GURUGRAM UNIVERSITY GURUGRAM
Scheme of Programme and syllabus for Bachelor of Science, With Major in Zoology (Single Major) in Accordance to NEP-2020
Subject: Zoology

SEMESTER 1

Course Code	Course Title	Course ID	L	T	P	L	T	P	Total Credits	MARKS				
			(Hrs)			Credits				TI	TE	PI	PE	Total
Core Course(s)														
CC-A1	Elemental Diversity of Non-Chordates-I		3	-	2	3	-	1	4	25	50	5	20	100
CC-A2	Fundamentals of Molecular Biology		3	-	2	3	-	1	4	25	50	5	20	100
CC-A3	Elemental Diversity of Non-Chordates-II		3	-	2	3	-	1	4	25	50	5	20	100

SEMESTER 2

Course Code	Course Title	Course ID	L	T	P	L	T	P	Total Credits	MARKS				
			(Hrs)			Credits				TI	TE	PI	PE	Total
Core Course(s)														
CC-A4	Basics of Diversity of Chordates-I		3	-	2	3	-	1	4	25	50	5	20	100
CC-A5	Basics of Diversity of Chordates-II		3	-	2	3	-	1	4	25	50	5	20	100
CC-A6	Aquaculture		3	-	2	3	-	1	4	25	50	5	20	100

SEMESTER 3

Course Code	Course Title	Course ID	L	T	P	L	T	P	Total Credits	MARKS				
			(Hrs)			Credits				TI	TE	PI	PE	Total
Core Course(s)														
CC-A7	Cell Biology and Animal Genetics		3	-	2	3	-	1	4	25	50	5	20	100
CC-A8	Pest Management		3	-	2	3	-	1	4	25	50	5	20	100

CC-A9	Biodiversity and Wildlife Management		3	-	2	3	-	1	4	25	50	5	20	100

SEMESTER 4

Course Code	Course Title	Course ID	L	T	P	L	T	P	Total Credits	MARKS				
			(Hrs)			Credits				TI	TE	PI	PE	Total
Core Course(s)														
CC-A10	Biomolecules and Mammalian Physiology		3	-	2	3	-	1	4	25	50	5	20	100
CC-A11	Cytogenetics		3	-	2	3	-	1	4	25	50	5	20	100
CC-A12	Basics of Endocrinology and Immunology		3	-	2	3	-	1	4	25	50	5	20	100

SEMESTER 5

Course Code	Course Title	Course ID	L	T	P	L	T	P	Total Credits	MARKS				
			(Hrs)			Credits				TI	TE	PI	PE	Total
Core Course(s)														
CC-A13	Ecology and Environment		3	-	2	3	-	1	4	25	50	5	20	100
CC-A14	Animal Taxonomy		3	-	2	3	-	1	4	25	50	5	20	100
CC-A15	Animal Behaviour and Chronobiology		3	-	2	3	-	1	4	25	50	5	20	100

SEMESTER 6

Course Code	Course Title	Course ID	L	T	P	L	T	P	Total Credits	MARKS				
			(Hrs)			Credits				TI	TE	PI	PE	Total
Core Course(s)														
CC-A16	Developmental Biology and Evolution		3	-	2	3	-	1	4	25	50	5	20	100
CC-A17	Biology of Insects		3	-	2	3	-	1	4	25	50	5	20	100
CC-A18	Parasitology		2	-	2	2	-	1	3	15	35	5	20	75

Semester 7; 8 (Honours) and Semester 8 (Honours with Research): Detailed Scheme will be prepared in due course of time.

Syllabus UG A2: Single Major

ZOOLOGY:SEMESTER-I								
CourseType	**Course Code**	**Name of the Course**	**Credit**	**Contact Hours/ Week**	**Internal Assessment marks**	**End Term Marks**	**Max. Marks**	**Exam Duration**
CC-A1 **4 credit**		**Elemental Diversity of Non-Chordates-I**	**3**	**3**	**25**	**50**	**75**	**2hrs.**
		Practical	**1**	**2**	**5**	**20**	**25**	**2hrs.**

Level of the course:100-199

Pre-requisite for the course (if any): Biology as a Subject at 4.0 Level (ClassXII)

Course Learning Outcomes (CLO)

1. Student will be able to describe unique characters and recognize life forms of phylum Protozoa
2. Student will be able to describe unique characters and recognize life forms of phylum Porifera
3. Student will be able to describe unique characters and recognize life forms of phylum Coelenterata
4. Student will be able to describe unique characters and recognize life forms of phylum Helminthes
5. Student will be capable of identifying the characters and classification of Non-Chordates

Instructions for Paper-Setter

1. Nine questions will be set in all. All questions will carry equal marks.
2. QuestionNo.1, which will be short answer type covering the entire syllabus, will be compulsory. The remaining eight questions will be set unit wise selecting two questions from each Unit I to IV. The candidate will be required to attempt question No. 1 and four more questions selecting one question from each unit.

UNIT	TOPICS	CONTACT HOURS
I	**Phylum Protozoa:** General characters and classification upto order level, Biodiversity and economic importance **Type study of *Plasmodium*** **Parasitic protozoans:** Life history, mode of infection and pathogenecity of *Trypanosoma* and *Leishmania*	**12**
II	**PhylumPorifera:** General characters and classification up to order level, Biodiversity and Economic importance, Type Study of *Sycon* Canal system in sponges, Spicules in Sponges	**11**
III	**Phylum– Coelentrata:** General characters and classification up to order level, Biodiversity and Economic importance, Type Study of *Obelia,* Corals and coral reefs **Polymorphism in Siphonophores**	**11**

IV	**Phylum–Helminthes:** General characters and classification up to order level, Biodiversity and Economic importance, Type study of Liver Fluke, *Fasciola hepatica* **Helminths Parasites:** Brief account of Life history, mode of infection and pathogenecity of *Schistosoma*, *Ancyclostoma*, *Trichinella*, *Wuchereria* and *Oxyuris*	11
V Practical	Classification up to orders with ecological note and economic importance of the following animals: **1. Protozoa:** Lamination of cultures of *Amoeba, Euglena* and *Paramecium;* permanent prepared slides: *Amoeba,Euglena, Trypanosoma, Noctiluca, Eimeria, Paramecium* (binary fission and conjugation), *Giardia,Entamoeba,Opalina, Vorticella,Balantidium,Nyctotherus,*radiolarian and formaniferanooze. **2.Parazoa(Porifera):***Sycon,Grantia,Euplectella,Hyalonema,Spongilla,Euspongia.* Permanent prepared slides: L.S. and T.S. *Sycon*; gemmules, spicules and sponging fibres of Sycon, canal system of sponges **3. Coelenterata:** *Porpita, Valella, Physalia, Aurelia, Rhizostoma, Metridium, Millipora, Alcyonium, Tubipora, Zoanthus, Madrepora, Favia, Fungia,* and *Astrea.* **Permanent prepared slides:** *Hydra* (W.M.), *Hydra* with buds, *Obelia* (colony and medusa), *Sertularia, Plumularia, Tubularia, Bougainvillea, Pennaria*(W.M.), *Aurelia* (sense organs and stages of life history). Permanent prepared slides: T.S. *Hydra* (Testis and Ovary region) **4. .Playhelminthes:** *Dugesia,Fasciola,Taenia,Echinocoecus.* **Permanent prepared slides:** *Miracidium,Sporocyst, Redia, Cercaria, Scolex* and *Proglotttids of Taenia* (mature and gravid). T.S. *Fasciola* (Different regions) **5. Aschelminthes:** *Ascaris*(male and female),*Ancylostoma, Meloidogyne* **Permanent prepared slides:** T.S. *Ascaris* (male and female), *Trichinella*	30

Learning Resources

1. Jordan,E. Land, P.S.Verma.2009.Invertebrate Zoology,S.Chandand Co.Ltd.New Delhi.
2. Ayyar,E.K andT.Anantha krishnan.1992.Manualof ZoologyVol.1 Invertebrates PartIand II,S.Viswanathan Printers and Publishers Pvt. Ltd. Madras.
3. Kotpal,R.L.2021. Zoology Invertebrates. Rastogi Publications, Meerut.
4. Nair, N.C.,N.Arumugam, N.Soundarapandian, T.Murugan and S.Leelavathy. 2010.A textbook of Invertebrates. Sara Publication, Nager coil.
5. RastogiV.B.2021.Invertebrate Zoology .Kedar Nath Ram Nath, Meerut
6. LalS.S.(2019)Practical Zoology Invertebrates .Rastogi Publications, Meerut
7. Anderson D.T.(1999) Invertebrate Zoology, Oxford University Press
8. Edward E.Ruppert, Robert D.Barnes (1994)· Invertebrate Zoology; Saunders College Pub.

ZOOLOGY:SEMESTER-I								
Course Type	**Course Code**	**Name of the Course**	**Credit**	**Contact Hours/ Week**	**Internal Assessment marks**	**End Term Marks**	**Max. Marks**	**Exam Duratio**
CC-A2 **4 credit**		**Fundamentals of Molecular Biology**	**3**	**3**	**25**	**50**	**75**	**2hrs.**
		Practical	**1**	**2**	**5**	**20**	**25**	**2hrs.**

Level of the course:100-199

Pre-requisite for the course (if any):Biology as a Subject at 4.0 Level (ClassXII)

Course Learning Outcomes(CLO)

1. Students will gain an understanding of the essential characteristics of DNA.
2: Students will acquire comprehensive knowledge about RNA and its functions.
3: Students will acquire knowledge about proteins, including their structure and functions.
4: Students will develop a comprehensive understanding of the mechanisms and regulation of gene expression.

Instructions for Paper-Setter

1. Nine questions will be set in all. All questions will carry equal marks.
2. QuestionNo.1, which will be short answer type covering the entire syllabus, will be compulsory. The remaining eight questions will be set unit wise selecting two questions from each Unit I to IV. The candidate will be required to attempt question No. 1 and four more questions selecting one question from each unit.

UNIT	TOPICS	CONTACT HOURS
I	**Nucleic acids:** Carriers of genetic information: Historical perspective; DNA as the carrier of genetic information (Griffith's, Hershey &Chase, Avery, McLeod & McCarty), Types of genetic material, denaturation and renaturation, Nucleosome. DNA replication, repair and recombination (Unit of replication, enzymes involved, replication origin and replication fork, fidelity of replication, extrachromosomal replicons	11
II	RNA synthesis and processing (transcription factors and machinery, formation of initiation complex, transcription activator and repressor, RNA polymerases, capping, elongation, and termination, RNA processing, RNA editing, splicing, and polyadenylation, structure and function of different types of RNA, RNA transport).	11
III	Protein synthesis and processing (Ribosome, formation of initiation complex, initiation factors and their regulation, elongation and elongation factors, termination, genetic code, amino acylation of tRNA, tRNA-identity, aminoacyl tRNA synthetase, and translational proof-reading, translational inhibitors, Post- translational modification of proteins).	12
IV	Control of gene expression at transcription and translation level (regulating the expression of prokaryotic and eukaryotic genes, role of chromatin in gene expression and gene silencing).	11

V Practical	1. Preparation of LB medium and raising E.coli. 2. Isolation of genomic DNA from E.coli./onion roots 3. RNA estimation by orcinol method. 4. DNA estimation by diphenylamine reagent/ UV Spectrophotometry. 5. Photographs establishing nucleic acid as genetic material (Messelson and Stahl's, Avery et al, Griffith's, Hershey & Chase's and Fraenkel &Conrat's experiments) 6. Study of Barr body from buccal smear preparation.	30

Learning Resources

- Lodish, H., Berk, A., Zipursky, S.L., Matsudaria, P., Baltimoe, D. and Darnell, J. 2021. Molecular Cell Biology, W.H Freeman and Co., New York., USA. 9th edition.
- Karp, G. Iwasa, J. Marshall W. 2019. Cell and Molecular Biology. Concepts and ExperimentsJohn Wiley and Sons New York. 9th edition.
- Krebs, J.E. Goldstein E.S. Kilpatrick S.T. 2017. Lewin's Genes XII. Jones and Bartlett Publishers, Inc. 12th edition.
- Watson,J.D.2017.Molecular Biology of the gene.Pearson Education India.7thedition.
- CooperG.M. and Hausman,R.E.2013.The Cell:A Molecular Approach.Sinauer Associates, Sunderland Massachusetts U.S.A. 6th edition.
- Becker,W.M.,Kleinsmith,L.J.,Hardin.J.and Bertoni,G.P.2008.TheWorld of the Cell. Pearson Benjamin Cumming Publishing, San Francisco. 7th edition.
- Alberts,B.Johnson A.Lewis, J.Raff, M.Roberts K.&Walter P.2007.Molecular Biology of Cell. W.W. Norton & Company. 5th edition.
- De Robertis, E.D.P.and DeRobertis ,E.M.F.2006. Cell and Molecular Biology. Lippincott Williams and Wilkins, New York. 8th edition.
- Sen, S. Kar, D.K. Johri, B.M. 2005. Cytologyand Genetics. Alpha Science International Ltd.

