- VI)

Examinations: 2023-2026

Department of Zoology

Khalsa College, Amritsar

(An Autonomous College)

S. No.	PROGRAMME OBJECTIVES
1.	To inculcate scientific temperament to broaden the outlook of students.
2.	To provide students a launch-pad for higher education.
3.	Skill development through practical, enabling them to solve common problems in their daily life.
4.	To undertake activities like field survey, photography, projects etc. to unearth their hidden talents.
5.	Holding Science exhibition, poster competition and educational trips, shaping their personality and preparing their minds to face, think and act in different situations.
6.	Participation in various cultural programs to build their confidence which help them to interact with different individuals in the society and work for welfare of the community.

S. No.	PROGRAMME SPECIFIC OUTCOMES (PSOS)
PSO-1	It is one of the most fundamental units of basic sciences studied at undergraduate level.
PSO-2	The programme helps to develop scientific tempers and attitudes which in turn can be useful for the scientific developments that make a nation or society to grow at a rapid pace.
PSO-3	After the completion of this course, students have the option to go higher studies i.e. Ph.D. and then do research work for the welfare of mankind
PSO-4	After higher studies, students can join as scientist or assistant professor and can even look for professional job oriented courses, such as civil services
PSO-5	Students can go to serve in industries and opt for establishing their own industrial units

COURSE SCHEME											
SEMESTER - I											
Course Code	**Course Name**	**Hours/ Week**	**Credits**			**Total Credits**	**Max Marks**				**Page No.**
			L	**T**	**P**		**Th**	**P**	**IA**	**Total**	
Major Courses											
ZOO-111A	Cell Biology	**3**	2	1	0	3	**56**		**50**	**200**	**5**
ZOO-111B	Biodiversity-I	**3**	2	1	0	3	**56**				**7**
ZOO-111P	Practical-I	**4**	0	0	2	2		**38**			**9**

SEMESTER - II											
Course Code	**Course Name**	**Hours/ Week**	**Credits**			**Total Credits**	**Max Marks**				**Page No.**
			L	**T**	**P**		**Th**	**P**	**IA**	**Total**	
Major Courses											
ZOO-121A	Ecology	**3**	2	1	0	3	**56**		**50**	**200**	**11**
ZOO-121B	Biodiversity-II	**3**	2	1	0	3	**56**				**13**
ZOO-121P	Practical-II	**4**	0	0	2	2		**38**			**15**

SEMESTER-III											
Course Code	**Course Name**	**Hours/ Week**	**Credits**			**Total Credits**	**Max Marks**				**Page No.**
			L	**T**	**P**		**Th**	**P**	**IA**	**Total**	
Major Courses											
ZOO-231A	Evolution	**3**	2	1	0	3	**56**		**50**	**200**	**17**
ZOO-231B	Biodiversity-III	**3**	2	1	0	3	**56**				**19**
ZOO-231P	Practical-III	**4**	0	0	2	2		**38**			**21**

SEMESTER-IV											
Course Code	**Course Name**	**Hours/ Week**	**Credits**			**Total Credits**	**Max Marks**				**Page No.**
			L	**T**	**P**		**Th**	**P**	**IA**	**Total**	
Major Courses											
ZOO-241A	Biochemistry	**3**	2	1	0	3	**56**		**50**	**200**	**23**
ZOO-241B	Animal Physiology	**3**	2	1	0	3	**56**				**26**
ZOO-241P	Practical-IV	**4**	0	0	2	2		**38**			**28**

SEMESTER-V											
Course Code	**Course Name**	**Hours/ Week**	**Credits**			**Total Credits**	**Max Marks**				**Page No.**
			L	**T**	**P**		**Th**	**P**	**IA**	**Total**	
Major Courses											
ZOO-351A	Developmental Biology	**3**	2	1	0	3	**56**		**50**	**200**	**30**
ZOO-351B	Genetics	**3**	2	1	0	3	**56**				**32**
ZOO-351P	Practical-V	**4**	0	0	2	2		**38**			**34**

SEMESTER-VI											
Course Code	**Course Name**	**Hours/ Week**	**Credits**			**Total Credits**	**Max Marks**				**Page No.**
			L	**T**	**P**		**Th**	**P**	**IA**	**Total**	
Major Courses											
ZOO-361A	Option (i)- Medical Zoology Option (ii)- Economic Entomology I Option (iii)- Inland Fisheries-I	**3**	2	1	0	3	**56**		**50**	**200**	**36**
ZOO-361B	Option (i)- Medical Laboratory Technology Option (ii)- Economic Entomology II Option (iii)- Inland Fisheries-II	**3**	2	1	0	3	**56**				**42**
ZOO-361P	Practical-VI (Related to Zoo-361A and B) as per Option (i), (ii) and (iii)	**4**	0	0	2	2		**38**			**48**

B.Sc. Medical Semester I
COURSE CODE: ZOO-111
COURSE TITLE: ZOOLOGY

Theory
ZOO-111A: CELL BIOLOGY

Periods/week: 4 **Credit Hours/Week: 3 hrs.**
Credits: LTP: 210
Maximum Marks: 56
Time: 3 Hrs. **Pass Marks: 35%**

Instructions for the Paper Setters:

1. There will be five sections.
2. Section A is compulsory and will be of 12 marks. The candidate will have to attempt any 6 questions out of 8 short answer type questions carrying two marks each covering the whole syllabus. The answer should not exceed 50 words.
3. Section B, C, D and E will be set from units I, II, III and IV respectively and will consists of two questions of 11 marks each from the respective units. The candidates are required to attempt one question from each of these sections. Each question in these sections should not have more than two sub-parts.

