Annexure - A (1 - 33)

Ch. Ranbir Singh University, Jind

Scheme of Examination and Syllabus for Under-Graduate Programme (Subject: Zoology)

Under Multiple Entry-Exit, Internship and CBCS-LOCF in accordance to NEP-2020w.e.f. 2023-24 (in phased manner)

Under Multiple Entry-Exit, Internship and CBCS-LOCF in accordance to NEP-2020
w.e.f. 2023-24 (in phased manner)
Subject: Zoology

SEMESTER-1									
Remarks	**Course Type**	**Course Code**	**Name of the Course**	**Credit**	**Contact Hours/ Week**	**Internal Assessment marks**	**End Term Marks**	**Max. Marks**	**Exam Duration**
Scheme A & C	**CC-1 MCC-1 4 credit**	B23-ZOO-101	Animal Diversity of Non-Chordates	3	3	20	50	70	3 hrs.
			Practical	1	2	10	20	30	4 hrs.
Scheme C only	**MCC-2 4 credit**	B23-ZOO-102	Type study of Non-chordates	3	3	20	50	70	3 hrs.
			Practical	1	2	10	20	30	4 hrs.
Scheme A	**CC-M1 2 credit**	B23-ZOO-103	Introduction of Non-Chordates	1	1	10	20	30	3 hrs.
			Practical	1	2	5	15	20	4 hrs.
Scheme A & C	**MDC-1 3 credit**	B23-ZOO-104	Basics of Zoology-I	2	2	15	35	50	3 hrs.
			Practical	1	2	5	20	25	4 hrs.
SEMESTER-2									
Remarks	**Course Type**	**Course Code**	**Name of the Course**	**Credit**	**Contact Hours/ Week**	**Internal Assessment marks**	**End Term Marks**	**Max. Marks**	**Exam Duration**
Scheme A & C	**CC-2 MCC-3 4 credit**	B23-ZOO-201	Animal Diversity of Chordates	3	3	20	50	70	3 hrs.
			Practical	1	2	10	20	30	4 hrs.
Scheme C only	**DSEC-1 4 credit**	B23-ZOO-202	Applied Zoology	3	3	20	50	70	3 hrs.
			Practical	1	2	10	20	30	4 hrs.
Scheme A only	**CC-M2 2 credit**	B23-ZOO-203	Introduction of Chordates	1	1	10	20	30	3 hrs.
			Practical	1	2	5	15	20	4 hrs.
Scheme A & C	**MDC-2 3 credit**	B23-ZOO-204	Basics of Zoology-II	2	2	15	35	50	3 hrs.
			Practical	1	2	5	20	25	4 hrs.

Under Multiple Entry-Exit, Internship and CBCS-LOCF in accordance to NEP-2020 w.e.f. 2023-24 (in phased manner)

Subject: Zoology

SEMESTER-3									
Remarks	Course Type	Course Code	Name of the Course	Credit	Contact Hours/ Week	Internal Assessment marks	End Term Marks	Max. Marks	Exam Duration
Scheme A, B & C	CC-3 MCC-4 4 credit	B23-ZOO-301	Cell Biology and Animal Genetics	3	3	20	50	70	3 hrs.
			Practical	1	2	10	20	30	4 hrs.
Scheme B & C	MCC-5 4 credit	B23-ZOO-302	Type study of Chordates	3	3	20	50	70	3 hrs.
			Practical	1	2	10	20	30	4 hrs.
Scheme A, B & C	MDC-3 3 credit	B23-ZOO-303	Basics of Zoology-III	2	2	15	35	50	3 hrs.
			Practical	1	2	5	20	25	4 hrs.
SEMESTER-4									
Remarks	Course Type	Course Code	Name of the Course	Credit	Contact Hours/ Week	Internal Assessment marks	End Term Marks	Max. Marks	Exam Duration
Scheme A, B & C	CC-4 MCC-6 4 credit	B23-ZOO-401	Biomolecules and Mammalian Physiology	3	3	20	50	70	3 hrs.
			Practical	1	2	10	20	30	4 hrs.
Scheme B & C	MCC-7 4 credit	B23-ZOO-402	Aquaculture	3	3	20	50	70	3 hrs.
			Practical	1	2	10	20	30	4 hrs.
Scheme B & C	MCC-8 4 credit	B23-ZOO-403	Pest Management	3	3	20	50	70	3 hrs.
			Practical	1	2	10	20	30	4 hrs.
Scheme B & C	DSE-1 4 credit Select one option	B23-ZOO-404	Biodiversity and Wildlife Management	3	3	20	50	70	3 hrs.
			Practical	1	2	10	20	30	4 hrs.
		B23-ZOO-405	Cytogenetics	3	3	20	50	70	3 hrs.
			Practical	1	2	10	20	30	4 hrs.

Under Multiple Entry-Exit, Internship and CBCS-LOCF in accordance to NEP-2020 w.e.f. 2023-24 (in phased manner)

Subject: Zoology

SEMESTER-5

Remarks	Course Type	Course Code	Name of the Course	Credit	Contact Hours/ Week	Internal Assessment marks	End Term Marks	Max. Marks	Exam Duration
Scheme A, B & C	CC-5 MCC-9 4 credit	B23-ZOO-501	Ecology and Environment	3	3	20	50	70	3 hrs.
			Practical	1	2	10	20	30	4 hrs.
Scheme B & C	MCC-10 4 credit	B23-ZOO-502	Animal Taxonomy	3	3	20	50	70	3 hrs.
			Practical	1	2	10	20	30	4 hrs.
Scheme B & C	DSE-2 4 credit Select one Option	B23-ZOO-503	Animal Behaviour and Chronobiology	3	3	20	50	70	3 hrs.
			Practical	1	2	10	20	30	4 hrs.
		B23-ZOO-504	Comparative Anatomy of Vertebrates	3	3	20	50	70	3 hrs.
			Practical	1	2	10	20	30	4 hrs.
Scheme B & C	DSE-3 4 credit Select one Option	B23-ZOO-505	Biology of Insects	3	3	20	50	70	3 hrs.
			Practical	1	2	10	20	30	4 hrs.
		B23-ZOO-506	Parasitology	3	3	20	50	70	3 hrs.
			Practical	1	2	10	20	30	4 hrs.