ZOOLOGY:SEMESTER-I								
Course Type	**Course Code**	**Name of the Course**	**Credit**	**Contact Hours/ Week**	**Internal Assessment marks**	**End Term Marks**	**Max. Marks**	**Exam Duratio**
CC-A3 4 credit		**Elemental Diversity of Non-Chordates-II**	**3**	**3**	**25**	**50**	**75**	**2hrs**
		Practical	**1**	**2**	**5**	**20**	**25**	**2hrs**

Level of the course:100-199

Pre-requisite for the course(if any):Biology as a Subject at 4.0 Level (ClassXII)

Course Learning Outcomes (CLO)

1. Student will be able to describe unique characters and recognize life forms of phylum Annelida
2. Student will be able to describe unique characters and recognize life forms of phylum Arthropoda
3. Student will be able todescribe unique characters and recognize life forms of phylum Molluscs
4. Student will be able to describe unique characters and recognize life forms of phylum Echinodermata and Hemichordates
5. Students will be capable of identifying the characters and classification of Non-Chordates

Instructions for Paper-Setter

1. Nine questions will be set in all. All questions will carry equal marks.
2. Question No.1, which will be short answer type covering the entire syllabus, will be compulsory. The remaining eight questions will be set unit wise selecting two questions from each Unit I to IV. The candidate will be required to attempt question No. 1 and four more questions selecting one question from each unit.

UNIT	TOPICS	CONTACT HOURS
I	**Phylum - Annelida:** General characters and classification up to order level, Biodiversity and economic importance of Annelida, Type study – *Pheretima* (Earthworm), Metamerism in Annelida **Trochophore larva:** Affinities, evolutionary significance	12
II	**Phylum - Arthropoda:** General characters and classification up to order level, Biodiversity and economic importance of insects, Type study – *Periplaneta*	11
III	**Phylum - Mollusca:** General characters and classification up to order level, Biodiversity and economic importance Type study – *Pila* Torsion and detorsion in gastropoda; Respiration and foot	11
IV	**Phylum - Echinodermata:** General characters and classification up to order level, Biodiversity and economic importance Type Study –*Asteries* (Sea Star), Echinoderm larvae, Aristotle's Lantern **Phylum – Hemichordata:** Type study: *Balanoglossus*	11

V Practical	Classification up to orders with ecological note and economic importance of the following animals: **1. Annelida Specimens:**Pheretima, Heteronereis, Polynoe, Aphrodite, Chaetopterus, Arenicola, Tubifex and Pontobdella. **2. Arthropoda Specimens:** Peripatus, Palaemon (Prawn), Lobster, Cancer (crab), Sacculina, Eupagurus (hermit crab), Lepas, Balanus, Cyclops, Daphnia, Lepisma, Periplaneta (cockroach), Schistocerca (locust), Poecilocerus (ak-hopper), Gryllus (cricket), Mantis (praying mantis),Cicada, Forticula (earwig), Dragon fly, termite queen, bug, moth, beetle, Polistes (wasp), Apis (honey bee), Bombyx (silk moth), Cimex (begbug), Pediculus (body louse). Millipedes, Scolopendra (centipedes), Palamnaeus (scorpion), Aranea (spider), Limulus (king crab). **3. Mollusca Specimens:** Mytilus, Ostrea, Cardium, Pholas, Solen (razor fish), Pecten, Holiotis, Patella, Aplysia, Doris, Limax, Loligo, Sepia, Octopus, Nautilus (complete and T.S.), Chiton and Dentalium. **4. Echinodermata Specimens:** Asterias, Echinus, Cucumara, Ophiothrix, Antedon and Asterophyton. **5. Hemichordata**: Balanoglossus **(B) Study of the following permanent stained preparations:** 1. T.S. Pheretima (pharyngeal and typhlosolar regions), Setae, septal nephridia and spermathecae of Pheretima. 2. Trachea and mouth parts of cockroach. 3.Statocyst of Palaemon. 4. Glochidium larva of Anodonta; radula and osphradium of Pila. 5. T.S. Star fish (arm) 6. T.S. Balanoglossus (through various regions). **(C) Demonstration by C. D.:** 1 Mouth parts and trachea of Periplanata (cockroach), radula of Pila; pedicillarae of Asterias. 2. Setae of earthworm, and mouth parts of Honey bee, House fly and cockroach. **(D) Preparation of models of the different systems of the following animals:** 1. Earthworm: Digestive, reproductive and nervous systems. 2. Grasshopper/ cockroach: Digestive, reproductive and nervous systems. 3. Pila: Pallial complex, digestive and nervous systems	30

Learning Resources

1. Jordan,E.L and P.S. Verma. 2009.Invertebrate Zoology,S.Chand and Co.Ltd. NewDelhi.
2. Ayyar,E.K and T.Ananthakrishnan.1992.ManualofZoologyVol.1 Invertebrates PartI and II,S.Viswanathan Printers and Publishers Pvt .Ltd. Madras.
3. Kotpal,R.L. 2021.Zoology Invertebrates. Rastogi Publications, Meerut.
4. Nair, N.C.,N.Arumugam, N.Soundarapandian, T .Muruganand S .Leelavathy. 2010 .Atext book of Invertebrates. Saras Publication, Nagercoil.
5. Rastogi V.B.2021. Invertebrate Zoology. Kedar Nath Ram Nath, Meerut
6. LalS.S.(2019) Practical Zoology Invertebrates. Rastogi Publications, Meerut
7. Anderson D.T.(1999) Invertebrate Zoology, Oxford University Press

8. EdwardE. Ruppert, Robert D.Barnes (1994)·Invertebrate Zoology; Saunders College Pub.

ZOOLOGY:SEMESTER-2								
Course Type	**Course Code**	**Name of the Course**	**Credit**	**Contact Hours/Week**	**Internal Assessment marks**	**End Term Marks**	**Max. Marks**	**Exam Duration**
CC-A4 4 credit		**Basics of Diversity of Chordates-I**	**3**	**3**	**25**	**50**	**75**	**2hrs.**
		Practical	**1**	**2**	**5**	**20**	**25**	**2hrs.**

Level of the course:100-199

Pre-requisite for the course (if any): Biology as a Subject at 4.0Level (ClassXII)

CourseLearningOutcomes(CLO)

1. Student will be able to describe unique character sand recognize life functions of Urochordates
2. Student will be able to describe unique characters and recognize life functions of Cephaiochordates
3. Student will be able to describe unique characters and recognize life functions of Cyclostomes
4. Student will be able to describe unique characters and recognize life functions of Pisces
5. Students will be capable of identifying the characters and classification of Chordates

Instructions for Paper-Setter

1. Nine questions will be set in all. All questions will carry equal marks.
2. Question No. 1, which will be short answer type covering the entire syllabus, will be compulsory. The remaining eight questions will be set unit wise selecting two questions from each Unit I to IV. The candidate will be required to attempt question No.1 and four more questions selecting one question from each unit.

UNIT	TOPICS	CONTACT HOURS
I	**Chordates:** Principles of classification; Origin and Evolutionary tree; Role of amnion in evolution; Salient features of chordates; Functional morphology of the types with examples emphasizing their biodiversity, economic importance and conservation measures where required.	12
II	General characters and classification of phyla upto orders with examples emphasizing their Biodiversity,economic importance and conservation measures where required. **Protochordates:** Systematic position, distribution, ecology, morphology and affinities Urochordata: *Herdmania*– type study Cephalochordata; *Amphioxus* – type study	11
III	General characters and classification of phyla upto orders with examples emphasizing their biodiversity,economic importance and conservation measures where required. **Cyclostomes:** Classification and ecological significance Type study of *Petromyzon.*	11
	General characters and classification of all phyla upto orders with examples emphasizing their biodiversity, economic importance and conservation measures where required.	

IV	**Pisces:** Scales & Fins, Parental care in fishes, fish migration. Type study of Labeo	11
V Practical	1.Classificationuptoorders,habit,habitats,external characters and economic importance (if any): **Protochordata :***Molqula, Hetryllus, Pyrosoma, Doliolum, Olikopleura,* and *Amphioxus.* **Cyclostomata :***Myxine, Petromyzon* and *Ammocoetus larva.* **Chondrichthyes:** *Zygaena, Pristis, Narcine*(electric ray), *Trygon, Rhinobatus, Raja* and *Chimaera.* **Osteichthyes :***Acipenser, Lepidosteus, Muraena, Mystus, Catla, Hippocampus, Syngnathus, Exocoetus, Anabas, Diodon, Ostraczion, Tetradon, Echinus, Lophius, Solea*and *Polypterus.* Any of the Lung Fishes. **2. Preparation of models of the different systems of the following animals:** Herdmania: General anatomy *Labeo*(locally available fish): Digestive and reproductive systems: cranial nerves **3. Study of the skeleton of *Scoliodon, Labeo*** **4. Study of the following prepared slides:** Tornaria larva, T.S. *Amphioxus* (through different regionds). Oikopleura, different types of scales. **5.Make permanent stained preparations of the following**: *Salpa,* Spicules, and Cycloid scales 1.**Makepermanentstainedpreparationsofthefollowing:***Salpa,*Spicules,and Pharynx of *Herdmania, Amphioxus*, Cycloid scales 2.Report on Animal Biodiversity of Sultanpur National Park, Gurugram. **6. Project Report:** 1. Migration in fishes 2. Ornamental fishes	30

Learning Resources

1. R.L.Kotpal.ModernText book of Zoology
2. E.L.Jordan and Verma.Chordate Zoology.
3. Barrington,E.J.W.The Biology of Hemichordata and Protochordata. Oliver and Boyd, Edinbourgh.
4. Walters,H.E.and Sayles,L.D.Biology of vertebrates.MacMillan &Co.,NewYork.
5. Kent, C.G. Comparative anatomy of vertebrates.
6. S.S. Lal.Practical Zoology Vertebrate

ZOOLOGY:SEMESTER-2								
Course Type	Course Code	Name of the Course	Credit	Contact Hours/ Week	Internal Assessment marks	End Term Marks	Max. Marks	Exam Duration
CC-A5 4 credit		Basics of Diversity of Chordates-II	3	3	25	50	75	2hrs.
		Practical	1	2	5	20	25	2hrs.

Level of the course:100-199

Pre-requisite for the course (if any): Biology as a Subject at 4.0Level(ClassXII)

Course Learning Outcomes (CLO)

1. Student will be able to describe unique characters and recognize life functions of Urochordates
2. Student will be able to describe unique characters and recognize life functions of Pisces
3. Student will be able to describe unique characters and recognize life functions of Amphibians & Reptiles
4. Student will be able to describe unique characters and recognize life functions of Birds & Mammals
5. Students will be capable of identifying the characters and classification of Chordates

Instructions for Paper-Setter

1. Nine questions will be set in all. All questions will carry equal marks.
2. Question No. 1, which will be short answer type covering the entire syllabus, will be compulsory. The remaining eight questions will be set unit wise selecting two questions from each Unit I to IV. The candidate will be required to attempt question No.1and four more questions selecting one question from each unit.

UNIT	TOPICS	CONTACT HOURS
I	**Chordates:** **Amphibia:** Origin, Evolutionary tree. Type study of frog (*Rana tigrina*), Parental Care in Amphibia	12
II	**Reptilia:** Type study of Lizard (Hemidactylus), Origin, Evolutionary tree. Extinct reptiles; Poisonous and non-poisonous snakes; Poison apparatus in snakes.	11
III	**Aves:** Type study of Pigeon (*Columba livia*); Flight adaptation, Principles of aerodynamics in Bird flight, migration in birds.	11
IV	**Mammals:** Classification, type study of Rat; Adaptive radiations of mammals and dentition. **Note: Type study includes detailed study of various systems of the animal.**	11

V Practical	**1.** Classification up to orders, habit, habitats, external characters and economic importance (if any) of the following animals:- **Amphibia** :*Necturus, Proteus, Amphiuma, Salamandra, Amblystoma, Axolotie larva, Alytes, Bufo, Rana.* **Reptilia** :*Hemidactylus, Calotes, Draco, Varanus, Phrynosoma, Chamaeleon, Typhops, Python, Eryx, Ptyas, Bungarus, Naja, Hydrus, Viper, Crocodilus, Gavialis, Chelone* (Turtle) and *Testudo* (Tortoise). **Aves** :*Casuarius, Arden, Anas, Milvus, Pavo, Eudynamis, Tyto* and *Alcedo, Halcyon* **Mammalia** :*Ornithorphynchus, Echidna, Didelphis, Macropus, Loris, Macaque, Hystrix, Funambulus, Felis, Panthera, Canis, Herpestes, Capra, Pteropus* **2. Preparation of models of the different systems of the following animals:** ***Hemidactylus*** **:** Digestive, arterial, venous and urinogenital systems. **Rat :** Digestive, arterial, venous and urinogenital systems. **3. Study of the skeleton** of *Rana* (Frog), *Varanus,* Pigeon or Gallus and *Orcyctolagus*/rat **4. Study of the following prepared slides**: Histology of rat (compound tissues). **5. Study and collection of Quill, Contour, Filoplume and Down feathers** **6. Project Report:** 1. Survey of diversity 2. Parental care 3. Dentition in mammals 4. Migration in birds	**30**

Learning Resources

1. R.L.Kotpal.ModernText book of Zoology
2. E.L.Jordan and Verma.Chordate Zoology.
3. Barrington,E.J.W.The Biology of Hemichordata and Protochordata. Oliver and Boyd, Edinbourgh.
4. Walters,H.E.and Sayles,L.D.Biology of vertebrates.MacMillan &Co.,New York.
5. Kent, C.G. Comparative anatomy of vertebrates.
6. S.S. Lal.Practical Zoology Vertebrate

ZOOLOGY:SEMESTER-2								
Course Type	Course Code	Name of the Course	Credit	Contact Hours/ Week	Internal Assessment marks	End Term Marks	Max. Marks	Exam Duratio
CC-A6		Aquaculture	3	3	25	50	75	2hrs.
4 credit		Practical	1	2	5	20	25	2hrs.