COURSE OBJECTIVES

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) Resolving Power of Microscope: Principles of light and phase contrast microscopy
  (b) Electron microscopy (TEM and SEM): Principle and construction
  (c) Fixation and fixatives; Bouin's Fluid (alcoholic and Aqueous), Carnoy's fluid, Normal Saline; Formalin solution, Mayer's albumen
  (d) Grades of Alcohol
  (e) Types of Stain: Borax carmine, Aceto-orcein, Haematoxylin, Eosin, Safranin, Leishman, Giemsa, Methylene Blue, Light green, fast green
  (f) Preparation of Permanent slides: Temporary and Permanent mounting, single and double staining

UNIT–II

- Organization of Cell: Extra nuclear and nuclear, ultrastructure and functions of cell organelles
  (a) Plasma Membrane: Structure of phospholipid, Fluid Mosaic Model
  (b) Types of diffusion, osmosis, active & passive transport
  (c) Bulk Transport: Phagocytosis, Pinocytosis
  (d) Endoplasmic reticulum: Structure, types and associated enzymes

(e) 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
  (e) Cilia and Flagella

UNIT–IV

- Nucleus: Structure and functions of nuclear membrane, nucleolus and chromosomes
- Cancer and its types; causes of cancer and characteristics of cancer cells.
- An elementary idea of cell transformation in cancer; role of P53 gene and telomerase enzyme
- An elementary idea of cellular basis of immunity: Active, passive, innate, humoral and cell mediated immunity, types and 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

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.

Theory

ZOO-111B: BIODIVERSITY-I (PROTOZOA TO ANNELIDA)

Periods/week: 4 **Credit Hours/Week: 3 hrs.**
Credits: LTP: 210
Maximum Marks: 56
Time: 3 Hrs. **Pass Marks: 35%**

Instructions for the Paper Setters:

1. There will be five sections.
2. Section A is compulsory and will be of 12 marks. The candidate will have to attempt any 6 questions out of 8 short answer type questions carrying two marks each covering the whole syllabus. The answer should not exceed 50 words.
3. Section B, C, D and E will be set from units I, II, III and IV respectively and will consists of two questions of 11 marks each from the respective units. The candidates are required to attempt one question from each of these sections. Each question in these sections should not have more than two sub-parts.

COURSE OBJECTIVES

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.

UNIT–I

Detailed study of the following animals-

- Protozoa:
  - *Amoeba proteus* emphasizing theories of amoeboid locomotion
  - *Paramecium caudatum* (Kappa particles in *P. aurelia*)
  - *Plasmodium vivax*

UNIT–II

Detailed study of the following animals-

- Porifera: Detailed study of the following animals-
  - *Sycon* (special reference to canal system)
- Coelenterata:
  - *Obelia*

UNIT–III

Detailed study of the following animals-

- Platyhelminthes:
  - *Fasciola hepatica*
  - *Taenia solium*
- Parasitic adaptations in *Fasciola* and *Taenia*

UNIT–IV

Detailed study of the following animals-

- Aschelminthes:
  - *Ascaris*

- Annelida:
  - *Pheretima posthuma*
- Economic importance of 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, NewYork.
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

CO-1.	The subject of biodiversity helps the students to know about the structural aspects of different animals
CO-2.	Students also gain knowledge about the taxonomies and evolutionary aspects of Zoology.
CO-3.	To study faunal diversity and learn to implement conservation measures to save biodiversity

Practical-I
ZOO-111P: (Related to ZOO-111A and ZOO-111B)

Periods/week: 6 **Credit Hours/Week: 2 hrs.**
Credits: LTP: 002
Maximum Marks: 38
Time: 3 Hrs. **Pass Marks: 35%**

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

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 A-C up to order. Write a note on their habit, habitat, special features and economic importance.	9
2	Identify the slides/models D-G and give two reasons for identification.	8
3	Identify the adaptive feature/nest.	5
4	Mark the distribution of animals of a realm on the map.	5
5	Project/ Assignment report	5
6	Viva-voce & Practical file.	6

COURSE OUTCOMES

CO-1.	Have a knowledge about all the different phyla of invertebrates
CO-2.	Understand the comparative structure of invertebrates
CO-3.	Have an insight about the microscopic life
CO-4.	Differentiate invertebrates on the basis of morphological characteristics

B.Sc. Medical Semester II
COURSE CODE: ZOO-121
COURSE TITLE: ZOOLOGY

Theory
ZOO-121A: ECOLOGY

Periods/week: 4 **Credit Hours/Week: 3 hrs.**
Credits: LTP: 210
Maximum Marks: 56
Time: 3 Hrs. **Pass Marks: 35%**

Instructions for the Paper Setters:

1. There will be five sections.
2. Section A is compulsory and will be of 12 marks. The candidate will have to attempt any 6 questions out of 8 short answer type questions carrying two marks each covering the whole syllabus. The answer should not exceed 50 words.
3. Section B, C, D and E will be set from units I, II, III and IV respectively and will consists of two questions of 11 marks each from the respective units. The candidates are required to attempt one question from each of these sections. Each question in these sections should not have more than two sub-parts.

COURSE OBJECTIVES

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

- Meaning of Ecology, its divisions and levels of organization
- Biotic and Abiotic components of Ecosystem, Ecological energetics (10% law), food chains and webs, major ecosystems of the world
- Temperature, light and soil as ecological factors

UNIT–II

- Biogeochemical cycles (Carbon, Nitrogen, Sulphur, Phosphorus and Water cycle)
- Adaptations, its types (Morphological, physiological and behavioural adaptations) in different animals

UNIT–III

- Characteristics of population and its regulation strategies
- Interactions among animals (Competition, Predation, Parasitism, Commensalism and Mutualism)
- Ecological succession and its types (Hydrosere and Xerosere), Concept of ecological niche

UNIT–IV

- Renewable and non-renewable natural resources and their conservation
- Causes, impact and control of air, water and soil 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

CO-1.	Have a knowledge about the biodiversity
CO-2.	assess effects of human activities on biosphere
CO-3.	Pursue various courses M.Sc. Environmental studies etc. in future & can opt for carrier in academics.
CO-4.	Work for wildlife and biodiversity agencies.

Theory

ZOO-121B: BIODIVERSITY-II (ARTHROPODA TO HEMICHORDATA)

Periods/week: 4 **Credit Hours/Week: 3 hrs.**
Credits: LTP: 210
Maximum Marks: 56
Time: 3 Hrs. **Pass Marks: 35%**

Instructions for the Paper Setters:

1. There will be five sections.
2. Section A is compulsory and will be of 12 marks. The candidate will have to attempt any 6 questions out of 8 short answer type questions carrying two marks each covering the whole syllabus. The answer should not exceed 50 words.
3. Section B, C, D and E will be set from units I, II, III and IV respectively and will consists of two questions of 11 marks each from the respective units. The candidates are required to attempt one question from each of these sections. Each question in these sections should not have more than two sub-parts.