SEMESTER-6

Remarks	Course Type	Course Code	Name of the Course	Credit	Contact Hours/ Week	Internal Assessment marks	End Term Marks	Max. Marks	Exam Duration
Scheme A, B & C	CC-6 MCC-11 4 credit	B23-ZOO-601	Developmental Biology & Evolution	3	3	20	50	70	3 hrs.
			Practical	1	2	10	20	30	4 hrs.
Scheme B & C	MCC-12 4 credit	B23-ZOO-602	Basics of Endocrinology and Immunology	3	3	20	50	70	3 hrs.
			Practical	1	2	10	20	30	4 hrs.
Scheme B & C	DSE-4 4 credit Select one Option	B23-ZOO-603	Reproductive Physiology	3	3	20	50	70	3 hrs.
			Practical	1	2	10	20	30	4 hrs.
		B23-ZOO-604	Neurophysiology	3	3	20	50	70	3 hrs.
			Practical	1	2	10	20	30	4 hrs.
Scheme B & C	DSE-5 4 credit Select one Option	B23-ZOO-605	Molecular Biology	3	3	20	50	70	3 hrs.
			Practical	1	2	10	20	30	4 hrs.
		B23-ZOO-606	Forensic Biology	3	3	20	50	70	3 hrs.
			Practical	1	2	10	20	30	4 hrs.

Under Multiple Entry-Exit, Internship and CBCS-LOCF in accordance to NEP-2020 w.e.f. 2023-24 (in phased manner)

Subject: Zoology

SEMESTER-7 (FOR HONOURS/HONOURS WITH RESEARCH IN ZOOLOGY)

Remarks	Course Type	Course Code	Name of the Course	Credit	Contact Hours/ Week	Internal Assessment marks	End Term Marks	Max. Marks	Exam Duration
For Honours in Zoology/ Honours with Research in Zoology	CC-H1 4 credit	B23-ZOO-701	Advances of Cell Biology	4	4	30	70	100	3 hrs.
	CC-H2 4 credit	B23-ZOO-702	Biochemistry and Bio-techniques	4	4	30	70	100	3 hrs.
	CC-H3 4 credit	B23-ZOO-703	Structure and Function of Invertebrates	4	4	30	70	100	3 hrs.
	DSE-H1 4 credit Select one Option	B23-ZOO-704	Biosystematics and Biostatistics	4	4	30	70	100	3 hrs.
		B23-ZOO-705	Computational Biology	4	4	30	70	100	3 hrs.
	PC-H1 4 credit	B23-ZOO-706	Practical Based on B23-ZOO-701 TO 704/705	4	8	30	70	100	6 hrs.

SEMESTER-8 (FOR HONOURS IN ZOOLOGY)

Remarks	Course Type	Course Code	Name of the Course	Credit	Contact Hours/ Week	Internal Assessment marks	End Term Marks	Max. Marks	Exam Duration
Honours in Zoology	CC-H4 4 credit	B23-ZOO-801	Structure and Function of Vertebrates	4	4	30	70	100	3 hrs.
	CC-H5 4 credit	B23-ZOO-802	Comparative Physiology	4	4	30	70	100	3 hrs.
	CC-H6 4 credit	B23-ZOO-803	Population Genetics & Evolution	4	4	30	70	100	3 hrs.
	DSE-H2 4 credit Select one option	B23-ZOO-804	Population and Community Ecology	4	4	30	70	100	3 hrs.
		B23-ZOO-805	Environment and Public Health	4	4	30	70	100	3 hrs.
	PC-H2 4 credit	B23-ZOO-806	Practical Based on B23-ZOO-801 TO 804/805	4	8	30	70	100	6 hrs.

ORSEMESTER-8 (FOR HONOURS WITH RESEARCH IN ZOOLOGY)

Remarks	Course Type	Course Code	Name of the Course	Credit	Contact Hours/ Week	Internal Assessment marks	End Term Marks	Max. Marks	Exam Duration
Honours with Research in Zoology	CC-H4 4 credit	B23-ZOO-801	Structure and Function of Vertebrates	4	4	30	70	100	3 hrs.
	CC-H5 4 credit	B23-ZOO-802	Comparative Physiology	4	4	30	70	100	3 hrs.
	Project/ Dissertation 12 credit	B23-ZOO-807	Project/Dissertation	8+4	-	-	-	300	-

ZOOLOGY: SEMESTER-I

Remarks	Course Type	Course Code	Name of the Course	Credit	ContactHours/ Week	Internal Assessment marks	End Term Marks	Max. Marks	Exam Duration
Scheme A & C	CC-1 MCC-1 4 credit	B23-ZOO-101	Animal Diversity of Non-Chordates	3	3	20	50	70	3 hrs.
			Practical	1	2	10	20	30	4 hrs.