Level of the course:200-299

Pre-requisite for the course (if any): Biology as a Subject at 4.0 Level (Class XII)

Course Learning Outcomes (CLO)

1. Students will understand about fresh water fishes of India
2. Students will capable to undertake about fishing craft sand gears
3. It will make the students understand about the seed production in fishes
4. Students will be able to explain the culture technology in fishery
5. Students will be able to identify fish specimens

Instructions for Paper-Setter

1. Nine questions will be set in all. All questions will carry equal marks.
2. QuestionNo.1, which will be short answer type covering the entire syllabus, will be compulsory. The remaining eight questions will be set unit wise Selecting two questions from each Unit I to IV. The candidate will be required to attempt question No.1 and four more questions selecting one question from each unit.

UNIT	TOPICS	CONTACT HOURS
I	**Introduction to world fisheries:** Production, utilization and demand, Major species cultured Fresh Water fishes of India: River system, reservoir, pond, tank fisheries; captive and culture fisheries, cold water fisheries.	12
II	Fishing crafts and gears. Fin fishes, Crustaceans, Mollusks and their culture. Traits of important cultivable fish and shell fish and their culture methods– Indian major carps, exotic carps, air breathing fishes, cold water fishes,fresh water prawns, mussels	11
III	Seed production: Natural seed resources –its assessment, collection, Hatchery production Nutrition: Sources of food(Natural, Artificial)and feed composition(Calorie and Chemical ingredients).	11
IV	**Field Culture:** Culture, Culture in Pond-running waters; recycled water culture, cage culture; polyculture. **Culture technology:** Induced breading in fishes, techniques and hormones; Fish Biotechnology (Transgenesis and Cryopreservation of gametes).	11
V	1.Identification of *Catlacatla,Labeorohita,L. calbasu, Cirrhinusmrigala,Puntiussarana, Channa punctatus, C. marulius, C.stariatus, Trichogasterfasciata, Mystusseenghala, M.cavasius, M.tengra, Callichrouspabola, C.bimaculatus, Wallagoattu,* Prawns, Crabs,	

Practical	Lobsters, Clams, Mussels & Oysters. 2. A study of the slides of fish parasites. 3. A study of the different types of nets, e.g., cast net, gill net, drift net and drag net. 4. Project report on: Freshwater fishes in Haryana and Pearl culture	**30**

Learning Resources

1. Arumugam N.(2014).Aqua culture and Fisheries, Saras Publication
2. Bardach,JE, Ryther & Mc Larney,Wo(1972) Aquaculture,NewYork:Wiley-Interscience.896pp.
3. Lagler,KF,Bardach,JE,Miller,RR&Passino,DRM(1977)Ichthyology,21ndEdition,NewYork,Wiley,506pp.
4. Khanna S S, & Singh H R (2014).Text book of Fish Biology and Fisheries 3rd education. Narendra Publishing House

ZOOLOGY: SEMESTER-3								
Course Type	**Course Code**	**Name of the Course**	**Credit**	**Contact Hours/ Week**	**Internal Assessment marks**	**End Term Marks**	**Max. Marks**	**Exam Duration**
CC-A07 4credit		**Cell Biology and Animal Genetics**	**3**	**3**	**25**	**50**	**75**	**2hrs.**
		Practical	**1**	**2**	**5**	**20**	**25**	**2hrs.**

Level of the course:100-199

Pre-requisite for the course (if any): Biology as a Subject at 4.0Level (Class XII)

Course Learning Outcomes (CLO)

1. Students will understand the nature and basic concept of cell biology and genetics.
2. Students will be able to apply the knowledge of internal structure of cell and their role in many metabolic function of organism.
3. Students will have acquaintance with the basic causes associated with in born errors and other genetic disorder and will be able to give counseling to general people.
4. Students will be able to explain the concept of gene interactions, Sex-linked inheritance and their role in medical sciences.
5. Students will be able to conduct the morphomatric analysis of chromosomes and demonstrate cell division.

Instructions for Paper-Setter

1. Nine questions will be set in all. All questions will carry equal marks.
2. QuestionNo.1, which will be short answer type covering the entire syllabus, will be compulsory. The remaining eight questions will be set unit wise selecting two questions from each Unit Ito IV. The candidate will be required to attempt question No. 1 and four more questions selecting one question from each unit.

UNIT	TOPICS	CONTACT HOURS
I	General structure of animal cell. **Plasma Membrane:** Fluid mosaic model, various modes of transport across the membrane, mechanism of active and passive transport, endocytosis and exocytosis. **Endoplasmic reticulum (ER):** types and functions. **Golgi complex:** Structure, associated enzymes and role of golgi-complex in animalcell.	12
II	**Ribosomes:** Types, biogenesis and role in protein synthesis. **Lysosomes:** Structure, enzymes and their role; polymorphism. **Mitochondria:** Structure, Mitochondria as semi-autonomous body, biogenesis, functions of mitochondria. **Cilia and Flagella**: Structure and Functions **Ultrastructure and functions of Nucleus:** Nuclear membrane, nuclear lamina, nucleolus, fine structure of chromosomes, nucleosome concept and role of histones, euchromatin and heterochromatin	11
III	Introduction and Mendel's Laws of Inheritance, Linkage and recombination: Cell Cycle, crossing-over and chiasma formation; gene mapping. **Sex determination and its mechanism:** male and female heterozygous systems, genetic balance system; role of Y-chromosome, male haploidy, cytoplasmicand environmental factors, role of hormones in sex determination. **Sex linked inheritance:** Haemophilia and colour blindness in man, eye colour in Drosophila, Non-disjunction of sex-chromosome in Drosophila, Sex-linked and sex	11

	influenced inheritance. **Extra chromosomal and cytoplasmic inheritance:** Kappa particles in Paramecium, Shell coiling in snails, Milk factor in mice	
IV	**Multipleallelism:** Eye colour in Drosophila; A, B,O blood group in man. **Human genetics:** Human karyotype, Chromosomal abnormalities involving autosomes and sex chromosomes, monozygotic and dizygotic twins. Inborn errors of metabolism (Alcaptonuria, Phenylketonuria, Albinism, sickle-cell anaemia). **Applied genetics**: Genetic counseling, pre-natal diagnosis, DNA-fingerprinting, transgenic animals.	**11**
V Practical	1. Cell division: Prepared slides of stages of mitosis and meiosis. 2. Salivary gland and polytene chromosomes of Drosophila/ Chironomus. 3. Temporary squash preparations of onion root tip/ grasshopper testis for the study of mitosis 4. Blood antigens and antibodies: Blood group testing 5. Preparation of Human Karyotype and Idiogram 6. Barr Body and Drumstick slide Preparations	**30**
	Learning Resources	
	1. Lodish et al: Molecular Cell Biology: Freeman & Co, USA (2004). 2. Alberts et al: Molecular Biology of the Cell: Garland (2002). 3. Cooper: Cell: A Molecular Approach: ASM Press (2000). 4. Karp: Cell and Molecular Biology: Wiley (2002). 5. Pierce B. Genetics. Freeman (2004). 6. Lewin B. Genes VIII. Pearson (2004). 7. Watson et al. Molecular Biology of the Gene. Pearson (2004). 8. Thomas J. Kindt, Richard A. Goldsby, Barbara A. Osborne, Janis K	

ZOOLOGY: SEMESTER-3								
Course Type	**Course Code**	**Name of the Course**	**Credit**	**Contact Hours/ Week**	**Internal Assessment marks**	**End Term Marks**	**Max. Marks**	**Exam Duration**
CC-A08		**Pest Management**	**3**	**3**	**25**	**50**	**75**	**2hrs.**
4 credit		**Practical**	**1**	**2**	**05**	**20**	**25**	**2hrs.**

Level of the course:200-299

Pre-requisite for the course (if any):Biology as a Subject at 4.0Level (Class XII)

Course Learning Outcomes (CLO)

1. Students will able to understand ecologically important and harmful insects.
2. Students Will be able to recognize life cycle of crop insects
3. It will make the students understand about the vegetable pest
4. Students will be able to explain about various pest control approaches
5. Students will be able to identify various insect and pest species

Instructions for Paper-Setter

1. Nine questions will be set in all. All questions will carry equal marks.
2. QuestionNo.1, which will be short answer type covering the entire syllabus, will be compulsory. The remaining eight questions will be set unit wise selecting two questions from each Unit Ito IV. The candidate will be required to attempt question No. 1 and four more questions selecting one question from each unit.

UNIT	TOPICS	CONTACTHOURS
I	Study of important insect pests of crops and vegetables: **Sugarcane:**(With their systematic position , habits and nature of damage caused. (a) Sugarcaneleaf-hopper*(Pyrillaperpusilla)* (b) SugarcaneWhitefly*(Aleurolobusbarodensis)* (c) Sugarcanetopborer*(Sciropophaganivella)* (d) Sugarcanerootborer *(Emmaloceradepresella)* (e) Gurdaspurborer*(Bissetiasteniellus)* LifecycleandcontrolofPyrillaperpusillaonly. **Cotton:(**With their systematic position, habits and nature of damage caused. (a) Pinkbollworm(*Pestinophoragossypfolla)* (b) Redcottonbug*(Dysdercuscingulatus)* (c) Cottongreyweevil(*Myllocerusundecimpustulatus)* (d) CottonJassid(*Amrascadevastans)* Life cycle and control of *Pectinophoregossypiella*	12
II	**Wheat**: Wheat stem borer (*Sesamiainferens)* with its systematic position, habits, nature of damage caused. Life cycle and control methods. **Paddy:(**With their systematic position, habits and nature of damage caused) (a) Gundhi bug(*Leptocorisaacuta)* (b) Ricegrasshopper*(Hieroglyphusbanian)* (c) Ricestemborer*(Scirpophagaincertullus)* (d) RiceHispa*(Diceladispaarmigera)* Life cycle and control of *Loptocorisaacuta* only	11

III	**Vegetables:**(Their systematic position, habits and nature of damage caused.. (a) *Aulacophorafaveicollis*–The Red pumpkin beetle. (b) *Dacuscucurbitas*–The pumpkin fruit fly. (c) *Tetranychustecarius*–The vegetable mite. (d) *Epilachna*– The Hadda beetle Lifecycle and control of *Aulacophorafaveicollis* **Storedgrains:**(Their systematic position, habits and nature of damage caused. (a) Pulsebeetle *(Callosobruchusmaculatus)* (b) Riceweevil *(Sitophilusoryzae)* (c) Wheatweevil *(Trogodermagranarium)* (d) RustRedFlourbeetles *(Triboliumcastaneum)* (e) Lessergrainborer *(Rhizoperthadominica)* (f) Grain&Flourmoth *(Sitotrogacerealella)* Life cycle and controlof *Trogodermagranarium*)	**11**
IV	Important bird and rodent pests of agriculture & their management. **Pest control:** Biological control, its history, requirement and precautions and feasibility of biological agents for control. **Chemical control:** History, Categories of pesticides, important pesticides from each category to pests against which they can be used, insect repellants and attractants. Integrated pest management	**11**
V Practical	1.External morphology, identification marks, nature of damage and host of the following pests:- (i) **Sugarcane**:Sugarcaneleaf-hopper, Sugarcance white fly, Sugarcane top borer, Sugarcane root borer, Gurdaspurborer (anytwo). (ii) **Cotton**:RedCottonbug (iii) **Wheat**:Wheat stemborer (iv) **Paddy**:Gundhibug, Ricegrasshopper,Ricestemborer,Ricehispa(anyone). (v) **Vegetables**:*Aulocophorafaveicollis,Dacuscucurbitas,Tetranychustecarious,Epilachna*(anythree). (vi) **Pests of stored grains:** Pulse beetle, Rice weevil, Grain & Flour moth, Rust-red flour beetle, lesser grain borer (any three). 2. Stages of life history of silk moth and honeybee. Preparation of permanent/ temporary slides for identification of mosquitoes	**30**

LearningResources

1. David Dent, Richard Binks (2020). Insect Pest Management CABI Publishing;3rd edition
2. LarryP Pedigo,MarlinE.Rice (2014)EntomologyandPestManagement.WavelandPrInc;6th edition
3. John R. Ruberson (2019)Handbook of Pest Management, CRCPress;1st edition
4. KalatiaM.K.(2021)Introductiontoprinciplesofpestanddiseasemanagement;WalnutPublication
5. Smith K M (2013) A Textbook of Agricultural Entomology by Hill, Cambridge University Press

ZOOLOGY:SEMESTER-3								
Course Type	Course Code	Nameofthe Course	Credit	Contact Hours/ Week	Internal Assessment marks	End Term Marks	Max. Marks	Exam Duration
CC-A09 4 credit		Biodiversity and Wildlife Management	3	3	25	50	75	2hrs.
		Practical	1	2	05	20	25	2hrs.