COURSE OBJECTIVES

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-** General characteristics and economic importance;
- Mouth Parts (types and modifications), Prawn (only appendages)
- Type study**:** *Periplaneta americana* (Cockroach)
- Social organizations in insects (Honey bee and Termite)

UNIT–II

- **Mollusca-** General Characteristics and Economic importance;
- Type study**:** *Pila globosa*
- Torsion and its effect, advantage and disadvantage of torsion, Detorsion, Pearl formation

UNIT–III

- **Echinodermata-** General Characteristics and Economic importance;
- Type study**:** *Asterias* (Star fish)
- Study of Echinoderm larvae

UNIT–IV

- **Hemichordata:** General Characteristics and Economic importance;
- *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

CO-1.	The subject of biodiversity helps the students to know about the structural aspects of different animals.
CO-2.	Students also gain knowledge about the taxonomies and evolutionary aspects of Zoology.
CO-3.	To study faunal diversity and learn to implement conservation measures to save biodiversity
CO-4.	The students get in depth knowledge about various animal phyla (Arthropoda to Hemichordata)
CO-5.	Detailed type studies of representative organisms of each phyla.
CO-6.	This course also provides detailed knowledge about evolutionary relationships between Non-Chordates, Hemichordates & Chordates.

Practical-II
ZOO-121P: (Related to ZOO-121A and ZOO-121B)

Periods/week: 6 **Credit Hours/Week: 2 hrs.**
Credits: LTP: 002
Maximum Marks: 38
Time: 3 Hrs. **Pass Marks: 35%**

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

1.	Classify the organisms up to orders with their ecological notes and economic importance.
2.	Understand the permanent stained slides of insects and molluscs.
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:**	Study of local invertebrates fauna/Preparation of scrap book

Guidelines for conduct of practical Examination: -

1.	Identify and classify the specimens A-C up to order. Write a note on their habit, habitat, special features and economic importance.	9
2.	Identify the slides/models D-G and give two reasons for identification.	8
3.	Identify the adaptive feature of animals/nest.	5
4.	Mark the distribution of animals of a realm on the map.	5
5.	Project/ Assignment report	5
6.	Viva-voce & Practical file.	6

COURSE OUTCOMES

CO-1.	Differentiate invertebrates on the basis of morphological characteristics
CO-2.	Understand the comparative structure of invertebrates
CO-3.	Have an insight about the internal systems of different invertebrates
CO-4.	Have a knowledge about different phyla of invertebrates

B.Sc. Medical Semester III
COURSE CODE: ZOO-231
COURSE TITLE: ZOOLOGY

Theory
ZOO-231A: EVOLUTION

Periods/week: 4 **Credit Hours/Week: 3 hrs.**
Credits: LTP: 210
Maximum Marks: 56
Time: 3 Hrs. **Pass Marks: 35%**

Instructions for the Paper Setters:

1. There will be five sections.
2. Section A is compulsory and will be of 12 marks. The candidate will have to attempt any 6 questions out of 8 short answer type questions carrying two marks each covering the whole syllabus. The answer should not exceed 50 words.
3. Section B, C, D and E will be set from units I, II, III and IV respectively and will consists of two questions of 11 marks each from the respective units. The candidates are required to attempt one question from each of these sections. Each question in these sections should not have more than two sub-parts.

Course Objectives: The paper aims to

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

UNIT–I

- Introduction to evolution & its significance.
- Evidences of organic evolution: Morphological, embryological, paleontological, biochemical, bio-geographical, taxonomical & cytological
- Theories of organic evolution: Lamarckism, Darwinism, Mutation Theory, Neo-Darwinism etc.

UNIT–II

- Origin of life: Mechanistic & Materialistic theories in detail
- Origin of prokaryotic & eukaryotic cells
- Concept of micro, macro and mega-evolution.
- Concept of Species
- Speciation & Role of Natural Selection in speciation

UNIT–III

- Fossils, its types, significance & evolutionary rate
- Evolutionary trends in Origin of Reptiles & their Extinction
- Evolution of man (in Brief)

UNIT–IV

- Fish migration, its types with examples
- Parental Care in Pisces
- Fish scales- types and functions
- Fins- their origin & types
- Poisonous & Non-poisonous snakes, Poison apparatus
- Flight adaptation: morphological, anatomical and physiological
- Bird migration- types & advantages
- Adaptive radiation and Dentition in Mammals

Suggested Readings:-

1. Avers, C. J.(1989). Evolution Process and Pattern in Evolution, Oxford University, Press, New York, Oxford.
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

CO-1.	To develop an understanding of concept evolution & different proposed theories of evolution
CO-2.	To develop understanding of origin of life and concept of species and speciation
CO-3.	To familiarize students with topics related to fossils, reptile origin & extinction, origin of man
CO-4.	To teach students about poisonous and non-poisonous snakes & poison apparatus in snakes
CO-5.	To develop basic knowledge of migratory and parental investment in fishes

Theory

ZOO-231B: BIODIVERSITY-III (CHORDATES)

Periods/week: 4 **Credit Hours/Week: 3 hrs.**
Credits: LTP: 210
Maximum Marks: 56
Time: 3 Hrs. **Pass Marks: 35%**

Instructions for the Paper Setters:

1. There will be five sections.
2. Section A is compulsory and will be of 12 marks. The candidate will have to attempt any 6 questions out of 8 short answer type questions carrying two marks each covering the whole syllabus. The answer should not exceed 50 words.
3. Section B, C, D and E will be set from units I, II, III and IV respectively and will consists of two questions of 11 marks each from the respective units. The candidates are required to attempt one question from each of these sections. Each question in these sections 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* (External Features, Body wall, Digestive system, Respiratory system, Blood vascular system, Nervous system, Urinogenital system).