Level of the course: 100-199

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

Course Learning Outcomes (CLO)

1. Student will be able to describe unique characters and recognize life forms of phylum Protozoa and Porifera
2. Student will be able to describe unique characters and recognize life forms of phylum Coelenterata and Helminthes
3. Student will be able to describe unique characters and recognize life forms of phylum Annelida and Arthropoda
4. Student will be able to describe unique characters and recognize life forms of phylum Mollusca, 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 Protozoa: General characters and classification up to class level Type study of *Plasmodium* Phylum Porifera: General characters and classification up to class level, Type study of *Sycon*	12
II	Phylum – Coelentrata: General characters and classification up to class level Type Study of*Obelia* Phylum – Platyhelminthes and Aschelminthes: General characters and classification up to class level, Type study of Liver Fluke, *Fasciola hepatica*	11
III	Phylum – Annelida: General characters and classification up to class level, Type study of Earthworm,*Pheretimaposthuma*(Habitat, habits, metamerism, digestive System, circulatory system, nervous system, reproductive system) Phylum – Arthropoda: General characters and classification up to class level, Type study of Cockroach,*Periplaneta americana* (Habitat, habits, external morphology, digestive system, respiratory system, excretory system, reproductive system)	11
IV	Phylum - Mollusca: General characters and classification up to class level, Type study of*Pila* Phylum – Echinodermata: General characters and classification up to class level, Type study of *Asterias* (Sea Star) (Habitat, habits, external morphology, water vascular system, Circulatory System) Phylum Hemichordata: General characters of Hemichordates with examples	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), *Opalina, Vorticella, Balantidium, Nyctotherus,* radiolarian and formaniferan ooze. 2. Parazoa (Porifera): *Sycon, Grantia, Euplectella, Hyalonema, Spongilla, Euspongia* 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, Aurelia* (sense organs and stages of life history). 4. Playhelminthes: *Dugesia, Fasciola, Taenia, Echinocoecus.* Permanent prepared slides: *Miracidium, Sporocyst, Redia, Cercaria, Scolex* and *Proglotttids of Taenia* (mature and gravid). 5. Aschelminthes: *Ascaris* (male and female), *Trichinella, Ancylostoma, Meloidogyne* 6. Annelida: *Pheretima, Heteronereis, Polynoe, Aphrodite, Chaetopterus, Arenicola, Tubifex* and *Pontobdella* 7. Arthropoda: *Peripatus, Palaemon* (Prawn), *Lobster, Cancer* (crab), *Sacculina, Eupagurus*(hermit crab), *Lepas, Balanus,Cyclops, Daphnia, Lepisma, Periplaneta*(cockroach), *Schistocerca* (locust), *Poecilocerus*(ak-	30

	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* (beg bug), *Pediculus* (body louse), *Millipede, Scolopendra*(centipede), *Palamnaeus*(scorpion), *Aranea* (spider), *Limulus* (king crab) *8.* Mollusca: *Mytilus, Ostrea, Cardium, Pholas, Solen* (razor/Fish), *Pecten, Holiotis, Patella, Aplysia, Doris, Limax, Loligo, Sepia, Octopus, Nautilus* (complete and T.S.), *Chiton* and *Dentalium* *9.* Echinodermata: *Asterias, Echinus, Cucumaia, Ophiothrix, Antedon* and *Asterophyton* 10. Hemichordata: *Balanoglossus* 11. Study of slides of Non-Chordates phyla; Staining of *Obelia* and *Sertularia*	

Suggested Evaluation Methods

InternalAssessment:	**End Term Examination:**
➢ **Theory** •Class Participation: 5 •Seminar/presentation/assignment/quiz/class test etc.: 5 •Mid-Term Exam: 10 ➢ **Practicum** •Class Participation: NA •Seminar/Demonstration/Viva-voce/Lab records etc.: 10 •Mid-Term Exam: NA	➢ **Theory** •Written Examination: 50 ➢ **Practicum** Practical Examination: 20

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-I

Remarks	Course Type	Course Code	Name of the Course	Credit	Contact Hours/ Week	Internal Assessment marks	End Term Marks	Max. Marks	Exam Duration
Scheme C only	MCC-2 4 credit	B23-ZOO-102	Type study of Non-chordates	3	3	20	50	70	3 hrs.
			Practical	1	2	10	20	30	4 hrs.

Level of the course: 100-199

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

Course Learning Outcomes (CLO)

1. Student will be able to describe about Type study of *Paramecium*
2. Student will be able to describe Type study of *Ascaris*
3. Student will be able to describe about Annelids and Arthropods
4. Student will be able to describe Type study of *Balanoglossus*
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	**PhylumProtozoa:** Biodiversity and economic importance of Protozoans; Type study of *Amoeba*, *Paramecium* **Phylum Porifera:** Biodiversity and economic importance of poriferans, Canal system in sponges, Spicules in sponges	12
II	**Phylum –Coelentrata:** Biodiversity and economic importance of cnidarians Corals and coral reefs Polymorphism in Siphonophores **Phylum – Platyhelminthes and Aschelminthes:** Biodiversity and economic importance of flat worms, Type study of *Ascaris lumbricoides* Common roundworms and their economic importance	11
III	**Phylum – Annelida:** Biodiversity and economic importance of annelids Metamerism in Annelida Larval forms in Annelids **Phylum – Arthropoda:** Biodiversity and economic importance of insects (insect vectors, lac insects, honey bee, insect pest), & crustaceans Type study of Grasshopper Evolutionary significance of *Peripatus*	11
IV	**Phylum - Mollusca:** Biodiversity and economic importance of Molluscs Torsion and detorsion in gastropoda **Phylum – Echinodermata:** Biodiversity and economic importance of echinoderms Larval forms of Echinoderm Aristotle's Lantern: Structure & Functions **Phylum – Hemichordata:** Type Study of *Balanoglossus*	11
V Practical	**Study of the following permanent stained preparations:** 1. L.S. and T.S. *Sycon;* gemmules, spicules and spongin fibres of *Sycon,* canal system of sponges 2. T.S. *Hydra* (testis and ovary region) 3. T.S. *Fasciola* (different regions) 4. T.S. *Ascaris* (male and female) 5. T.S. *Pheretima*(pharyngeal and typhlosolar regions), Setae, septal nephridiaand spermathecae of *Pheretima.* 6. Trachea and mouthparts of cockroach. 7. Statocyst of *Palaemon.* 8. Glochidium larva of *Anodonta;* radula and osphradium of *Pila.* 9. T.S. Star fish (arm). 10. T.S. *Balanoglossus* (through various regions).	30