Level of the course:100-199

Pre-requisite for the course (if any): Biology as a Subject at4.0 Level (Class XII)

Course Learning Outcomes (CLO)

1.Students will be able to understand about wild life zones of India
2.Students will be able to explain the concepts of Protected area system
3.It will make the students underst and about IUCN categories
4.Students will be able to explain the mechanism of biodiversity threats
5.Students will be able to understand about understanding of wildlife management methods

Instructions for Paper-Setter

1. Nine questions will be set in all. All questions will carry equal marks.
2. QuestionNo.1, which will be short answer type covering the entire syllabus, will be compulsory. The remaining eight questions will be set unit wise selecting two questions from each Unit Ito IV. The candidate will be required to attempt question No. 1 and four more questions selecting one question from each unit.

UNIT	TOPICS	CONTACTHOURS
I	Concept of Bio-Diversity and Wild life, Levels of Biodiversity Pattern and distribution of Wildlife in India, Wild life zones of India Techniques of animal counts (Examples of Tiger count)	12
II	Conservation of biodiversity: *in-situ* and *ex-situ* Concept of Protected Area Systems Important Protected Areas of India (Bio-sphere reserve, National Park & Wildlife sanctuaries)	11
III	Red Data Book and it suses; IUCN Categories of wildlife species Climate change and loss of biodiversity	11
IV	Threats to biodiversity: habitat loss, poaching of wildlife, man-wild life conflicts Wildlife Tourism; Biosphere Reserves concept and Indian Biosphere Reserves; Location & Significance	11

V Practical	1. Study of biodiversity among various organisms (List in gofall the animals found in and around your house and also try to find out their Zoological names). 2. Identification and photography of various species. 3. Study of adaptive characteristics of various vertebrates in different climate. 4. Study of biodiversity in grass land and pond water by using Shannon-Weiner index. 5. Comparison of two species of birds belonging to same genus (Inter specific difference).	**30**

Learning Resources

1. Trends in wild life biodiversity conservation and management. B.B. Hosettiand M. Venkateshwarlu.
2. Wild life conservation and management .Reena Mathur.
3. Concepts of Wild life management .B.B. Hosetti.
4. Techniques for wildlife Census in India by W.A. Rogers (Afieldmanual); Wildlife Institute of India, Dehradun.
5. Wildlife Wealth of India by T.C. Majupuria; Tecpress Services,L.P.,487/42-SOL-Wattenslip, Pratunam Bangkok, 10400, Thailand.
6. Ali, S.Ripley S.D. Hand book of Birds of India, Pakistan 10-Vols.Oxford University Press, Bombay.
7. The Book of Indian Animals by S.H. Prater, BNHS-Publication, Bombay.
8. Wild life in India by V.B.Saharia Natraj Publishers, Dehradun.
9. E.P. Gee, The Wild life of India.

ZOOLOGY:SEMESTER-4								
Course Type	Course Code	Nameofthe Course	Credit	Contact Hours/ Week	Internal Assessment marks	End Term Marks	Max. Marks	Exam Duration
CC-A10 4 credit		Biomolecules and Mammalian Physiology	3	3	25	50	75	2hrs.
		Practical	1	2	05	20	25	2hrs.

Pre-requisite for the course (if any): Biology as a Subject at4.0Level (Class XII)

Course Learning Outcomes (CLO)

1. Students will be able to understand and explain the mechanism that works to keep the human body functioning.
2. Students will be able to explain the interaction and interdependence of physiological and biochemical processes.
3. It will make the students understand the appropriate functioning of each body system in animals and mechanism of working.
4. Students will be able to explain the mechanism of action of hormones and related molecules involved in various physiological processes
5. Students will be able to understand and perform biological and analytical techniques in labs to explain biological activities

InstructionsforPaper-Setter

1. Nine questions will be set in all. All questions will carry equal marks.
2. Question No. 1, which will be short answer type covering the entire syllabus, will be compulsory. The remaining eight questions will be set unit wise selecting two questions from each Unit I to IV. The candidate will be required to attempt question No.1and four more questions selecting one question from each unit.

UNIT	TOPICS	CONTACT HOURS
I	Introduction, classification, structure, function and general properties of proteins, carbohydrates and lipids. Nomenclature, classification and mechanisms of enzyme action; Enzyme Kinetics, factors affecting enzyme activity, inhibition of enzymes **Nutrition:** Nutritional components: Carbohydrates, fats, lipids, Vitamins and Minerals; Types of nutrition & feeding, Digestion of lipids, proteins, carbohydrates & nucleic acids; symbiotic digestion, lactose in tolerance, Physico-chemical mechanism of Absorption of nutrients & assimilation; control of secretion of digestive juices.	12
II	**Muscles:** Types of muscles, ultra-structure of skeletal muscle, neuro muscular junction. Bio-chemical and physical vents during muscle contraction, single muscle twitch, tetanus, muscle fatigue, muscle tone, oxygen debt., Cori's cycle, single unit smooth muscles **Circulation**: Origin, conduction and regulation of heart beat; cardiac cycle, electrocardiogram, cardiac output, fluid pressure and flow pressure in closed and open circulatory system; Composition and functions of blood & lymph; Mechanism of coagulation of blood, coagulation factors; anticoagulants, haemopoiesis.	11

III	**Respiration:** Exchange of respiratory gases, transport of gases, lung air volumes, oxygen dissociation curve of haemoglobin, Bohr's effect, Hamburger's phenomenon (Chloride shift), control / regulation of respiration (peripheral reflexes, chemical control and Higher centres), Myoglobin. **Excretion:**Patterns of excretory products viz. Amonotelic, ureotlic uricotelic, ornithine cycle (Kreb's – Henseleit cycle) for urea formation in liver; Urine formation, composition of Urine, counter-current mechanism of urine formation, osmoregulation, micturition.	**11**
IV	**Neural Integration:** Nature, origin and propagation of nerve impulse along with medullated & non-medullated nerve fibre, conduction of nerve impulse across synapse, synaptic delay and synaptic fatigue, Neurotransmitter. **Reproduction:**Spermatogenesis,Capacitationofspermatozoa,oogenesis,ovulation,formationof corpusluteum, oestrous-anoestrous cycle, Menstrual cycle in human, fertilization, implantation and gestation, parturition	**11**
V Practical	1. Qualitative tests for identification of simple sugars, disaccharides and polysaccharides. 2. Study of human salivary amylase activity: Effect of temperature, pH, Concentration. 3. Estimation of abnormal constituents of urine (Albumin, sugar, ketone bodies). 4. Use of Kymograph unit & respirometer. 5. Haematin crystal preparation. 6. Estimation of Hb. 7. DLC of Man/ RBC count/ WBC count. 8. Blood antigens and antibodies: Blood group testing	**30**

LearningResources

1. Agarwal R A, Srivastava A. K., Kumar K. Animal Physiology and Biochemistry; S Chand Publishing; Twenty Third edition, 1978.
2. VasantikaKashyap(2021) AText-Book of Animal Physiology and Biochemistry; Kedar Nath Ram Nath Publisher
3. Arumugam N, FatimaD, Narayanan L.M. (2016) Animal Physiology and Biochemistry; Saras Publication
4. Moyes C, Schulte P(2015). Principles of Animal Physiology, Pearson; 3rd edition
5. Satya narayana (2021). Biochemistry, Elsevier; 6th edition

ZOOLOGY:SEMESTER-4								
Course Type	**Course Code**	**Name of the Course**	**Credit**	**Contact Hours/ Week**	**Internal Assessment marks**	**End Term Marks**	**Max. Marks**	**Exam Duration**
CC-A11 4 credit		**Cytogenetics**	**3**	**3**	**25**	**50**	**75**	**2hrs.**
		Practical	**1**	**2**	**05**	**20**	**25**	**2hrs.**

Level of the course:100-199

Pre-requisite for the course (if any): Biology as a Subject at 4.0Level (Class XII)

Course Learning Outcomes (CLO)

1. Students will be able to understand about Biology of chromosomes
2. Students will be able to explain the concept of gene mutations and genetics of cell cycle
3. It will make the students understand about Human cytogenetics
4. Students will be able to explain the mechanism molecular cytogenetics
5. Students will be able to understand about practical exposure of cytogenetics

Instructions for Paper-Setter

1. Nine questions will be set in all. All questions will carry equal marks.
2. Question No.1, which will be short answer type covering the entire syllabus, will be compulsory. The remaining eight questions will be set unit wise selecting two questions from each Unit Ito IV. The candidate will be required to attempt question No. 1 and four more questions selecting one question from each unit.

UNIT	TOPICS	CONTACT HOURS
I	**Biology of Chromosomes:** Molecular anatomy of eukaryotic chromosomes. Heterochromatin and euchromatin. Giant Chromosomes: Polytene and Lampbrush Chromosomes **Sex Chromosomes:** Sex determination. Dosage compensation in *C. elegans, Drosophila* and Humans. **ChromosomeBandingTechniques:**Q-banding,C-banding,G-banding,R-banding,T-banding,High-Resolution & Replication banding and Nuclease banding. Functional significance of chromosome bands.	12
II	**Genes in Pedigrees:** Mendelian pedigree pattern. Heritable diseases in human. Inheritance of mitochondrial diseases, Non-Mendelian traits. **GeneMutations:**Spontaneous mutations – Base pair substitution and frame shift mutations. Induced mutations – Radiation, chemical and environmental. *In –vitro* site specific mutagenesis. Detection of mutagens – The Ames test and sister chromatid exchanges. **Genetics ofCellCycle:** Genetic regulation of cell division in yeast and eukaryotes. Molecular basis of cellular check points. Molecular basis of neoplasia.	11
III	**Human Cytogenetics:** Human karyotype, Nomenclature for normal chromosomes (ISCN), Variablechromosome features, Nomenclature for acquired chromosome aberrations **Numerical and Structural Abnormalities of Human Chromosomes –Syndromes:** Autosomal syndromes –cat-cry syndrome, Trisomy13, Trisomy 18, Trisomy 21.Sex	11

	chromosomal syndromes – Turner syndrome, Klinefelter syndrome, XYY, True and Pseudo-hermaphroditism. **The mechanisms which contribute to cytogenetic alterations:** Polyploidy ,Aneuploidy, Duplications, deletions, inversions, translocations.	
IV	**MolecularCytogeneticTechniques:**FISH,Chromosomepainting,automatedkaryotyping,Flowcytometery, DNA fingerprinting, Molecular Markers in Genome Analysis, PCR and its applications in genome analysis, Microarrays. **Genome Projects:** Human genome project – history, organization, goals and value of the project. Genetic & Physical mapping of the human genome, Human genome diversity project, Model organisms and other genome projects.	**11**
V Practical	1. Identification of meiotic and mitotic stages from permanent slides. 2. Study of chiasma frequency and terminalisation co-efficient. 3. Study of mitosis from hepatic ceacae /bonemarrow of suitable animals (invertebrate /vertebrate) and preparation of karyotype and idiogram. 4. Nuclear sexing from polymorpho nuclear leucocytes 5. Preparation of human buccal smear to study sex chromatin. 6. Preparation of pedigree sand pedigree analysis. 7. Introduction of banding techniques. 8. PCR: Introduction 9. Isolation of genomic DNA. 10. A Survey /Project report for the study of: a) ABO and Rh blood groups b) Some morpho genetic and behavioural traits. c) Some biochemical traits.	**30**

LearningResources

1. Atherly, A.C.,J.R.Girton and J.F.Mc Donald.TheScience of Genetics. SaudersCollege Publishing, Harcort Brace College Publishers, NY.
2. Brooker,R.J.Genetics:Analysis and Principles.Benjamin/Cummings,LongmanInc.
3. Fairbanks,D.J. and W.R.Anderson.Genetics–The Continuity of Life. Brook/Cole Publishing Company ITP, NY, Toronto.
4. Gardner,E.J.,M.J. Simmons and D.P.Snustad. Principles of Genetics. JohnWileyand Sons.Inc., NY.
5. Griffiths, A.J.F.,J.H. Miller, D.T.Suzuki, R.C. Lewontin and W.M.Gelbart. An introduction to genetic analysis.
6. W.H.Free man and company, NY.Lewin, B.Genes. VI. Oxford University Press, Oxford, NewYork, Tokyo.
7. Snustad, D.P.and M.J.Simmons.Principles of Genetics.JohnWiley and Sons.Inc., NY.
8. Watson, J.D., N.H.Hopkins, J.W.Roberts, J.A.Steitzand A.M.Weiner. Molecular Biology of Genes. The Benjamin /Cummings Publishing Company Inc., Tokyo.
9. Tom Strachan & Read, A.P.Human Molecular Genetics 3rd edition, Garland Publishing 2004, London

ZOOLOGY:SEMESTER-4								
Course Type	**Course Code**	**Name of the Course**	**Credit**	**Contact Hours/ Week**	**Internal Assessment marks**	**End Term Marks**	**Max. Marks**	**Exam Duration**
CC-A12 **4 credit**		**Basics of Endocrinology and Immunology**	3	3	25	50	75	2 hrs.
		Practical	1	2	05	20	25	2 hrs.