UNIT–II

- **Cyclostomata:** External Characters of *Petromyzon*
- Affinities of Cyclostomata
- **Pisces**-Type study:
  - *Labeo* (External Features, Body wall, Digestive system, Respiratory system, Blood vascular system, Nervous system, Urinogenital system).
  - Economic importance of fishes

UNIT–III

- **Amphibia**-Type study:
  - Frog (External features, digestive system, respiratory system, blood vascular system, nervous system-brain & cranial nerves, sense organs, urinogenital system)
  - Economic importance of Amphibians

- **Reptilia**-Type study:
  - Uromastix, (External features, digestive system, respiratory system, blood vascular system, nervous system-brain & cranial nerves, sense organs, urinogenital system)
  - Economic importance of reptiles

UNIT–IV

- **Aves**-Type study:

- Pigeon (External features, digestive system, respiratory system, blood vascular system, nervous system-brain & cranial nerves, sense organs, urinogenital system)
- Economic importance of birds

- **Mammals**-Type study:
  - Rat (External features, digestive system, respiratory system, blood vascular system, nervous system-brain & cranial nerves, sense organs, Urinogenital system)

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. Jollie, M. (1968), Chordate Morphology, Reinhold, New York.
4. Kardong, K. V. (1995), Vertebrates – Comparative Anatomy, Function, Evolution. W.B.C. Pub. , Oxford.
5. Kent, G. C. and Carr, R. K. (2001), Comparative Anatomy of the Vertebrates (9th ed), McGraw Hill Higher Education, New York.
6. Linzey, D. (2001), Vertebrate Biology, McGraw Hill Publishing Company, New York.
7. Pough, F. H., Heiser, J. B. and McFarland, W. N. (1990), Vertebrate Life (3rd ed), Macmillan Pub. Co., New York.
8. Young, J. Z. (1982), The Life of Vertebrates, New York.
9. Parker, T.J. and Haswell, W.A (1981) Text Book of Zoology, Vol. II (Vertebrates), ELBS and Macmillian Press Ltd.

Course Outcomes

CO-1.	Understand of internal system of chordates
CO-2.	Understand of interrelationships of chordates; their characteristics and affinities
CO-3.	Understanding the basis of their relation to other animals by body structure, external characters
CO-4.	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

Practical-III
ZOO-231P: (Related to ZOO-231A and ZOO-231B)

Periods/week: 6 **Credit Hours/Week: 2 hrs.**
Credits: LTP: 002
Maximum Marks: 38
Time: 3 Hrs. **Pass Marks: 35%**

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.	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.	9
2.	Identify the given system of the animal from chart/model. Draw a well labeled diagram.	8
3.	Identify the given slide stating two reasons for its identification.	6
4.	Identify evolutionary phenomenon and give its significance.	5
5.	Project/ Assignment report	4
6.	Viva-voce & Practical file.	6

Course Outcomes

CO-1.	Understanding of 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.	In-depth knowledge of museology- placement and arrangement of animals depicting their classification and interrelationships
CO-4.	Understanding of various concepts relevant to classification
CO-5.	Understanding of anatomy of vertebrates
CO-6.	Gain knowledge to identify various animals based on morphologicalfeatures.
CO-7.	Gain knowledge to distinguish between poisonous and non-poisonoussnakes
CO-8.	The student will be able to describe the morphology, habit and habitat. Systematic position and various systems
CO-9.	Identified the taxonomic status of the entire chordates and discussed the evolutionary model of the group.
CO-10.	To make them aware of the economic importance of some classes
CO-11.	To understand organs through permanent slides
CO-12.	Imparted the knowledge on ecology of some important fishes, amphibians reptiles, birds and mammals

B.Sc. Medical Semester IV
COURSE CODE: ZOO-241
COURSE TITLE: ZOOLOGY

Theory
ZOO-241A: BIOCHEMISTRY

Periods/week: 4 **Credit Hours/Week: 3 hrs.**
Credits: LTP: 210
Maximum Marks: 56
Time: 3 Hrs. **Pass Marks: 35%**

Instructions for the Paper Setters:

1. There will be five sections.
2. Section A is compulsory and will be of 12 marks. The candidate will have to attempt any 6 questions out of 8 short answer type questions carrying two marks each covering the whole syllabus. The answer should not exceed 50 words.
3. Section B, C, D and E will be set from units I, II, III and IV respectively and will consists of two questions of 11 marks each from the respective units. The candidates are required to attempt one question from each of these sections. Each question in these sections 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

Stereochemistry of Carbohydrates
Essential Amino acids and fatty acids

UNIT–II

- **Enzymes:**
  - Nature, classification and their functions
  - Coenzymes
  - Cofactors
- **Lipid Metabolism:**
  - β-Oxidation of fatty acid
  - Ketosis and its significance

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:**
  - Hydrolysis of Proteins
- **Metabolism of amino acids**
  - Oxidative deamination
  - Transamination
  - Decarboxylation
  - 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

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.	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, theirtypes 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.	Discuss 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.

Theory

ZOO-241B: ANIMAL PHYSIOLOGY

Periods/week: 4 **Credit Hours/Week: 3 hrs.**
Credits: LTP: 210
Maximum Marks: 56
Time: 3 Hrs. **Pass Marks: 35%**

Instructions for the Paper Setters:

1. There will be five sections.
2. Section A is compulsory and will be of 12 marks. The candidate will have to attempt any 6 questions out of 8 short answer type questions carrying two marks each covering the whole syllabus. The answer should not exceed 50 words.
3. Section B, C, D and E will be set from units I, II, III and IV respectively and will consists of two questions of 11 marks each from the respective units. The candidates are required to attempt one question from each of these sections. Each question in these sections 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:**
  - o Types of Digestion: Intracellular & Extracellular digestion
  - o Digestion of dietary constituents: Carbohydrates, Proteins, Fats and Nucleic acids
  - o Regulation of digestive processes
  - o Absorption of digested food components
  - o Enzymatic digestion and symbiotic digestion.
- **Respiration:**
  - o Transport of Respiratory Gases in Blood: Transport of O2 and CO2
  - o Oxygen dissociation curve of haemoglobin
  - o Bohr effect, Chloride shift and Haldane effect
  - o Control of breathing: Respiratory centres & their biological significance

UNIT–II

- **Heart:**
  - o Origin, conduction and regulation of heart beat
  - o Cardiac cycle and Cardiac output
  - o Electrocardiogram
  - o Blood pressure and micro-circulation
- **Blood:**
  - o Composition and functions of blood and lymph
  - o Blood clotting, anticoagulants, Role of vitamin K in blood clotting
  - o Blood groups including Rh factor

o Haemopoiesis: Erythropoiesis, Leucopoiesis, Thrombopoiesis; haemostasis

- **Excretion:**
  - o Physiology of Urine formation
  - o Osmoregulation, water and solute regulation in different habitats

UNIT–III

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

UNIT–IV

- **Physiology of Behaviour:**
  - o Taxes and reflexes and its significance
  - o Instinctive behaviour and motivation
  - o Learning, types of learning and reasoning
- **Endocrine:**
  - o Structure, hormones, functions and disorders in endocrine glands: 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 andMacmillian 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.