	Preparation of the following slides: 1. Temporary preparation of *Volvo, Paramecium,* Gemmules and spicules of *Sycon;* mouth parts and trachea of *Periplaneta*(cockroach). 2. Preparation of permanent stained whole mounts of *Hydra, Obelia, Sertularia, Plumularia* and *Bougainvillea.* 3. Preparation of mouth parts of Mosquito, House fly and cockroach. **Study of Internal Anatomy** 1. Computer, simulated study/ model of: (i) *Earthworm*: Digestive, reproductive and nervous systems (ii) *Pila* : Pallial complex, digestive and nervous system 2. Demonstration of internal anatomy of cockroach: Digestive, reproductive and nervous systems	

Suggested Evaluation Methods

InternalAssessment:	**End Term Examination:**
➢ **Theory** •Class Participation: 5 •Seminar/presentation/assignment/quiz/class test etc.: 5 •Mid-Term Exam: 10 ➢ **Practicum** •Class Participation: NA •Seminar/Demonstration/Viva-voce/Lab records etc.: 10 •Mid-Term Exam: NA	➢ **Theory** •Written Examination: 50 ➢ **Practicum** Practical Examination: 20

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-I

Remarks	Course Type	Course Code	Name of the Course	Credit	Contact Hours/ Week	Internal Assessment marks	End Term Marks	Max. Marks	Exam Duration
Scheme A	CC-M1 2 credit	B23-ZOO-103	Introduction of Non-Chordates	1	1	10	20	30	3 hrs.
			Practical	1	2	5	15	20	4 hrs.

Level of the course: 100-199

Pre-requisite for the course (ifany): 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

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 with their ecological and economic importance Phylum Porifera: General characters and classification of Porifera with their ecological and economic importance	4
II	Phylum – Coelentrata: General characters and classification of Coelentrata with their ecological and economic importance Phylum – Platyhelminthes and Aschelminthes: General characters and classification of Helminthes with their ecological and economic importance	4
III	Phylum – Annelida: General characters and classification of Annelida with their ecological and economic importance Phylum – Arthropoda: General characters and classification of Arthropods with their ecological and economic importance	4
IV	Phylum - Mollusca: General characters and classification of Mollusca with their ecological and economic importance Phylum – Enchinodermata: General characters and classification of Echinoderms with their ecological and economic importance Phylum Hemichordata: General Characters of Hemichordates with examples	3
V Practical	Classification up to orders with ecological note and economic importance of the following animals: 1. Protozoa: Permanent slides: *Amoeba, Euglena, Trypanosoma, Noctiluca, Eimeria, Paramecium* (binary fission and conjugation), *Opalina, Vorticella, Balantidium, Nyctotherus,* radiolarian and formaniferan ooze. 2. Porifera: *Sycon, Grantia, Euplectella, Hyalonema, Spongilla, Euspongia* 3. Coelenterata: *Porpita, Valella, Physalia, Aurelia, Rhizostoma, Metridium, Millipora, Alcyonium, Tubipora, Zoanthus, Madrepora, Favia, Fungia,* and *Astrea.* Permanent slides of*Hydra* (W.M.), *Hydra* with buds, *Obelia* (colony and medusa), *Sertularia, Plumularia, Tubularia, Bougainvillea, Aurelia.* 4. Playhelminthes: *Dugesia, Fasciola, Taenia, Echinocoecus.* Permanent prepared slides: *Miracidium, Sporocyst, Redia, Cercaria, Scolex* and *Proglotttids of Taenia* (mature and gravid). Aschelminthes: *Ascaris* (male and female), *Trichinella, Ancylostoma, Meloidogyne* 5. Annelida: *Pheretima, Heteronereis, Polynoe, Aphrodite, Chaetopterus, Arenicola, Tubifex* and *Pontobdella* 6. Arthropoda: *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* (Bed bug), *Pediculus* (Head louse), *Millipede, Scolopendra*(centipede), *Palamnaeus*(scorpion), *Aranea* (spider), *Limulus* (king crab) 7. Mollusca: *Mytilus, Ostrea, Cardium, Pholas, Solen* (razor / Fish), *Pecten, Holiotis, Patella, Aplysia, Doris, Limax, Loligo, Sepia, Octopus, Nautilus* (complete and T.S.), *Chiton* and *Dentalium* 8. Echinodermata: *Asterias, Echinus, Cucumaia, Ophiothrix, Antedon* and *Asterophyton* 9. Hemichordata: *Balanoglossus*	30

Suggested Evaluation Methods

InternalAssessment:

- **Theory**
  - Class Participation: 4
  - Seminar/presentation/assignment/quiz/class test etc.: NA
  - Mid-Term Exam: 6

End Term Examination:

- **Theory**
  - Written Examination: 20
- **Practicum**
  - Practical Examination: 15

➢ **Practicum** •Class Participation: NA •Seminar/Demonstration/Viva-voce/Lab records etc.: 5 •Mid-Term Exam: NA	

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-I

Remarks	Course Type	Course Code	Name of the Course	Credit	Contact Hours/ Week	Internal Assessment marks	End Term Marks	Max. Marks	Exam Duration
Scheme A & C	MDC-1 3 credit	B23-ZOO-104	Basics of Zoology-I	2	2	15	35	50	3 hrs.
			Practical	1	2	5	20	25	4 hrs.