Level of the course:100-199

Pre-requisite for the course (if any): Biology as a Subject at 4.0Level (Class XII)

Course Learning Outcomes (CLO): Students will be able to

1. Develop an in-depth comprehensive knowledge of endocrinology from a physiological cellular and molecular perspective.
2. This course will make students understand the basic structure and chemical organization of hormones and various signaling molecules.
3. The students will how the immune system can fight infection and other diseases
4. Students will able to understand the concept of vaccines and its cons and pros.
5. The student will get practical knowledge of basic structure and function of hormones and Immune system.

InstructionsforPaper-Setter

1. Nine questions will be set in all. All questions will carry equal marks.
2. Question No. 1, which will be short answer type covering the entire syllabus, will be compulsory. The remaining eight questions will be set unit wise selecting two questions from each Unit I to IV. The candidate will be required to attempt question No.1and four more questions selecting one question from each unit.

UNIT	TOPICS	CONTACT HOURS
I	**Introduction to hormone:** History of endocrinology, Classification and Characteristic, pituitary gland and its general physiological action: Adenohypophysis hormone (somatotropin and prolactin), Glycoprotein hormones (FSH, LH and TSH), Neuro-hypophysis hormone (oxytocin and vasopressin, urotensin), physiological role of adrenal hormone, Thyroid hormone action in poikilotherms and homeotherms.	12
II	**Hormone Action and applications;** Membrane and nuclear receptor hormones (regulation and signal transduction) Permissive actions of hormones and termination of hormone action. Endocrine feedback to stumuli. **Hormone and human health:** Production of hormones as pharmaceuticals, Genctic analysis of Hormonal disorders. Hormones on IVF, Pregnancy testing and Amniocentesis.	11
III	Over view of Immune System: Introduction to basic concepts in immunology, Components of immune systemof Innate and Adaptive Immunity, Cells and organs of immune system (primary and secondary organs), Basic properties of antigen B and T cell epitopes, Adjuvants and haptens, structure ,classes and functions of antibodies.	11

IV	**Working of immune system:** Structure and functions of MHC molecules. Basic properties and functions of cytokines, Complement system (component and pathways), Introduction to concept of auto immunity (Rheumatoid Arthritis and tolerance, AIDS). General introduction to Vaccines with its function in biological sciences.	**11**
V Practical	1. Study of the permanent slides of all the endocrine glands Histological study of lymphoid organs spleen, thymus and lymph nodes through slides/ Photographs 3. Preparation of stained blood film to study various types of blood cells. 4. Ouchterlony's double immune-diffusion method. 5. ABO blood group determination. 6. Demonstration of a. ELISA b. Immuno electrophoresis 7. Immunological diagnosis of pregnancy. 2. Qualitative test for the presence of sugar in urine.	**30**

LearningResources

1. General Endocrinology C.Donnell Turner Pub Saunders Toppan Endocrinology: An Integrated Approach; Stephen Nussey and Saffron Whitehead. Oxford: BIOS Scientific Publishers; 2001.
2. Hadley, M.E. and Levine J.E. 2007. Endocrinology, 6thEdition. Pearson Prentice- Hall, Pearson Education Inc., New Jersey.
3. Kindt,T. J.,Goldsby, R.A.,Osborne, B.A. and Kuby,J (2006).Immunology, VI Edition. W.H. Freeman and Company.
4. David, M., Jonathan, B., David, R.B. and Ivan R.(2006).Immunology, VII Edition, Mosby, Elsevier Publication.
5. Abbas,K.Abul and Lechtman H. Andrew (2003.) Cellular and Molecular Immunology. V Edition. Saunders Publication

Multidisciplinary Course from the department for pool of the Courses in the University
These Courses are to be offered to students of different Discipline/Subject

Semester-1

Course Code	Course Title	Course ID	L	T	P	L	T	P	Credits	MARKS				
			(Hrs)			Credits				TI	TE	PI	PE	Total
MDC-1	Exploring the world of Animals-I		2	-	2	2	-	1	3	15	35	5	20	75

Semester-2

Course Code	Course Title	Course ID	L	T	P	L	T	P	Credits	MARKS				
			(Hrs)			Credits				TI	TE	PI	PE	Total
MDC-2	Exploring the world of Animals-II		2	-	2	2	-	1	3	15	35	5	20	75

Semester-3

Course Code	Course Title	Course ID	L	T	P	L	T	P	Credits	MARKS				
			(Hrs)			Credits				TI	TE	PI	PE	Total
MDC-3	Basics of Public Health and Water-borne diseases		2	-	2	2	-	1	3	15	35	5	20	75

ZOOLOGY: SEMESTER-I

CourseType	CourseCode	Name of the Course	Credit	Contact Hours/ Week	Internal Assessmentmarks	End Term Marks	Max. Marks	Exam Duration
MDC-1 3 credits		Exploring the World of Animals-I	2	2	15	35	50	2 hrs.
		Practical	1	2	5	20	25	2 hrs.

Level of the course: 100-199

Pre-requisite for the course (if any): NA

Course Learning Outcomes (CLO)

1. Student will be able to learn about Kingdom Animalia
2. Student will be able to learn about basic characters and some interesting facts about Invertebrates
3. Student will be able to describe unique characters and recognize life functions of phylum Annelida and Arthropoda
4. Student will be able to describe unique characters and recognize life functions of phylum Mollusca, Echinodermata and Hemichordates
5. Students will be capable understand the role of non-chordates in their surroundings

Instructions for Paper-Setter

1. Nine questions will be set in all. All questions will carry equal marks.
2. Question No. 1, which will be short answer type covering the entire syllabus, will be compulsory. The remaining eight questions will be set unit wise selecting two questions from each Unit I to IV. The candidate will be required to attempt question No. 1 and four more questions selecting one question from each unit.

UNIT	TOPICS	CONTACT HOURS
I	Zoology: Definition and scope, introduction to Animal Kingdom, animal characters Non-Chordates and Invertebrates with examples, Introduction to basic characters of non-chordates; Biodiversity: Introduction and Scope; General characters and interesting features of Protozoa and disease caused by some protozoa such as Amoeba, Plasmodium, Trypanosoma, Giardia and Leishmania and Porifera; Economic importance of sponges	7
II	General characters and interesting features of Coelentrata and Annelida; Ecological importance of corals; ecological role of Earthworm; Economic importance of Leech	8
III	General characters of Arthropoda and Mollusca; Study of basic characters of insects and snails; Insects as pest: Grasshopper, Economic importance of Honey Bee and Silkworm, Basics of Apiculture and Sericulture; Snails as pest in Paddy fields	8
IV	General characters of Echinodermata; Study of basic characters of Star fish with reference to its role in ecosystem; Economic importance of Star Fish	7
V Practical	1. To study the non-chordates from pond water 2. To study the different parts of Insects by examining Housefly, butterfly, beetles 3. To study the life cycle of Butterfly/Mosquito 4. To study the life cycle of Honeybee 5. Identifications of following specimens of various phyla: Sycon, Aurelia, Earthworm, Grasshopper, Palaemon, Octopus, Asterias	30

Learning Resources

1. Jordan, E.L and P.S. Verma. 2009. Invertebrate Zoology, S.Chand and Co. Ltd. New Delhi.
2. Ayyar, E.K and T. Ananthakrishnan. 1992. Manual of Zoology Vol.1 Invertebrates Part I and II, S.Viswanathan Printers and Publishers Pvt. Ltd. Madras.
3. Kotpal, R.L. 2021. Zoology Invertebrates. Rastogi Publications, Meerut.
4. 5. Rastogi V.B. 2021 . Invertebrate Zoology. Kedar Nath Ram Nath , Meerut
6. Lal S.S. (2019) Practical Zoology Invertebrates. Rastogi Publications, Meerut

ZOOLOGY: SEMESTER-2								
Course Type	**CourseCode**	**Name of theCourse**	**Credit**	**Contact Hours/ Week**	**Internal Assessment marks**	**End Term Marks**	**Max. Marks**	**Exam Duration**
MDC-2 3 credits		**Exploring the world of Animals-II**	**2**	**2**	**15**	**35**	**50**	**2 hrs.**
		Practical	**1**	**2**	**5**	**20**	**25**	**2 hrs.**

Level of the course: 100-199

Pre-requisite for the course (if any): NA

Course Learning Outcomes (CLO)

1. Student will learn the role of different groups of chordates in mantling an equilibrium in our ecosystem
2. Students will be able to identify local fishes species and their role in the ecosystem.
3. Course will help to understand how the natural systems on which we depend function.
4. Course will give the idea about how birds are economically important.
5. Student will learn about identification of chordates

Instructions for Paper-Setter

1. Nine questions will be set in all. All questions will carry equal marks.
2. Question No. 1, which will be short answer type covering the entire syllabus, will be compulsory. The remaining eight questions will be set unit wise selecting two questions from each Unit I to IV. The candidate will be required to attempt question No. 1 and four more questions selecting one question from each unit.

UNIT	TOPICS	CONTACT HOURS
I	**Basics of Chordates:** Define Salient features of chordates, Difference between non chordates and chordates. General Characters and unique features of protochordates with examples	**8**
II	**Pisces (Fishes):** Characteristic features of freshwater and marine fishes, Edible fishes of India, Composite fish culture. **Class Amphibia:** Unique Features of amphibians, Parental care in amphibians, Role of amphibians in ecosystem, Identification and differences in Frog and Toad.	**8**
III	**Class Reptilia:** Features of Reptiles, Common reptiles of India, Identification of Poisonous and non-poisonous snakes, Differences between crocodile and Gharial, Turtle and tortoise	**7**
IV	**Class Aves:** Characteristic features of birds, Common birds of India, Flight adaptations in birds, Commercialuses of birds, Role of birds in agriculture. **Class Mammals:** Characters and economic importance of mammals, Common mammals of India	**7**
V Practical	1. Identifying feature of different class of chordates- *Bufo, Alytus, Hyla, Varanus, Draco, Chamaleon, Naja, Viper, Gavialis, Crocodile, Chelone, Testudo,* Spiny ant eater, *Echidna, Loris* 2. Study of different types of feathers. 3. Study of different local species of fishes- *Catla, Labeo, Cirrhinus mrigala, Channa* etc. 4. Study of nesting pattern of some local birds and mammals	**30**

Learning Resources

1. R.L.Kotpal. Modern Textbook of Zoology
2. E.L. Jordan and Verma. Chordate Zoology.
3. Barrington, E.J.W. The Biology of Hemichordata and Protochordata. Oliver and Boyd, Edinbourgh.
4. Walters, H.E. and Sayles, L.D. Biology of vertebrates. MacMillan & Co., New York.
5. Kent, C.G. Comparative anatomy of vertebrates.
6. S.S. Lal. Practical Zoology Vertebrate

ZOOLOGY: SEMESTER-3								
Course Type	**Course Code**	**Name of theCourse**	**Credit**	**Contact Hours/ Week**	**Internal Assessmentmarks**	**End Term Marks**	**Max. Marks**	**Exam Duration**
MDC-3 3 credits		**BASICS OF PUBLIC HEALTH AND WATER BORNE DISEASES**	**2**	**2**	**15**	**35**	**50**	**2 hrs.**
		Practical	**1**	**2**	**5**	**20**	**25**	**2 hrs.**

Level of the course: 100-199

Pre-requisite for the course (if any): NA

Course Learning Outcomes (CLO)

By studying this course, students will be able to

- know the sources of microbial water contamination and its impact on human know the sources of microbial water contamination and its impact on human health.
- understand the relationship between human behavior and water quality.
- learn remediation strategies for several types of microbial water quality contamination.
- be able to grasp the basic concepts of various water sources and transmission mechanisms of infectious agents from those sources to humans.
- examine the multiple water-borne pathogens, their modes of transport and transmission, their public health effects, and existing methods for disease prevention and remediation.

Instructions for Paper-Setter

1. Nine questions will be set in all. All questions will carry equal marks.
2. Question No. 1, which will be short answer type covering the entire syllabus, will be compulsory. The remaining eight questions will be set unit wise selecting two questions from each Unit I to IV. The candidate will be required to attempt question No. 1 and four more questions selecting one question from each unit.