Course Outcomes

CO-1.	To develop understanding of the various fundamental concepts related to physiology of digesting & absorption
CO-2.	To develop understanding of circulatory system and blood components
CO-3.	To familiarize students with topics related to nervous and muscular system and their working
CO-4.	To teach students the various aspects of respiratory system and exchange of respiratory gases
CO-5.	To develop basic knowledge of innate and acquired behaviours
CO-6.	To develop an understanding of endocrine glands, their functioning and associated disorders

Practical-IV
ZOO-241P: (Related to ZOO-241A and ZOO-241B)

Periods/week: 6 **Credit Hours/Week: 2 hrs.**
Credits: LTP: 002
Maximum Marks: 38
Time: 3 Hrs. **Pass Marks: 35%**

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 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 labeled sketches of their respective–views.	12
2.	Write down the procedure and determine the constituent in the given sample.	08
3.	Write the procedure and perform the given physiology experiment.	08
4.	Report on visit to fossil park/study of local vertebrate fauna.	04
5.	Viva-voce & Practical file.	06

Course Outcomes

CO-1.	Analyse vertebrate skeletal system
CO-2.	Compare and contrast the skeletons of fish, frog, lizard, bird and a mammal
CO-3.	Development skill for the observation of blood cells and haemin crystals.
CO-4.	Attain knowledge of qualitative analysis of macromolecules, excretory products, bloodglucose and cholesterol
CO-5.	Illustrate the enzyme activity from suitable material.
CO-6.	Demonstrate the effect of various physical and chemical factors onenzyme activity
CO-7.	This also will provide a basic understanding of the experimental methods and designs that can beused for further study and research.

B.Sc. Medical Semester V
COURSE CODE: ZOO-351
COURSE TITLE: ZOOLOGY

Theory
ZOO-351A: DEVELOPMENTAL BIOLOGY

Periods/week: 4 **Credit Hours/Week: 3 hrs.**
Credits: LTP: 210
Maximum Marks: 56
Time: 3 Hrs. **Pass Marks: 35%**

Instructions for the Paper Setters:

1. There will be five sections.
2. Section A is compulsory and will be of 12 marks. The candidate will have to attempt any 6 questions out of 8 short answer type questions carrying two marks each covering the whole syllabus. The answer should not exceed 50 words.
3. Section B, C, D and E will be set from units I, II, III and IV respectively and will consists of two questions of 11 marks each from the respective units. The candidates are required to attempt one question from each of these sections. Each question in these sections should not have more than two sub-parts.

COURSE OBJECTIVES

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
  - Oogenesis
  - Spermatogenesis (with particular reference to Spermiogenesis)
  - Vitellogenesis
- Egg maturation, egg membranes
- Types of eggs
- Parthenogenesis
- Fertilization and Amphimixis

Unit-II

- Cleavage and its patterns; Types of Blastulae
- Gastrulation- Morphogenetic movements
- Cell Determination- Ooplasmic determinants
- Cell differentiation
- Tissue interactions, basic concepts of organizers and inductors and their role
- Embryonic development of *Herdmania*

Unit-III

- Development up to three germinal layers and their fate in frog and chick
- Fate maps of chick and frog embryos

- Metamorphosis in Frog

Unit-IV

- Early embryonic development of rabbit
- Foetal (embryonic) membranes, their formation and role
- Mammalian placenta–its formation, types and functions
- Regeneration

Suggested Readings:

1. Balinsky, B.I. (1981), An Introduction to Embryology, Saunders, Philadelphia.
2. Bellairs, R. (1971), Development Processes in Higher Vertebrates, University of MiamiPress, Miami.
3. Berrill. N.J. (1971), Developmental Biology. McGraw Hill, New Delhi.
4. Ebert, J.D. & Sussex, IM. (1970), Interacting Systems in Development, Holt, Rinehartand 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

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.	Understanding and significance of regeneration and metamorphosis
CO-7.	Know about the embryonic development of *Herdmania*, frog, chick and rabbit
CO-8.	Knowledge about mammalian placenta, its formation, types and function
CO-9.	Understand the process of regeneration, ageing and finally death

Theory
ZOO-351B: GENETICS

Periods/week: 4 **Credit Hours/Week: 3 hrs.**
Credits: LTP: 210
Maximum Marks: 56
Time: 3 Hrs. **Pass Marks: 35%**

Instructions for the Paper Setters:

1. There will be five sections.
2. Section A is compulsory and will be of 12 marks. The candidate will have to attempt any 6 questions out of 8 short answer type questions carrying two marks each covering the whole syllabus. The answer should not exceed 50 words.
3. Section B, C, D and E will be set from units I, II, III and IV respectively and will consists of two questions of 11 marks each from the respective units. The candidates are required to attempt one question from each of these sections. Each question in these sections should not have more than two sub-parts.

COURSE OBJECTIVES

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

- **Mendelian genetics:** Law of segregation, Independent assortment, dominance and co-dominance.
- **Modification of Mendelian Ratios:** Non-allelic gene interaction, Modified F_2 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, linkage groups, sex-linked characters, chromosomal map.
- **Crossing Over and Recombination:** crossing over, frequency of crossing over, Synaptonemal complex, cytological basis of crossing over, Crossing over in post- replication tetrad stage (*Neurospora crassa* experiment)

Unit-II

- **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, exceptions as in split and overlapping genes

Unit-III

- **Mutations:** Classification of mutations: Spontaneous and induced mutations, Somatic and germinal mutations, Point and gross mutations, Forward and reverse mutations, Insertion and deletion; **Mutagens:** Physical and chemical mutagens. Inborn errors of metabolism in man (Phenylketonuria, Alkaptonuria, Albinism). Somatic mutations and carcinogenesis.

- **Regulation of gene expressions** in prokaryotes (Operon model) and in eukaryotes.
- **Extra nuclear inheritance:** Chloroplast with special reference to *Mirabilis jalapa* and kappa particles in *Paramecium*, maternal gene effect.

Unit-IV

- **Population genetics:** Equilibrium of gene frequencies and Hardy-Weinberg law.
- **Genetic recombination** in bacteria (conjugation, transduction and transformation): plasmids as vectors.
- **Applied Genetics:** Recombinant DNA technology, Gene cloning and its applicationsin medicine and agriculture, DNA fingerprinting and its applications.