Level of the course: 100-199

Pre-requisite for the course (ifany): NA

Course Learning Outcomes (CLO)

1. Student will be able to learn about Kingdom Animalia
2. Student will be able to learn about Chordates
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, Invertebrate Phyla, Introduction to basic characters of animal with special reference to the non chordates; Biodiversity: Introduction and Scope; General characters of Protozoa and Porifera; Study of Amoeba and sponges with special reference to its structure and economic importance	8
II	General characters of Coelentrata and Annelida; Ecological importance of corals; Morphology of earthworm and its ecological role; 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; Snails as pest in Paddy fields	7
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 characters of burrowing non chordates e.g. Earthworm 4. To study the life cycle of Butterfly/Mosquito 5. To study various minor phyla as connecting link 6. Identifications of Non-Chordates specimens of various phyla	30

Suggested Evaluation Methods

InternalAssessment:

- **Theory**
  - Class Participation: 4
  - Seminar/presentation/assignment/quiz/class test etc.: 4
  - Mid-Term Exam: 7
- **Practicum**
  - Class Participation: NA
  - Seminar/Demonstration/Viva-voce/Lab records etc.: 5
  - Mid-Term Exam: NA

End Term Examination:

- **Theory**
  - Written Examination: 35
- **Practicum**
  Practical Examination: 20

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

Remarks	Course Type	Course Code	Name of the Course	Credit	Contact Hours/ Week	Internal Assessment marks	End Term Marks	Max. Marks	Exam Duration
Scheme A & C	CC-2 MCC-3 4 credit	B23-ZOO-201	Animal Diversity of Chordates	3	3	20	50	70	3 hrs.
			Practical	1	2	10	20	30	4 hrs.

Level of the course: 100-199

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

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. 1 and four more questions selecting one question from each unit.

UNIT	TOPICS	CONTACT HOURS
I	**Chordates**: Salient features of chordates; Principles of classification; **Protochordates**: Urochordata: Systematic position, distribution, ecology, morphology and affinities Urochordata: Type Study of Herdmania	12
II	**Pisces**: General characters and classification up to classes with examples emphasizing their biodiversity, Scales & Fins, Type study of *Labeo*	11
III	**Amphibia**: General characters and Classification upto class level; Type study of frog, Parental Care and Neoteny in Amphibia **Reptilia:** General characters and Classification upto classes,	11
IV	**Aves:** General characters and Classifications upto classes. Flight/Aerial adaptation in birds, *Archaeopteryx* as missing link **Mammals:** General characters and classification up to classes; Type study of Rat	11
V Practical	1. Classification upto orders, 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, Ostracion, Tetradon, Echinus, Lophius, Solea*and *Polypterus.* Any of the Lung Fishes. • Amphibia: *Necturus, Proteus, Amphiuma, Salamandra, Ambystoma, Axolotl larva, Alytes, Bufo, Rana.* • Reptilia: *Hemidactylus, Calotes, Draco, Varanus, Phrynosoma, Chamaeleon, Typhlops, Python, Eryx, 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 *Scoliodon, Labeo, Rana* (Frog), *Varanus,* Pigeon or Gallus and *Orcyctolagus*/rat. 3. Study of the following permanent slides: Tornaria larva, T.S. *Amphioxus* (through different regions). Oikopleura, Histology of rat (compound tissues), different types of scales. 4. Make permanent stained preparations of the following: *Salpa,* Spicules, and Pharynx of *Herdmania, Amphioxus,* Cycloid scales 5. Field Visit to Protected areas/National Park/Wildlife Sanctuary or Zoo.	30

Suggested Evaluation Methods

InternalAssessment:

- **Theory**
  - Class Participation: 5
  - Seminar/presentation/assignment/quiz/class test etc.: 5
  - Mid-Term Exam: 10
- **Practicum**
  - Class Participation: NA
  - Seminar/Demonstration/Viva-voce/Lab records etc.: 10

End Term Examination:

- **Theory**
  - Written Examination: 50
- **Practicum**
  Practical Examination: 20

•Mid-Term Exam: NA	

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-2

Remarks	Course Type	Course Code	Name of the Course	Credit	Contact Hours/ Week	Internal Assessment marks	End Term Marks	Max. Marks	Exam Duration
Scheme C only	DSEC-1 4 credit	B23-ZOO-202	Applied Zoology	3	3	20	50	70	3 hrs.
			Practical	1	2	10	20	30	4 hrs.