UNIT	TOPICS	CONTACT HOURS
I	Introduction to Public Health, Definition, scope, concept, and importance of public health microbiology; Concept of health and disease; Common terms and definitions in water quality, aquatic resources of the world and sources of drinking water; Water, sanitation, and hygiene (WASH) – fact sheets, WHO guidelines and resolutions; common contaminants of drinking water and linkages to disease;	**8**
II	Water pollution (water quality properties, types of water pollution, point and non-point sources of water pollution); Types of contaminants influencing water quality; Water Treatment, Control of Water Borne Diseases. water-borne pathogens (types, sources, and transmission); microbial testing of Water; monitoring and surveillance of water quality.	**8**
III	Water-Borne Diseases: Source of infection, transmission, symptoms, prevention and treatment/mitigation Bacterial infections- Cholera, Typhoid fever, E. coli infection, Campylobacteriosis, Dysentery, Typhoid fever. Viral infections: Rotavirus, Hepatitis A and E, Poliomyelitis, Polyomavirus infection.	**7**
IV	Protozoal infections, Amoebiasis, Giardiasis. Parasitic worms: Fascioliasis, Hookworm infections; Vector-borne infections: Malaria, Dengue, Leishmaniasis, Japanese encephalitis, Lymphatic filariasis Detection Methods for water-borne pathogens	**7**
V Practical	1. To determine dissolved oxygen in water samples collected from different water bodies 2. To determine temperature, pH, and total dissolved solids (TDS) in water samples from different locations. 3. Isolation and identification of protozoa and other parasites from different water samples. 4. Study about WASH Institute (Water Sanitation and Hygiene Institute)/ Shri Ram Institute for Industrial Research. 5. Project report on water quality monitoring system in your city	**30**

Learning Resources
1. Aquatic Pollution: An Introductory Text, 3rd Edition, Edward A. Laws, ISBN 9780471348757. 2. Waterborne Disease, 1st edition (January 15, 1997), Paul Hunter, ISBN 0125515707. 3. Microbiology of Waterborne Diseases, Steven Percival, Rachel Chalmers, Martha Embrey, Paul Hunter, Jane Sellwood and Peter Wyn-Jones, ISBN 978012551570-2.

Minor Course from the department of Zoology

(These courses are offered by each department for students of other departments/same department to gain a broader understanding beyond the major discipline)

Semester 1

Course Code	Course Title	Course ID	L	T	P	L	T	P	Credits	MARKS				
			(Hrs)			Credits				TI	TE	PI	PE	Total
MIC-1	Introduction to Non-Chordates		1	-	2	1	-	1	2	5	20	5	20	50

Semester 2

Course Code	Course Title	Course ID	L	T	P	L	T	P	Credits	MARKS				
			(Hrs)			Credits				TI	TE	PI	PE	Total
MIC-2	Introduction to Chordates		1	-	2	1	-	1	2	5	20	5	20	50

Semester 3

Course Code	Course Title	Course ID	L	T	P	L	T	P	Credits	MARKS				
			(Hrs)			Credits				TI	TE	PI	PE	Total

MIC-3	Introductory Human Physiology		3	-	2	3	-	1	4	25	50	5	20	100

Semester 6

Course Code	**Course Title**	**Course ID**	**L**	**T**	**P**	**L**	**T**	**P**	**Credits**	**MARKS**				
			(Hrs)			**Credits**				**TI**	**TE**	**PI**	**PE**	**Total**
MIC-4	Basics of Forensic Biology		3	-	2	3	-	1	4	25	50	5	20	100

ZOOLOGY: SEMESTER-I								
Course Type	**Course Code**	**Name of the Course**	**Credit**	**Contact Hours/ Week**	**Internal Assessment marks**	**End Term Marks**	**Max. Marks**	**Exam Duration**
MIC-1 2 credits		**Introduction to Non-Chordates**	**1**	**1**	**5**	**20**	**25**	**2 hrs.**
		Practical	**1**	**2**	**5**	**20**	**25**	**2 hrs.**

Level of the course: 100-199

Pre-requisite for the course (if any): NA

Course Learning Outcomes (CLO)

1. Student will be able to understand about phylum Protozoa and Porifera
2. Student will be able to understand about phylum Coelenterata and Helminthes
3. Student will be able to understand about phylum Annelida and Arthropoda
4. Student will be able to understand about phylum Mollusca, Echinodermata and Hemichordates
5. Students will be capable of identifying the characters and classification of Non-Chordates up to class level

Instructions for Paper-Setter

1. Nine questions will be set in all. All questions will carry equal marks.
2. Question No. 1, which will be short answer type covering the entire syllabus, will be compulsory. The remaining eight questions will be set unit wise selecting two questions from each Unit I to IV. The candidate will be required to attempt question No. 1 and four more questions selecting one question from each unit.

UNIT	TOPICS	CONTACT HOURS
I	Phylum Protozoa: General characters and classification of Protozoa up to class level with their ecological and economic importance Phylum Porifera: General characters and classification of Porifera up to class level with their ecological and economic importance	4
II	Phylum – Coelenterata: General characters and classification of Coelenterates up to class level with their ecological and economic importance Helminths: General characters and classification of Helminthes up to class level with their ecological and economic importance	4
III	Phylum – Annelida: General characters and classification of Annelids up to class level with their ecological and economic importance Phylum – Arthropoda: General characters and classification of Arthropods up to class level with their ecological and economic importance	4
IV	Phylum - Mollusca: General characters and classification of Mollusca up to class level with their ecological and economic importance Phylum – Enchinodermata: General characters and classification of Echinoderms up to class level with their ecological and economic importance	3

	Phylum Hemichordata: General Characters of Hemichordates with examples	
V Practical	Classification up to orders with ecological note and economic importance of the following animals: 1. Protozoa: Permanent slides: *Amoeba, Euglena, Paramecium* (binary fission and conjugation), *Opalina* 2. Porifera: *Sycon, Grantia, Euplectella, Hyalonema,* 3. Coelenterata: *Physalia, Aurelia, Metridium, Millipora, Favia, Fungia,* Permanent slides of *Hydra* (W.M.), *Hydra* with buds, *Obelia* (colony and medusa), *Aurelia.* 4. Playhelminthes: *Fasciola, Taenia,* Aschelminthes: *Ascaris* (male and female), *Ancylostoma,* 5. Annelida: *Pheretima, Heteronereis, Polynoe, Chaetopterus, Tubifex* and *Pontobdella* 6. Arthropoda:, *Palaemon* (Prawn), *Cancer* (Crab), *Periplaneta* (cockroach), *Poecilocerus* (ak- hopper), *Mantis* (praying mantis), Dragon fly, termite queen, bug, moth, *Polistes* (wasp), *Apis* (Honey bee), *Bombyx* (Silk moth) 7. Mollusca: *Mytilus, Ostrea, Solen* (razor Fish), *Pecten, Octopus, Chiton* and *Dentalium* 8. Echinodermata: *Asterias, Echinus, Cucumaia, Antedon*	**30**

Learning Resources

1. Jordan, E.L and P.S. Verma. 2009. Invertebrate Zoology, S.Chand and Co. Ltd. New Delhi.
2. Ayyar, E.K and T. Ananthakrishnan. 1992. Manual of Zoology Vol.1 Invertebrates Part I and II, S.Viswanathan Printers and Publishers Pvt. Ltd. Madras.
3. Kotpal, R.L. 2021. Zoology Invertebrates. Rastogi Publications, Meerut.
4. Nair, N.C., N. Arumugam, N. Soundarapandian, T. Murugan and S. Leelavathy. 2010. A textbook of Invertebrates. Saras Publication, Nagercoil.
5. Rastogi V.B. 2021 . Invertebrate Zoology. Kedar Nath Ram Nath , Meerut
6. Lal S.S. 2019. Practical Zoology Invertebrates. Rastogi Publications, Meerut
7. Anderson D.T. (1999) Invertebrate Zoology, Oxford University Press
8. Edward E. Ruppert, Robert D. Barnes (1994)· Invertebrate Zoology ; Saunders College Pub.

ZOOLOGY: SEMESTER-2								
Course Type	**Course Code**	**Name of the Course**	**Credit**	**Contact Hours/ Week**	**Internal Assessment marks**	**End Term Marks**	**Max. Marks**	**Exam Duration**
MIC-2 2 credits		**Introduction to Chordates**	**1**	**1**	**5**	**20**	**25**	**2 hrs.**
		Practical	**1**	**2**	**5**	**20**	**25**	**2 hrs.**

Level of the course: 100-199

Pre-requisite for the course (if any): NA

Course Learning Outcomes (CLO)

1. Student will be able to describe unique characters of Protochordates
2. Student will be able to describe unique characters of Pisces
3. Student will be able to describe unique characters of Amphibians & Reptiles
4. Student will be able to describe unique characters of Birds & Mammals
5. Students will be capable of identifying the characters and classification of Chordates

Instructions for Paper-Setter

1. Nine questions will be set in all. All questions will carry equal marks.
2. Question No. 1, which will be short answer type covering the entire syllabus will be compulsory. The remaining eight questions will be set unit wise selecting two questions from each Unit I to IV. The candidate will be required to attempt question No. 1 and four more questions selecting one question from each unit.

UNIT	TOPICS	CONTACT HOURS
I	Chordates: Salient features of chordates; Principles of classification; Origin and evolutionary tree of chordates Protochordates: Urochordata & Cephalochordates: Systematic position, distribution, ecology, morphology and affinities	4
II	Cyclostomata: General characters and classification up to class level. Ecological significance of cyclostomes Pisces: General characters and classification up to classes with examples emphasizing their biodiversity, Scales & Fins,	4
III	Amphibia: General Characters and Classification up to class level; Parental Care and Neoteny in Amphibia Reptilia: General Characters and Classification up to classes, Extinct reptiles; Poisonous apparatus in snakes	4
IV	Aves: General Characters and classifications up to class level. Flight/Aerial adaptation in birds Mammals: General Characters and classification up to class level. Adaptive radiations of mammals, dentition in mammals.	3

V **Practical**	1. Classification upto orders, habit, habitats, external characters and economic importance (if any): • Protochordata: *Molgula, Pyrosoma, Doliolum, Olikopleura,* and *Amphioxus.* • Cyclostomata: *Petromyzon* and *Ammocoetus larva*. • Chondrichthyes: *Zygaena, Pristis, Narcine* (electric ray), *Trygon, Rhinobatus* and *Chimaera.* • Osteichthyes: *Acipenser, Muraena, Mystus, Catla, Hippocampus, Syngnathus, Exocoetus, Anabas, Diodon, Tetradon, Echinus, Solea* and *Polypterus.* Any of the Lung Fishes. • Amphibia: *Necturus, Proteus, Amphiuma, Salamandra, Amblystoma, Axolotl larva, Alytes, Bufo, Rana.* • Reptilia: *Hemidactylus, Calotes, Draco, Varanus, Phrynosoma, Chamaeleon, Python, Ptyas, Bungarus, Naja, Hydrus, Viper, Crocodilus, Gavialis, Chelone* (Turtle) and *Testudo* (Tortoise). • Aves: *Casuarius, Arden, Anas, Milvus, Pavo, Eudynamis, Tyto, Alcedo, Halcyon* • Mammalia: *Ornithorhynchus, Echidna, Didelphis, Macropus, Loris, Macaque, Hystrix, Funambulus, Felix, Panthera, Canis, Herpestes, Capra, Pteropus.* 2. Study of the skeleton of *Orcyctolagus*/rat 3. Study of the following prepared slides: T.S. *Amphioxus* (through different regions). Histology of rat (compound tissues), different types of scales.	**30**
Learning Resources		
	1. R.L.Kotpal. Modern Textbook of Zoology 2. E.L. Jordan and Verma. Chordate Zoology. 3. Barrington, E.J.W. The Biology of Hemichordata and Protochordata. Oliver and Boyd, Edinbourgh. 4. Walters, H.E. and Sayles, L.D. Biology of vertebrates. MacMillan & Co., New York. 5. Kent, C.G. Comparative anatomy of vertebrates. 6. S.S. Lal. Practical Zoology Vertebrate	

ZOOLOGY: SEMESTER-3								
Course Type	**Course Code**	**Name of the Course**	**Credit**	**Contact Hours/ Week**	**Internal Assessment marks**	**End Term Marks**	**Max. Marks**	**Exam Duration**
MIC-3 4 credits		**Introductory Human Physiology**	**3**	**3**	**25**	**50**	**75**	**2 hrs.**
		Practical	**1**	**2**	**5**	**20**	**25**	**2 hrs.**

Level of the course: 100-199

Pre-requisite for the course (if any): Biology as a Subject at 4.0 Level (Class XII)

Course Learning Outcomes (CLO)

1. Students will gain knowledge about the basic principles of physiology of both cells and organisms.
2. Students will acquire appropriate understanding of functioning of each system of human body and their regulation
3. Students will be able to perform some basic qualitative analytical test of some biomolecules

Instructions for Paper-Setter

1. Nine questions will be set in all. All questions will carry equal marks.
2. Question No. 1, which will be short answer type covering the entire syllabus, will be compulsory. The remaining eight questions will be set unit wise selecting two questions from each Unit I to IV. The candidate will be required to attempt question No. 1 and four more questions selecting one question from each unit.