Suggested readings:

1. Ayala, F.J. & Kiger, Jr. J.A. (1980), Modern Genetics. The Benjamin CummingsPublishing 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, (8thEd), 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), TheBenjamin /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, NewDelhi.
8. Zubay. U.G. (1987), Genetics, The Cummings Publishing Co., Inc.

COURSE OUTCOMES

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.

Practical-V
ZOO-351P: (Related to ZOO-351A and ZOO-351B)

Periods/week: 6 **Credit Hours/Week: 2 hrs.**
Credits: LTP: 002
Maximum Marks: 38
Time: 3 Hrs. **Pass Marks: 35%**

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

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	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 up to tadpole Chick up to 96 hrs
9.	Preparation of charts showing various life stages of any vertebrate	

10.	Preparation of slide for Barr body from cheek cells

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

Guidelines for conduct of Practical Examination:

1.	Two Numerical based on Mendel/Hardy Weinberg Law.	12
2.	Perform the experiment for Dermatoglyphic/ Random mating/ Variance.	6
3.	Identification of given spots.	8
4.	Make a pedigree chart from the given data.	6
5.	Viva-voce and practical file.	6

COURSE OUTCOMES

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	Demonstration of segregation in preserved material: Maize
CO-4.	Understanding cytoplasmic inheritance inn 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	Analyse variance in pea pod

B.Sc. Medical Semester VI
COURSE CODE: ZOO-361
COURSE TITLE: ZOOLOGY

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

Options	ZOO-361A	ZOO-361B
(i)	Medical Zoology	Medical Laboratory Technology
(ii)	Economic Entomology I	Economic Entomology II
(iii)	Inland Fisheries (Aquaculture)-I	Inland Fisheries (Aquaculture)-II

Theory
ZOO-361A: MEDICAL ZOOLOGY

Periods/week: 4 **Credit Hours/Week: 3 hrs.**
Credits: LTP: 210
Maximum Marks: 56
Time: 3 Hrs. **Pass Marks: 35%**

Instructions for the Paper Setters:

1. There will be five sections.
2. Section A is compulsory and will be of 12 marks. The candidate will have to attempt any 6 questions out of 8 short answer type questions carrying two marks each covering the whole syllabus. The answer should not exceed 50 words.
3. Section B, C, D and E will be set from units I, II, III and IV respectively and will consists of two questions of 11 marks each from the respective units. The candidates are required to attempt one question from each of these sections. Each question in these sections should not have more than two sub-parts.

COURSE OBJECTIVES

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 Helminths.
3.	Study the life cycle and control measures of arthropod vectors of human disease.
4.	Understand human defence mechanisms and study the structure and function of antibodies.

UNIT–I

- **Introduction of Parasitology**: Pertaining to various terminologies in use. Classification of Parasites and Hosts, Definitions: Phoresis, Hyperparasitism, Superparasitism, Brood Parasitism, Parasitoids.
- **Brief introduction to pathogenic Microbes:** Viruses, Ricketsiae, Spirochaetes and Bacteria.
- **Epidemic disease**: Typhoid, Cholera, Smallpox; their occurrence and eradication programmes.

UNIT–II

- **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

- **Life cycle and control measures of arthropod vectors of human disease:** Malaria *(Anopheles stephens, A. culicifaces* Yellow fever, Dengue and Dengue haemorrhagic fever, Chikungunya, *(Aedes aegypti A. albopicuts)*; Filariasis *(Culex pipien satigeans) Mansonia* sp. Japanese Encephalitis *(C. trinanelorhynchus);* Plague *(Stenophalide cheopis)* and Epidemic Typhus *(Pediculus spp).*

UNIT–IV

- **Brief introduction to human defence mechanisms**: Types of immunity-innate and adaptive. Features of immune response, memory, specificity and recognition of self and non-self. Primary and secondary lymphoid organs.
- **Humoral and cell mediated immune response.** Physical & chemical properties of antigens.
- Antibodies structure, Classes and functions of immunoglobulins A, D, E, G and M.

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., NewYork.
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

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, and 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-361B: MEDICAL LABORATORY TECHNOLOGY

Periods/week: 4 **Credit Hours/Week: 3 hrs.**
Credits: LTP: 210
Maximum Marks: 56
Time: 3 Hrs. **Pass Marks: 35%**

Instructions for the Paper Setters:

1. There will be five sections.
2. Section A is compulsory and will be of 12 marks. The candidate will have to attempt any 6 questions out of 8 short answer type questions carrying two marks each covering the whole syllabus. The answer should not exceed 50 words.
3. Section B, C, D and E will be set from units I, II, III and IV respectively and will consists of two questions of 11 marks each from the respective units. The candidates are required to attempt one question from each of these sections. Each question in these sections should not have more than two sub-parts.

COURSE OBJECTIVES

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

- **Antigens and antibody interactions-** Sero-diagonstic assays (Precipitation, agglutination immunodiffusion, ELISA, RIA).
- **Vaccines:** conventional vaccines, Viral vaccines, Bacterial vaccines, peptide vaccines, genetically engineered vaccines
- **Laboratory Techniques:** Calorimetry, 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, platelet count

UNIT–III

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

UNIT–IV

- **Histopathology:** Common fixatives and staining techniques
- **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 inurine 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., NewYork.
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

CO-1.	Knowledge related to the techniques involved in 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 impact of diseases and endo-parasites on human health
CO-5.	Learn about Physiology of Human Immune response.