Level of the course: 100-199

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

Course Learning Outcomes (CLO)

1. Students will be able to identify different species and casts of honeybees and species of silkworm.
2. Students will be able to use the tools and techniques used in apiculture, sericulture, aquaculture, piggery poultry and leather Industry and capabilities to initiate startups will develop
3. Students will able to explain the basic concept of Poultry and Pisciculture
4. Student will understand the basic concepts of industry based applied methods.
5. Students will develop skills in basic laboratory techniques and understand the principles 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	Apiculture: History and introduction; Honey bee and kinds; Social organization and colony nests; Lifecycle; Bee keeping, selection, methods, products; Honey composition, quality and importance Sericulture: Silkworm moth species and their life cycle; Rearing of silkworm, silk reeling, twisting and weaving; Silk composition, kind and uses; Diseases and pests of silkworm	12
II	Prawn Culture: Introduction to Prawns, species; Prawn farming methods, processing and preservation of prawns. Pearl Culture: Historical background, species; Pearl formation, composition, quality and commercial value, Artificial culturing, synthetic pearl types and their manufacturing, methods of harvesting.	11
III	Pisciculture: Economically important fresh water and marine fishes; Fish culture, Fish farming technologies, Problems of seed collection from natural resources, Induced breeding methods, Products and by products from pisciculture Poultry: Nomenclature and breeds of poultry birds; Egg structure and quality, nutritive values, factors affecting size and egg processing, Poultry products and by products	11
IV	Fur and leather industry: Fur producing animals; Fur farming, dressing, processing and dyeing, Fur industry in India; Animals of leather industry, processing of skin, flaying, curing salting and tanning. Piggery and other utilities of animals: Characteristics of swine and important breeds, Products and by products; Pharmaceuticals from animals; Uses of animals in vaccine production	11
V Practical	1. Life cycle of Chicken, Poultry farming 2. Life history of honeybee. 3. Morphology of Carp, Cat fish and Perch. 4. Fishing Crafts and Gears 5. Preparation of permanent slides of phytoplankton and zooplanktons which constitute the food of commercial fishes, their identification and study of important characters. 6. Field visit to aviary/fish pond and fish market/sericulture unit/Prawn farm and preparation of field report.	30

Suggested Evaluation Methods

InternalAssessment:

- **Theory**
  - Class Participation: 5
  - Seminar/presentation/assignment/quiz/class test etc.: 5
  - Mid-Term Exam: 10
- **Practicum**

End Term Examination:

- **Theory**
  - Written Examination: 50
- **Practicum**
  Practical Examination: 20

•Class Participation: NA •Seminar/Demonstration/Viva-voce/Lab records etc.: 10 •Mid-Term Exam: NA	

Learning Resources

1. Concepts of Insect Control by Ghosh M. R. Wiley Eastern Ltd. New Delhi.
2. Economic Zoology. Shukla Upadhyay, Rastogi Publication, Meerut, India, 1998.
3. Insect Pest Management by Dent, D.
4. Agricultural Entomology by Hill, D.S., Timber Press.
5. General and Applied Entomology by Nayar K. K. and T. N. Ananthkrishnan and B. V. Davis, Tata McGrew Hill Publications. New Delhi.
7. Agricultural Pests: Biology and Control Measures by B. M. Deoray and T. B. Nikam, Nirali Publication, Pune.

ZOOLOGY: SEMESTER-2

Remarks	Course Type	Course Code	Name of the Course	Credit	Contact Hours/ Week	Internal Assessment marks	End Term Marks	Max. Marks	Exam Duration
Scheme A only	CC-M2 2 credit	B23-ZOO-203	Introduction of Chordates	1	1	10	20	30	3 hrs.
			Practical	1	2	5	15	20	4 hrs.

Level of the course: 100-199

Pre-requisite for the course (ifany): 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 upto 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 upto class level; Parental Care and Neoteny in Amphibia Reptilia: General Characters and Classification upto classes, Extinct reptiles; Poisonous apparatus in snakes	4
IV	Aves: General Characters and classifications upto class level. Flight/Aerial adaptation in birds, *Archaeopteryx* as missing link Mammals: General Characters and classification up to class; Adaptive radiations of mammals, dentition in mammals.	3
V Practical	1. Classification upto orders, 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, Ostracion, Tetradon, Echinus, Lophius, 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, Typhlops, Python, Eryx, 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 *Scoliodon, Labeo, Rana* (Frog), *Varanus,* Pigeon or Gallus and *Orcyctolagus*/rat, Palates of birds, skulls of dog & rabbit. 3. Study of the following prepared slides: Tornaria larva, T.S. *Amphioxus* (through different regions). Oikopleura, Histology of rat (compound tissues), different types of scales. 4. Make permanent stained preparations of the following: *Salpa,* Spicules, and Pharynx of *Herdmania, Amphioxus*, Cycloid scales 5. Field Visit to National Park or Zoo.	30

Suggested Evaluation Methods

InternalAssessment:

- **Theory**
  - Class Participation: 4
  - Seminar/presentation/assignment/quiz/class test etc.: NA
  - Mid-Term Exam: 6
- **Practicum**
  - Class Participation: NA
  - Seminar/Demonstration/Viva-voce/Lab records etc.: 5

End Term Examination:

- **Theory**
  - Written Examination: 20
- **Practicum**
  Practical Examination: 15

•Mid-Term Exam: NA	

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-2

Remarks	Course Type	Course Code	Name of the Course	Credit	Contact Hours/ Week	Internal Assessment marks	End Term Marks	Max. Marks	Exam Duration
Scheme A & C	MDC-2 3 credit	B23-ZOO-204	Basics of Zoology-II	2	2	15	35	50	3 hrs.
			Practical	1	2	5	20	25	4 hrs.