UNIT	TOPICS	CONTACT HOURS
I	**Physiology of Digestion:** Physiology of digestion in the alimentary canal; Absorption of carbohydrates, proteins, lipids. **Physiology of Respiration:** Pulmonary ventilation, Respiratory volumes and capacities, Transport of Oxygen and carbon dioxide in blood, oxygen dissociation curve of hemoglobin, Bohr's effect, Hamburger's phenomenon (Chloride shift)	12
II	**Physiology of Circulation:** Structure of Heart, Origin and conduction of the cardiac impulse, Cardiac cycle, electrocardiogram, cardiac output, Composition and functions of blood & lymph **Excretion:** ornithine cycle (Kreb's– Henseleit cycle) for urea formation in liver. Urine formation, counter-current mechanism of urine concentration, osmoregulation	11
III	**Neural Integration:** Structure of neuron, Nature, origin and propagation of nerve impulse along with medullated & non-medullated nerve fibre, conduction of nerve impulse across synapse.	11

IV	**Chemical integration of Endocrinology:** physiology of hypothalamus, pituitary, thyroid, parathyroid, adrenal, pancreas and gonads. **Physiology of reproduction:** Spermatogenesis, oogenesis, Fertilization, Menstrual cycle, monozygotic and dizygotic twins. Parthenogenesis. Implantation and gestation	**11**
V **Practical**	1. Knowledge of daily requirement and deficiency disorders of macronutrients (Carbohydrates, Fats and proteins) and micronutrients like Iron, Zinc, Calcium, Magnesium etc. in the diet of children, young adults, pregnant/lactating and elderly 2. Study of activity of salivary amylase under optimum conditions, effect of temperature, pH on activity of Salivary amylase 3. Preparation of Hematin crystals from dry or fresh blood 4. Study the Use of respirometer/Kymograph	**30**

Learning Resources

1. Karp, G. (2015). Cell and Molecular Biology: Concepts and Experiments, VIII Edition, John Wiley & Sons Inc.
2. Nelson, D. L., Cox, M. M. and Lehninger, A.L. (2009). Principles of Biochemistry. IV Edition. W.H. Freeman and Co.
3. Chatterjee C C , Human Physiology. 1992.
4. Guyton, Text book of Medical Physiology, 10th Ed. W B Saunders 23
5. Wood, D.W. Principles and Animal physiology,1968.

ZOOLOGY: SEMESTER-6								
Course Type	**Course Code**	**Name of the Course**	**Credit**	**Contact Hours/ Week**	**Internal Assessment marks**	**End Term Marks**	**Max. Marks**	**Exam Duration**
MIC-4 4 credits		**BASICS OF FORENSIC BIOLOGY**	**3**	**3**	**25**	**50**	**75**	**2 hrs.**
		Practical	**1**	**2**	**5**	**20**	**25**	**2 hrs.**

Level of the course: 100-199

Pre-requisite for the course (if any): Biology as a Subject at 4.0 Level (Class XII)

Course Learning Outcomes (CLO)

1. Students will be able to understand basics of forensic biology, scope of forensic biology in national and international field
2. Students will learn crime scene investigation, collection of various samples and evidences and analysis
3. Students will learn various methods used in forensic studies and analysis, and perform some basic methods.
4. Students will learn about legal aspects, different national agencies and institutions, legal aids

Instructions for Paper-Setter

3. Nine questions will be set in all. All questions will carry equal marks.
4. Question No. 1, which will be short answer type covering the entire syllabus, will be compulsory. The remaining eight questions will be set unit wise selecting two questions from each Unit I to IV. The candidate will be required to attempt question No. 1 and four more questions selecting one question from each unit.

UNIT	TOPICS	CONTACT HOURS
I	Scope of forensics: Definition, history, international and national fields, evidences and their classification- specific socio-economic offences against human body, property, terrorism, pollution, adulteration- description of sham crime scene, establishment of identity and importance of motivation.	12
II	Finger printing: History, fundamental and principles, Henry system, primary classification and computerized prints; Types of injuries/wounds; signs and symptoms of death time; time of death and post mortem changes; Blood stains; grouping and identification; disputed paternity and DNA tests; Physical evidences-Identification, comparison; collection methods and preservation of hair, fibre, paint, glass and soil- Fire arms, tool marks and impressions	11
III	Forensic medicine: Insects of forensic importance, Biology of insects of forensic importance, venoms and poisons, methods employed for forensic analysis, Medico legal issues of organ transplantation, organ racketing, euthanasia, sexual offences, rape, semen analysis.	11

	Food poisons & narcoanalysis: Classification and sources of drugs, narcotics, cosmetics and abortifacients, physiological and psychological effects, toxic nature of poisoning, sources of poisons, Toxicity testing, methods and instruments for toxicity analysis, Narco-analysis.	
IV	Information technology and legal aspects: cyber-crime, law of robotics, laws and data mining, super imposing techniques, e-com and intelligent systems, justice and law- sources, enactments, judiciary, legal aid, laws of copyrights and patents. Forensic sourcing: Enforcement agencies, public and private: police, CBI- National Institute of criminology and forensic science, Interpol, Prisons and rehabilitation	**11**
V Practical	1. Principle and procedure for DNA extraction from fresh/clotted blood. 2. Principle and procedure for DNA extraction from hair, tissue and buccal swap. 3. Principle and procedure for Blood grouping from dried strains / dots. 4. Principle and procedure for Paternity testing using PCR methods 5. Pedigree Analysis-chart method. 6. Principle and procedure for Semen analysis (cattle sample from veterinary department). 7. Principle and procedure for Fingerprinting analysis	**30**

Learning Resources

1. Forensic Medicine (1979), Simpson, K, ELBS (8th edition)
2. Criminalistics, an introduction to forensic sciences: (1978). Safertein, R. Frentice Hall of India, New Delhi.
3. An introduction to Forensic DNA Analysis (2002). Rudin, N and Crim, K.I.C CRC Press, New York.

Vocational Course from the department for pool of the Courses in the University

(These courses are offered by each department for students of other departments/same department and is focused on practical work, preparing students for a particular skilled profession.

Semester 4

Course Code	Course Title	Course ID	L	T	P	L	T	P	Credits	MARKS				
			(Hrs)			Credits				TI	TE	PI	PE	Total
VOC-1	Apiculture		2	-	4	2	-	2	4	15	25	15	35	100

Semester 5

Course Code	Course Title	Course ID	L	T	P	L	T	P	Credits	MARKS				
			(Hrs)			Credits				TI	TE	PI	PE	Total
VOC-2	Vermi-composting		2	-	4	2	-	2	4	15	25	15	35	100

Semester 6

Course Code	Course Title	Course ID	L	T	P	L	T	P	Credits	MARKS				
			(Hrs)			Credits				TI	TE	PI	PE	Total

VOC-3	Tools and Techniques in Zoology		2	-	4	2	-	2	4	15	25	15	35	100

ZOOLOGY: SEMESTER-4								
Course Type	**Course Code**	**Name of the Course**	**Credit**	**Contact Hours/ Week**	**Internal Assessmentmarks**	**End Term Marks**	**Max. Marks**	**Exam Duration**
VOC-1 4 credit		**APICULTURE**	**2**	**2**	**15**	**35**	**50**	**2 hrs.**
		Practical	**2**	**4**	**15**	**35**	**50**	**2 hrs.**

Level of the course: 100-199

Pre-requisite for the course (if any): NA

Course Learning Outcomes (CLO)

By studying this course, students will be able to

- Learn about different species of economically important Honey bees that are cultured, their identification and behavior.
- Learn about bee-keeping and technologies in honey production
- Know about the opportunities and employment in apiculture
- Make various products and by-products obtained from beekeeping and their importance.
- Develop skills necessary for self-employment in beekeeping sector.
- Enhance collaborative learning and communication skills through practical sessions, teamwork, group discussions, assignments and projects.

Instructions for Paper-Setter

1. Nine questions will be set in all. All questions will carry equal marks.
2. Question No. 1, which will be short answer type covering the entire syllabus, will be compulsory. The remaining eight questions will be set unit wise selecting two questions from each Unit I to IV. The candidate will be required to attempt question No. 1 and four more questions selecting one question from each unit.

UNIT	TOPICS	CONTACT HOURS
I	Introduction to Apiculture; history of beekeeping, The major types of economically important honeybees, their Identification, General morphology, Social organization of bee colony, behavioral patterns (bee dance, swarming).	8
II	Methods of bee keeping; Selection of bee species for apiculture –*Apiscerana indica, Apis mellifera;* Bee keeping equipment and methods of extraction of honey (Indigenous and Modern) & processing; Apiary management - Honey flow period and lean period, effects of pollutants on honeybees. Artificial Bee Rearing (Newton and Langstroth box)	8
III	Qualities of Good Bee Flora. Some Important Bee Flora of India and their General characters. Role of Bees in cross pollination in horticulture and agriculture Honey bee Diseases, their causes, symptoms, control and prevention Honey bee Enemies, their control and prevention.	7
IV	Products of Apiculture Industry (Honey, Bees Wax, Propolis, Royal jelly, Pollen etc.) and their uses; Modern methods in employing artificial Beehives for cross pollination in horticultural gardens- stationary and migratory bee keeping. Bee keeping industries – Recent advancements, employment opportunities, economics in small and large-scale beekeeping, Expenditure, Net Income, and Additional benefits.	7

V Practical	1. Study of the life history of honey bees: *Apiscerana indica, Apis mellifera, Apis dorsata, Apis florea,* etc. from specimen/ photographs - Egg, larva, pupa, adult (queen, drone, worker). Distinguishing characters of workers of three bee species. 2. Study of morphological structures of honey bees through permanent slides/photographs– mouthparts and appendages: antenna, wings, sting, legs. 3. Study of natural beehive and identification of queen cells, drone cells and brood. 4. Study of an artificial hive (Langstroth/Newton), its various parts and demonstration of beekeeping equipment 6. Identification of honeybee enemies: Predators-Insects and non-insects. 7. Training of Bee keeping in Artificial boxes 8. Study of bee pasturage – visit to fields/gardens/orchards for studying the bee activity (role in pollination, nectar collection) and preparation of herbarium of nectar and pollen yielding flowering plants (floral mapping). 9. Project: Visit to an apiary/honey processing unit/institute and submission of a report.	**60**

Learning Resources

1. Singh, S. (1962). Beekeeping in India, Indian Council of Agricultural Research, New Delhi.
2. Mishra, R.C. (1995). Honeybees and their management in India. Indian Council of Agricultural Research, New Delhi.
3. Prost, P. J. (1962). Apiculture. Oxford and IBH, New Delhi.
4. Rahman, A. (2017). Beekeeping in India. Indian Council of Agricultural Research, New Delhi.
5. Gupta, J.K. (2016). Apiculture, Indian Council of Agricultural Research, New Delhi.
6. Bees and Mankind 1982, J.B.Free, George Allen & Unwin (Pub.), Limited London, UK.

ZOOLOGY: SEMESTER-5								
Course Type	**Course Code**	**Name of the Course**	**Credit**	**Contact Hours/ Week**	**Internal Assessmentmarks**	**End Term Marks**	**Max. Marks**	**Exam Duration**
VOC-2 4 credit		**VERMICULTURE**	**2**	**2**	**15**	**35**	**50**	**2 hrs.**
		Practical	**2**	**4**	**15**	**35**	**50**	**2 hrs.**

Level of the course: 100-199

Pre-requisite for the course (if any): NA

Course Learning Outcomes (CLO)

By studying this course, students will be able to

- Learn about biology of different species of economically important Earthworms that are cultured for vermicomposting
- knowledge on role of earth worms in making organic matter from biodegradable wastes.
- Acquire skills on production of vermicompost.
- Explain benefits and problems with vermiculture and vermicompost.
- Enhance collaborative learning and communication skills through practical sessions, teamwork, group discussions, assignments and projects.

Instructions for Paper-Setter

1. Nine questions will be set in all. All questions will carry equal marks.
2. Question No. 1, which will be short answer type covering the entire syllabus, will be compulsory. The remaining eight questions will be set unit wise selecting two questions from each Unit I to IV. The candidate will be required to attempt question No. 1 and four more questions selecting one question from each unit.