Practical-VI
ZOO-361P: (Related to ZOO-361A and ZOO-361B)

Periods/week: 6 **Credit Hours/Week: 2 hrs.**
Credits: LTP: 002
Maximum Marks: 38
Time: 3 Hrs. **Pass Marks: 35%**

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

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, Helminths 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 haematocrit
		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, Helminths and arthropods mentioned in the theory syllabus.
9.	Demonstration of	Fixation, embedding, cutting of tissue sections, and their staining (routine haematoxylin and eosin)
10.	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.	8
2.	Write down the procedure, precautions and perform the experiment for physico-chemical examination of urine.	10
3.	Perform an experiment on Haematology.	6
4.	Identification, pathogenicity and host of parasitic organism.	4
5.	Estimation of blood sugar/urea/cholesterol/ protein in the given sample.	4
6.	Viva-voce and practical file.	6

COURSE OUTCOMES

CO-1.	Students get to know about laboratory safety rules like proper handling of patients, specimens, needles etc.
CO-2.	Students will get technical knowhow regarding estimation of Haemoglobin level, ESR, blood sugar, protein, cholesterol etc.
CO-3.	Students will be able to prepare thick and thin blood films and counting of WBC, RBC and DLC
CO-4.	Students will be able to study the protozoans, parasitic helminthes , arthropods vectors of various diseases through permanent slides
CO-5.	Students will also perform physic-chemical examination of urine
CO-5.	Students will be able to examine stool for intestinal parasite

B.Sc. Medical Semester VI
COURSE CODE: ZOO-361
COURSE TITLE: ZOOLOGY
Theory
ZOO-361A: ECONOMIC ENTOMOLOGY I

Periods/week: 4 **Credit Hours/Week: 3 hrs.**
Credits: LTP: 210
Maximum Marks: 56
Time: 3 Hrs. **Pass Marks: 35%**

Instructions for the Paper Setters:

1. There will be five sections.
2. Section A is compulsory and will be of 12 marks. The candidate will have to attempt any 6 questions out of 8 short answer type questions carrying two marks each covering the whole syllabus. The answer should not exceed 50 words.
3. Section B, C, D and E will be set from units I, II, III and IV respectively and will consists of two questions of 11 marks each from the respective units. The candidates are required to attempt one question from each of these sections. Each question in these sections should not have more than two sub-parts.

COURSE OBJECTIVES

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, life cycle, nature of damage and control measures of thefollowing pests of crops:

A. Sugarcane:

1) Sugarcane leaf hopper *(Pyrilla perpusilla)*
2) Sugarcane top borer *(Scirpophaga nivella/excerptalis)*
3) Sugarcane stem borer *(Chilotrea infuscatellus)*
4) Stalk borer (*Chilo auricilius*)
5) Sugarcane termites

B. Cotton:

1) Pink bollworm *(Pectinophora gossypiella)*
2) Red cotton bug *(Dysdercus cingulatus)*
3) Cotton grey weevil *(Myllocerus maculosus)*
4) American bollworm (*Helicoverpa armigera*)
5) Cotton jassid *(Empoasca devastans)*
6) Cotton whitefly (*Bemisia tabaci*)

UNIT–II

Systematic position, habits, life cycle, nature of damage and control measures of thefollowing pests of crops:

A. Paddy:

1) Rice gundhy Bug *(Leptocorisa varicornis)*
2) Rice grasshopper *(Heiroglyphus banian)*
3) Rice Hispa *(Dicladispa armigera)*
4) Yellow stem borer (Scirpophaga incertulas)
5) Rice leaf folder (Cnaphalocrocis medinalis)

B. Wheat:

1) Wheat stem borer *(Sesamia inferens).*
2) Termites
3) Wheat Aphid (*Sitobion miscanthi*) and Jassid
4) Armyworm (*Mythima separata*)

UNIT–III

Systematic position, habits, life cycle, nature of damage and control measures of thefollowing pests of vegetables and **stored grains**:

C. Vegetables:

1) Red pumpkin beetle *(Aulacophora foveicollis)*
2) Pumpkin fruit fly *(Zeugodacus cucurbitae)*
3) Hadda beetle *(Epilachna vigintioctopunctata)*
4) Cabbage caterpillar (Pieris brassicae)
5) Brinjal fruit and shoot borer (Leucinodes orbonalis)

D. 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)*

UNIT–IV

Useful Insects: Classification, life cycle, commercial rearing, natural enemies (Diseases andInsect-pest) and economically beneficial products of-

1. Sericulture
2. Apiculture
3. Lac culture

Suggested Reading:

1. Alford, D.V. (1999), A text book of Agricultural Entomology. Blackwell SciencePublishers, Cambridge, U.K.
2. Atwal, A.S. and Dhaliwal, G.S. (1997), Agricultural pest of South Asia and theirmanagement, Kalyani Publishers, New Delhi.
3. Dhaliwal, G.S. and Arora, R. (1996), Principles of insect management, Globe offsetPress, 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

CO-1.	Acquaint with the common pests of our major crops and the damage caused.
CO-2.	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 Apiculture, Sericulture and lac culture.
CO-7.	Student will be able to explain the important pests of apiculture, sericulture and lac culture.

Theory

ZOO-361B: ECONOMIC ENTOMOLOGY II

Periods/week: 4 **Credit Hours/Week: 3 hrs.**
Credits: LTP: 210
Maximum Marks: 56
Time: 3 Hrs. **Pass Marks: 35%**

Instructions for the Paper Setters:

1. There will be five sections.
2. Section A is compulsory and will be of 12 marks. The candidate will have to attempt any 6 questions out of 8 short answer type questions carrying two marks each covering the whole syllabus. The answer should not exceed 50 words.
3. Section B, C, D and E will be set from units I, II, III and IV respectively and will consists of two questions of 11 marks each from the respective units. The candidates are required to attempt one question from each of these sections. Each question in these sections should not have more than two sub-parts.

COURSE OBJECTIVES-

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, habits, life cycle, disease caused and control measures of thefollowing pests of Medical and Veterinary importance:

1) Mosquitoes *(Anopheles, Culex & Aedes)*
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 (*Xenopsylla*)
8) Poultry louse *(Menopon gallinae)*
9) Sucking louse *(Haematopinus eurysternus)*

UNIT–II

Detailed study of Mouth parts of:

1) Biting and chewing type- Cockroach, Grasshopper
2) Piercing and sucking type- Red cotton bug, Mosquito
3) Sponging type- House fly
4) Chewing and lapping type- Honey bee
5) Siphoning type- Butterfly

UNIT–III

Integrated pest control:

- Concept of IPM,
- Practices and scope
- Limitations of IPM

Biological control of insect pests:

- Principles and history
- Modern status
- Agents of bio control- Microbial control, parasites and predators

UNIT–IV

Chemical Control:

- History
- Principle of chemical control
- Categories of pesticides
- Important pesticides of each category
- Hazards and limitations

Recent methods of pest suppression:

- Sterile insect release methods
- Behavioural control involving the use of pheromones
- Insect attractants and repellents
- Hormonal control

Suggested Reading Material:

1. Alford, D.V. (1999), A textbook of Agricultural Entomology. Blackwell SciencePublishers, 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 offsetPress, 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

CO-1.	Acquaint 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.