Level of the course: 100-199

Pre-requisite for the course (ifany): 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 and Salient features of chordates, Difference between non chordates and chordates. Characters of protochordates	8
II	**Pisces(Fishes):** Characteristic features of freshwater and marine fishes, Edible fishes of India, Composite fish culture. **Class Amphibia:** Features of amphibians, Parental care in amphibians, Role of amphibians in ecosystem, Identification of turtles and tortoise, Frog and Toad.	8
III	**Class Reptilia:** Features of Reptiles, Common reptiles of India, Identification of Poisonous and non poisonous snakes, Difference between crocodile and Gharial	7
IV	**Class Aves:** Characteristic features of birds, Common birds of India, Flight adaptations in birds, Commercial uses of birds, Role of birds in agriculture. **Class Mammals:** Characters and economic importance of mammals	7
V Practical	1. Identifying feature of different class of chordates 2. Study of connecting links in chordates 3. Study of different types of feathers. 4. Study of different local species of fishes 5. Study of nesting pattern of some local birds, mammals	30

Suggested Evaluation Methods

InternalAssessment:

- **Theory**
  - Class Participation: 4
  - Seminar/presentation/assignment/quiz/class test etc.: 4
  - Mid-Term Exam: 7
- **Practicum**
  - Class Participation: NA
  - Seminar/Demonstration/Viva-voce/Lab records etc.: 5
  - Mid-Term Exam: NA

End Term Examination:

- **Theory**
  - Written Examination: 35
- **Practicum**
  Practical Examination: 20

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

Remarks	Course Type	Course Code	Name of the Course	Credit	Contact Hours/ Week	Internal Assessment marks	End Term Marks	Max. Marks	Exam Duration
Scheme A, B & C	CC-3 MCC-4 4 credit	B23-ZOO-301	Cell Biology and Animal Genetics	3	3	20	50	70	3 hrs.
			Practical	1	2	10	20	30	4 hrs.

Level of the course: 200-299

Pre-requisite for the course (ifany): Biology as a Subject at 4.0 Level (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 inborn errorsand 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 linkedinheritance 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. 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	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 animal cell.	12
II	Ribosomes: Types, biogenesis and role in protein synthesis. Lysosomes: Structure, enzymes and their role; polymorphism Mitochondria: Structure, Mitochondria as semiautonomous 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, cytoplasmic and 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-influenced inheritance Extra chromocomal and cytoplasmic inheritance: Kappa particles in Paramecium, Shell coiling in snails, Milk factor in mice	11
IV	Multiple allelism: 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-finger printing, 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 Drum stick slide Preparations	30

Suggested Evaluation Methods

InternalAssessment:

- **Theory**
  - •Class Participation: 5
  - •Seminar/presentation/assignment/quiz/class test etc.: 5
  - •Mid-Term Exam: 10
- **Practicum**
  - •Class Participation: NA
  - •Seminar/Demonstration/Viva-voce/Lab records etc.: 10
  - •Mid-Term Exam: NA

End Term Examination:

- **Theory**
  - •Written Examination: 50
- **Practicum**
  Practical Examination: 20

Learning Resources
1. Molecular Cell, Biology, J. Darnell, H. Lodish and D. Baltimore Scientific American Book, Inc., USA.
2. Cell Biology, Genetics, Molecular Biology, Evolution and Ecology by P. S. Verma and V.K. Aggarwal
3. Molecular Biology of the Cell, B. Alberts, D. Bray, J. Lewis, M. Raff, K. Roberts and J.D. Watson. Garland Publishing Inc., New York.
4. Cell Biology and Genetics by P.K. Gupta
5. Cell Biology and Genetics by Veer Bala Rastogi.
6. Principles of Genetics by M. Gardner, J. Simmons, D. P. Snustad
7. Genetics by D. P. Snustad, J. Simmons

ZOOLOGY: SEMESTER-3

Remarks	Course Type	Course Code	Name of the Course	Credit	Contact Hours/ Week	Internal Assessment marks	End Term Marks	Max. Marks	Exam Duration
Scheme B & C	MCC-5 4 credit	B23-ZOO-302	Type study of Chordates	3	3	20	50	70	3 hrs.
			Practical	1	2	10	20	30	4 hrs.

Level of the course: 200-299

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

Course Learning Outcomes (CLO)

1. Student will be able to describe about Urochordates
2. Student will be able to describe about Pisces
3. Student will be able to describe about Amphibians & Reptiles
4. Student will be able to describe about 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. 1 and four more questions selecting one question from each unit.

UNIT	TOPICS	CONTACT HOURS
I	Chordates: Origin and Evolutionary tree of chordates. Protochordates: Cephalochordata: Systematic position, distribution, ecology, morphology and affinities, Cephalochordata: Type study of *Amphioxus*	12
II	Agnatha: General characters Cyclostomata: General characters and classification upto class level. Ecological significance of cyclostomes Petromyzon: Structural & functional morphology type study	11
III	Reptilia: Type study of Lizard (*Hemidactylus*): Structural & Functional morphology, Extinct reptiles; Poisonous apparatus in snakes	11
IV	Aves: Type study of Pigeon (*Columba livia)*; Structural & Functional morphology Mammals: Adaptive radiations of mammals, dentition in mammals.	11
V Practical	1. Classification upto orders, 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, Ostracion, Tetradon, Echinus, Lophius, Soleaand Polypterus.* Any of the Lung Fishes. • Amphibia: *Necturus, Proteus, Amphiuma, Salamandra, Amblystoma, Axolotl larva, Alytes, Bufo, Rana.* • Reptilia: *Hemidactylus, Calotes, Draco, Varanus, Phrynosoma, Chamaeleon, Typhlops, Python, Eryx, 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. Internal anatomy of the following animals: (i) Computer simulated model/study of : (a) *Herdmania*: General anatomy; (b) *Rat*: Digestive, arterial, venous and urinogenital systems; (c) *Hemidactylus*: Digestive, arterial, venous and urinogenital systems (ii) Demonstration & Study of Internal Anatomy of locally available fish (*Labeo).* Digestive and reproductive systems, cranial nerves, Ear ossicle 3. Study of the skeleton of *Scoliodon, Labeo, Rana* (Frog), *Varanus,* Pigeon or Gallus and *Orcyctolagus*/rat, Palates of birds, skulls of dog & rabbit. 4. Study of the following prepared slides: Tornaria larva, T.S. *Amphioxus* (through different regions). Oikopleura, Histology of rat (compound tissues), different types of scales. 5. Make permanent stained preparations of the following: *Salpa,* Spicules, and Pharynx of *Herdmania, Amphioxus,* Cycloid scales 6. Field Visit to National Park or Zoo.	30