UNIT	TOPICS	CONTACT HOURS
I	Vermiculture - definition, meaning, history, economic importance and scope; Role in bio transformation of the residues generated by human activity and production of organic fertilizers; Useful species of earthworms, local and exotic species of earthworms; Role of earthworm in maintenance of soil structure and their role as recycling, reduce, reuse, restore (4r's), choosing right species of earthworm	8
II	Earthworm biology and rearing: Key to identify the species of earthworm, life cycle of *Eisenia fetida*, *Lampito mauritii* and their role on ecology, an ecofriendly approach to sustainable agriculture	8
III	Small scale earthworm farming for home gardens - earthworm compost for home gardens; Conventional commercial composting - Preparation of vermibed, earthworm composting on larger scale (pit, brick and, heap systems, and Kadapa slab method); Harvesting, packaging, transport and storage of Vermicompost; Enemies of earthworms, sickness and worm's enemies; prevention and control.	7
IV	Applications of vermiculture; Benefits of vermicompost; Use of vermicompost in agriculture; Basic characteristics of earthworm suitable for vermicomposting; Problems in vermicomposting; vermicomposting of dairy waste	7

V **Practical**	1. Key to identify different types of earthworms. 2. Study of external features of earth worm species. 3. Study of life stages & development of *Eisenia fetida.* 4. Study of life stages & development of *Lampito mauritii* 5. Study of vermiculture, vermiwash & vermicompost equipments, devices. 6. Preparation of vermibeds, maintenance of vermicompost & climatic conditions. 7. Harvesting, packaging, transport and storage of Vermicompost.	**60**

Learning Resources

- Bhatt J.V. & S.R. Khambata (1959) "Role of Earthworms in Agriculture" Indian Council of Agricultural Research, New Delhi
- Edwards, C.A. and J.R. Lofty (1977) "Biology of Earthworms" Chapman and Hall Ltd., London.
- Lee, K.E. (1985) "Earthworms: Their ecology and Relationship with Soils and Land Use" Academic Press, Sydney.
- Kevin, A and K.E.Lee (1989) "Earthworm for Gardeners and Fisherman" (CSIRO, Australia, Division of Soils).
- Tripathi, G (2003). Vermiresources Technology Discovery Publishing House, New Delhi.
- Sharma R.K. & Bhardwaj P (2018). Green Farming- Earthworms and Vermitechnology. RAR Publication, New Delhi.

ZOOLOGY: SEMESTER-6								
Course Type	**Course Code**	**Name of the Course**	**Credit**	**Contact Hours/ Week**	**Internal Assessmentmarks**	**End Term Marks**	**Max. Marks**	**Exam Duration**
VOC-3 4 credits		**Tools and Techniques in Zoology**	**2**	**2**	**15**	**35**	**50**	**2 hrs.**
		Practical	**2**	**4**	**15**	**35**	**50**	**2 hrs.**

Level of the course: 100-199

Pre-requisite for the course (if any): NA

Course Learning Outcomes (CLO)

By studying this course, students will be able to

- Learn about basic principles, operation and applications of various techniques used in Zoology and Molecular Biology
- Observe and learn about parts and working of various instruments such as Microscopes, Centrifuge, spectrophotometer, microtome PCR etc
- Gain advanced practical and analytical skills and apply the same in the field of research in Biology

Instructions for Paper-Setter

1. Nine questions will be set in all. All questions will carry equal marks.
2. Question No. 1, which will be short answer type covering the entire syllabus, will be compulsory. The remaining eight questions will be set unit wise selecting two questions from each Unit I to IV. The candidate will be required to attempt question No. 1 and four more questions selecting one question from each unit.

UNIT	TOPICS	CONTACT HOURS
I	Microscopy: Working principles, basic operation and application of Light, phase contrast, fluorescence, confocal, electron microscopy (TEM, SEM); Centrifugation: Working principles, basic operation and application of Microcentrifuge, ultracentrifuge, density gradient centrifugation, applications in cell component isolation and molecular weight determination.	8
II	Chromatography: Working principles, basic operation and application of TLC, gel permeation, ion exchange, affinity chromatography, HPLC; Electrophoresis: Working principles, basic operation and application of Agarose, polyacrylamide, SDS-polyacrylamide gel electrophoresis, capillary electrophoresis, 2D electrophoresis, pulsed field gel electrophoresis;	8
III	Molecular Biology Techniques: Working principles, basic operation and application of DNA isolation; PCR (Gradient PCR, RT-PCR); blotting techniques	7
IV	Histopathological Techniques: Tissue preparation and staining; Analytical Instruments: Working principles, basic operation and application of Spectrophotometers, analytical balances, ph meters, etc.; Sterilization and Aseptic Techniques: Working principles, basic operation and application of Autoclaves, ovens, laminar air flow, etc.	7

V Practical	1. Light microscope and its parts observation of unstained and stained cells. 2. Demonstration of Separation of cell organelles by Differential centrifugation 3. Separation of amino acids, etc. by paper and thin layer Chromatography Demonstration of column Chromatography. 4. Demonstration/observation of measurement of pH meter and preparation of buffer. 5. Procedure of fixation, dehydration, section cutting of any animal tissue. 6. Demonstration of sterilization of glassware in autoclave 7. Study and Demonstration of basic electrophoretic unit	**60**
	Learning Resources	
	1. Wilson, K. and Walker, J. Principles and Techniques of Practical Biochemistry Cambridge University Press. 2. Holmeand, D. and Peck, H. Analytical Biochemistry. Longman 3. Scopes, R. Protein Purification - Principles and Practices. Springer Verlag. 4. Pattabhi V and Gautham N. Biophysics, Kluwer Academic Publishers. 5. Robert Braun. Introduction to instrumental analysis - Mc.Crew.Hil 6. Bisen & Mathw. Tools and Techniques in Life Sciences,- CBS Publishers & distributors.	

Skill Enhancement Course from the department for pool of the Courses in the University

(These courses are offered by each department for students of other departments/same department and is designed to provide value-based and/or skill-based knowledge and should contain both theory and lab/hands-on/training/field work.)

Semester 1

Course Code	Course Title	Course ID	L	T	P	L	T	P	Credits	MARKS				
			(Hrs)			Credits				TI	TE	PI	PE	Total
SEC-1	Bird Watching Techniques		1	-	4	1	-	2	3	5	20	15	35	75

Semester 2

Course Code	Course Title	Course ID	L	T	P	L	T	P	Credits	MARKS				
			(Hrs)			Credits				TI	TE	PI	PE	Total
SEC-2	Taxidermy		1	-	4	1	-	2	3	5	20	15	35	75

Semester 6

Course Code	Course Title	Course ID	L	T	P	L	T	P	Credits	MARKS				
			(Hrs)			Credits				TI	TE	PI	PE	Total
SEC-3	Wildlife Study by Camera Trapping		1	-	4	1	-	2	3	5	20	15	35	75

Semester 8

Course Code	Course Title	Course ID	L	T	P	L	T	P	Credits	MARKS				
			(Hrs)			Credits				TI	TE	PI	PE	Total
SEC-4/ Field Training	One from Pool/ Discipline specific course		2	-	4	2	-	2	4	15	35	15	35	100

SEC-SKILL ENHANCEMENT COURSE

ZOOLOGY: SEMESTER-I

Course Type	Course Code	Name of the Course	Credit	Contact Hours/ Week	Internal Assessment marks	End Term Marks	Max. Marks	Exam Duration
SEC-1		Bird Watching Techniques	1	1	5	20	25	2 hrs.
		Practical	2	4	15	35	50	2 hrs.

Level of the course: NA

Pre-requisite for the course(if any):NA

Course Learning Outcomes(CLO):

1. Students will be able to learn about the theory of camera trap
2. Learners will be able to learn about installation of camera trap
3. This Practice will be effective for students for collection of data with camera trap
4. Learners will be able theory of camera trap field operations
5. Students will get practical exposure of camera trap

Instructions for Paper-Setter

1. Nine questions will be set in all. All questions will carry equal marks.
2. Question No. 1, which will be short answer type covering the entire syllabus, will be compulsory. The remaining eight questions will be set unit wise selecting two questions from each Unit I to IV. The candidate will be required to attempt question No. 1and four more questions selecting one question from each unit.

UNIT	TOPICS	CONTACTHOURS
I	Introduction to Bird watching Characteristics of Birds with flight adaptations. Important field signs of bird watching	4
II	Zoological Names of Important birds Field characters of important birds Sexual dimorphism in birds	4
III	Important Indian Bird areas Important Bird areas of Haryana Resident & Migratory Birds of North India	4

IV	Birds as bio-indicators Birds in food chain and Agriculture Bird Migration	**3**
V **Practical**	1. Instruments in Bird watching 2. Identification of Birds 3. Sexual Dimorphism studies in Birds 4. Field visits to local Bird areas and report	**60**

Learning Resources

1. Birds of Indian sub-continent by Richard Grimmett, Inskipp.
2. Birds of Haryana. A field guide by Kalsi and Coworkers
3. Birds of Basai Wetlands Haryana by Deepak Rai and Coworkers.
4. Birding basics: Tips, tools and techniques for great bird watching by Noah Stryckar.

ZOOLOGY: SEMESTER-2								
Course Type	**Course Code**	**Name of the Course**	**Credit**	**Contact Hours/ Week**	**Internal Assessment marks**	**End Term Marks**	**Max. Marks**	**Exam Duration**
SEC-2		**TAXIDERMY**	**1**	**1**	**5**	**20**	**25**	**2hrs.**
		Practical	**2**	**4**	**15**	**35**	**50**	**2 hrs.**

Level of the course: NA

Pre-requisite for the course (if any):NA

Course Learning Outcomes (CLO):

1. Students will be able to learn about the materiality of the taxidermy animal with in the museum context
2. Learners will be able to develop knowledge and understanding of how to sustain a line of enquiry in a series of related art works
3. This Practice will be effective in the uses of a range drawing and in development studies which consider a creative response to the taxidermy animal.
4. Learners will be able for editing of visual ideas derived from research and study of the taxidermy animal.
5. Students will get practical exposure of Taxidermy procedure

Instructions for Paper-Setter

1. Nine questions will be set in all. All questions will carry equal marks.
2. Question No. 1, which will be short answer type covering the entire syllabus, will be compulsory. The remaining eight questions will be set unit wise selecting two questions from each Unit I to IV. The candidate will be required to Attempt question No. 1and four more questions selecting one question from each unit.

UNIT	TOPICS	CONTACT HOURS
I	General introduction to Taxidermy; Past and present scenario of Taxidermy; Types of Taxidermy for different animals; Applications of taxidermy	4
II	Layout of Taxidermy- Techniques and Materials used for Skinning, Cleaning and Preservation of dead animals; Keeping the record of dead animal-age, sex, Infestation of pests	4
III	Methods of Taxidermy in Fishes, Snakes and Birds; Instruments used in Taxidermy; Maceration; Chemical treatments and procedure of Tanning	4
IV	Economic importance of Taxidermy; Role of Taxidermy in conservation and education; Factors affecting Taxidermy; Ethical issues; Pros and cons of Taxidermy	3

V **Practical**	1. Visit to any zoological museum; 2. Identification of animals in Museum; 3. Prepare small models of animals; 4. To study the best and easiest method of Taxidermy of Birds; 5. Procedure of Taxidermy in mammals; Enlist the different types of chemicals used for Taxidermy; 6. Enlist the different types of instruments used for taxidermy	**60**

Learning Resources

1. Taxidermy by Alexis Turner. Rizzoli.
2. Taxidermy by Leon Pray.
3. Home Book of taxidermy and tanning by Gerold. J Grantz.Stackpole Books,1985.

ZOOLOGY: SEMESTER-6								
Course Type	**Course Code**	**Name of the Course**	**Credit**	**Contact Hours/ Week**	**Internal Assessment marks**	**End Term Marks**	**Max. Marks**	**Exam Duration**
SEC-3 3 credit		**Wildlife Study by Camera Trapping**	**1**	**1**	**5**	**20**	**25**	**2 hrs.**
		Practical	**2**	**4**	**15**	**35**	**50**	**2 hrs.**

Level of the course: 100-199

Pre-requisite for the course (if any): NA

Course Learning Outcomes (CLO)

By studying this course, students will be able to-

1. learn about the camera trapping
2. learn about installation of camera trap
3. learn to collect data with camera trap
4. learn theory of camera trap field operations
5. get practical exposure of camera trap

Instructions for Paper-Setter

1. Nine questions will be set in all. All questions will carry equal marks.
2. Question No. 1, which will be short answer type covering the entire syllabus, will be compulsory. The remaining eight questions will be set unit wise selecting two questions from each Unit I to IV. The candidate will be required to attempt question No. 1 and four more questions selecting one question from each unit.

UNIT	TOPICS	CONTACT HOURS
I	Definition and scope of wildlife study by Camera trap, equipment needed; camera properties; Theory and practice various modes and settings of Camera trap.	4
II	Concept of how to operate camera trapping in field; choosing a camera trap, selection of best site for installing camera trap; Layout, Grid, Transect or Points; site preparation; setting up the Camera Trap.	4
III	Collection of data through camera trap; Data management; What the collected data can tells us., Information retrieval; data analysis	4
IV	Use of Camera Trap in wildlife studies. Field studies for hands on experience on camera trap	3

V **Practical**	1. Practical Knowledge of camera trap 2. Practical working of camera trap 3. Extraction of field data from camera trap	**60**

Learning Resources

1. Camera trapping for wildlife research by Frensco Rovero and Fridolin Zimmerman
2. Camera traps in animal ecology. Methods and Analyses by Allan F.O. Channel, James D. Nichols
3. Camera trapping Guide. Tracks, sign and behavior of eastern wild life by Janet Pesaturo.

SEC 4/Field training for Semester 8 will be decided later on.