Practical-VI
ZOO-361P: (Related to ZOO-361A and ZOO-361B)

Periods/week: 6 **Credit Hours/Week: 2 hrs.**
Credits: LTP: 002
Maximum Marks: 38
Time: 3 Hrs. **Pass Marks: 35%**

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

1.	Study feeding apparatus (mouth parts) of insects.
2.	Study different types of larvae and pupae of insects.
3.	Study external morphology of pests of stored grains and of medical/veterinary important insects.
4.	Study of life stages of silkworm and honeybees.
5.	Demonstrate various techniques and equipment 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	Cockroach, Grasshopper, Red cotton bug, Mosquito, House fly, honey bee and butterfly
2.	A study of different types of larvae and pupae of insects.	
3.	External morphology and identification marks of the pests:	**Crop pests:** *Pyrilla perpusilla*, *Pectinophora gossypiella*, *Leptocorisa varicornis*, *Heiroglyphus banian*, *Dacus cucurbitae*
		Stored grain pests: *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 equipment 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.	Grain storage structures	
9.	Assignment on local insect fauna	

Guidelines for conduct of Practical Examination:

1.	Identify given spots and give two points for identification.	12
2.	Draw & write a note on the life cycle of given specimen along with its uses.	8
3.	Identify the instrument and write down its working and application.	6
4.	Project report on apiary/godowns/granary.	6
5.	Viva-voce and practical file.	6

COURSE OUTCOMES

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

B.Sc. Medical Semester VI
COURSE CODE: ZOO-361
COURSE TITLE: ZOOLOGY

Theory
ZOO-361A: INLAND FISHERIES I

Periods/week: 4 **Credit Hours/Week: 3 hrs.**
Credits: LTP: 210
Maximum Marks: 56
Time: 3 Hrs. **Pass Marks: 35%**

Instructions for the Paper Setters:

1. There will be five sections.
2. Section A is compulsory and will be of 12 marks. The candidate will have to attempt any 6 questions out of 8 short answer type questions carrying two marks each covering the whole syllabus. The answer should not exceed 50 words.
3. Section B, C, D and E will be set from units I, II, III and IV respectively and will consists of two questions of 11 marks each from the respective units. The candidates are required to attempt one question from each of these sections. Each question in these sections should not have more than two sub-parts.

COURSE OBJECTIVES

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.
- Different types of fins and scales

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 onnative fish fauna.
- Stages of gonadal, maturity of fishes, reproduction process, natural breeding, techniquesof fish breeding. Natural collection of carp spawn and its care, transport etc.
- Induced Breeding: History, Technique, Chemicals involved in induced breeding andImpact on fish culture.

UNIT–IV

- Pond culture: Construction of pond, Types of pond, Fertilization of pond andMaintenance 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 andSri Lanka-A Hand Book of Zoological Survey of India, Kolkatta.
3. Jhingran V.G. (1991), Fish and Fisheries of India, Hindustan Publishing Corporation ofIndia, 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

CO-1.	Observe the 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 freshwater and marine water fishes and other aquaculture organisms
CO-4.	Differentiate between different structure of mouth related to feeding habits
CO-5.	Insight of 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.	Role of aquatic weeds and their control

Theory

ZOO-361B: INLAND FISHERIES II

Periods/week: 4 **Credit Hours/Week: 3 hrs.**
Credits: LTP: 210
Maximum Marks: 56
Time: 3 Hrs. **Pass Marks: 35%**

Instructions for the Paper Setters:

1. There will be five sections.
2. Section A is compulsory and will be of 12 marks. The candidate will have to attempt any 6 questions out of 8 short answer type questions carrying two marks each covering the whole syllabus. The answer should not exceed 50 words.
3. Section B, C, D and E will be set from units I, II, III and IV respectively and will consists of two questions of 11 marks each from the respective units. The candidates are required to attempt one question from each of these sections. Each question in these sections should not have more than two sub-parts.

COURSE OBJECTIVES

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.

UNIT–I

- Riverine fisheries of river Sutlej and Beas.
- Reservoir Fisheries: Gobind Sagar, Pong Dam
- Environmental factors affecting life in water bodies.

UNIT–II

- Culture Systems: Conventional, Extensive, Intensive, Monoculture and Polyculture.
- Species of fish suitable for integrated aquaculture.
- Integration of fish farming with duckry, poultry, piggery and dairy.
- Integration of crop cultivation to fish farming (paddy and horticulture).
- Sewage fed fisheries.

UNIT–III

- Cold water fisheries: Mhaseer fisheries and Trout fisheries.
- Fish Disease and their control: Viral, Bacterial, Fungal, Helminthes, 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 andSri Lanka-A Hand Book of Zoological Survey of India, Kolkatta.
3. Jhingran V.G. (1991), Fish and Fisheries of India, Hindustan Publishing Corporation ofIndia, Delhi.

4. Johal M.S. & Tandon K.K. (1979, 1980), Monograph on the Fishes of reorganizedPunjab, (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

CO-1.	Understand riverine fisheries of Sutlej and Beas
CO-2.	Insight of reservoir fisheries
CO-3.	Understanding of various fish culture systems and integrate fish farming along with sewage fed fisheries
CO-4.	Know-how of cold water fisheries like Mhaseer and trout
CO-5.	In-depth knowledge of fish diseases and their control
CO-6.	Marketing of fish and fish by-products

Practical-VI
ZOO-361P: (Related to ZOO-361A and ZOO-361B)

Periods/week: 6 **Credit Hours/Week: 2 hrs.**
Credits: LTP: 002
Maximum Marks: 38
Time: 3 Hrs. **Pass Marks: 35%**

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

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 prepared identification keys for these fishes,	*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	Both of a male and a 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	a. Temperature b. pH c. Dissolved oxygen d. Phosphates

	pond water	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.	12
2.	Estimation of physico-chemical parameters of pond water.	6
3.	Identification of Zoo/ Phytoplankton and their important characteristics.	6
4.	Write morphometric/meristic characters of a fish species.	4
5.	Project report.	4
6.	Viva-voce and practical file	6

COURSE OUTCOMES

CO-1.	Identify fishes based on the morphological characters
CO-2.	Analyse morphometric characters and meristics 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