Suggested Evaluation Methods

InternalAssessment:	End Term Examination:
➢ Theory	➢ Theory

•Class Participation: 5 •Seminar/presentation/assignment/quiz/class test etc.: 5 •Mid-Term Exam: 10 ➢ **Practicum** •Class Participation: NA •Seminar/Demonstration/Viva-voce/Lab records etc.: 10 •Mid-Term Exam: NA	•Written Examination: 50 ➢ **Practicum** Practical Examination: 20

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

Remarks	Course Type	Course Code	Name of the Course	Credit	Contact Hours/ Week	Internal Assessment marks	End Term Marks	Max. Marks	Exam Duration
Scheme A, B & C	MDC-3 3 credit	B23-ZOO-303	Basics of Zoology-III	2	2	15	35	50	3 hrs.
			Practical	1	2	5	20	25	4 hrs.

Level of the course: 200-299

Pre-requisite for the course (ifany): NA

Course Learning Outcomes (CLO)

1. To understand the basic anatomical concepts of skeletal and bones.
2. Course will help to understand importance of blood group system in humans.
3. The student will learn the physiology of respiration in humans.
4. The course will make students understand the aspect of cell structure and its function.
5. Course will provide practical knowledge of osteology in humans.

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	Humans Skeleton and bones: Characteristics (axial and appendicular skeleton), Joints, cartilage and ligaments, interaction between skeletal muscles and nerves. ABO and RH system in humans, methods of determination, importance and dangers of blood transfusion.	8
II	Human cell and chromosomes: Cell as unit of life, morphology and functional elements of human chromosome Sex Determination: Definition, different types and scope.	8
III	Respiration in humans: Anatomy and physiology of respiration, factors affecting change of gases and diffusing capacity. Introduction to Dental Formula, types and development of tooth.	7
IV	Darwinism, species and population: Concept of evolution, theory of Darwinism, Neo-Darwinism, Genetic drift, Hardy Weinberg Law Human Evolution: Origin and evolution, adaptive evolution.	7
V Practical	1. To study different Human bones: Skull, Vertebrae, Girdles and limb bones. 2. Preparation of mitotic chromosomes from onion root tips. 3. Study of different slides of mitosis and meiosis. 4. Blood grouping in Human	30

Suggested Evaluation Methods

InternalAssessment:

- **Theory**
  - Class Participation: 4
  - Seminar/presentation/assignment/quiz/class test etc.: 4
  - Mid-Term Exam: 7
- **Practicum**
  - Class Participation: NA
  - Seminar/Demonstration/Viva-voce/Lab records etc.: 5
  - Mid-Term Exam: NA

End Term Examination:

- **Theory**
  - Written Examination: 35
- **Practicum**
  Practical Examination: 20

Learning Resources

1. Essentials of human Osteology by A.K. Dutta
2. Cell Biology and Genetics by P.K. Gupta.
3. Evolution by Strikberger M. W.
4. Evolutionary Biology by Futuyama.
5. Comparative anatomy of Vertebrates by Kent C.G.
6. Practical Zoology Vertebrates by S.S. Lal

ZOOLOGY: SEMESTER-4

Remarks	Course Type	Course Code	Name of the Course	Credit	Contact Hours/ Week	Internal Assessment marks	End Term Marks	Max. Marks	Exam Duration
Scheme A, B & C	CC-4 MCC-6 4 credit	B23-ZOO-401	Biomolecules and Mammalian Physiology	3	3	20	50	70	3 hrs.
			Practical	1	2	10	20	30	4 hrs.

Level of the course: 200-299

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

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, 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 Transport through biomembranes (Active and Passive), osmotic pressure, hydrogen ion concentration and buffers	12
II	Nutrition: Nutritional components: Carbohydrates, fats, lipids, Vitamins and Minerals; Types of nutrition & feeding, Digestion of lipids, proteins, carbohydrates & nucleic acids; symbiotic digestion, lactose intolerance, Physico-chemical mechanism of Absorption of nutrients & assimilation; control of secretion of digestive juices. Muscles: Types of muscles, ultra-structure of skeletal muscle, neuromuscular junction. Bio-chemical and physical events during muscle contraction, single muscle twitch, tetanus, muscle fatigue, muscle tone, oxygen debt., Cori's cycle, single unit smooth muscles, their physical and functional properties.	11
III	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. 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 alongwith medullated & non-medullated nerve fibre, conduction of nerve impulse across synapse, synaptic delay and synaptic fatigue, Neurotransmitter. Chemical integration of Endocrinology: Structure, chemical nature and mechanism of peptide and steroid hormone action; physiology of hypothalamus, pituitary, thyroid, parathyroid, adrenal, pancreas and gonads, Hormonal disorders. Reproduction: Spermatogenesis, Capacitation of spermatozoa, oogenesis, ovulation, formation of corpus luteum, 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. Study of permanent slides of endocrine glands 9. Blood antigens and antibodies: Blood group testing	30

Suggested Evaluation Methods

InternalAssessment:

- **Theory**
  - Class Participation: 5
  - Seminar/presentation/assignment/quiz/class test etc.: 5
  - Mid-Term Exam: 10
- **Practicum**

End Term Examination:

- **Theory**
  - Written Examination: 50
- **Practicum**
  Practical Examination: 20

•Class Participation: NA •Seminar/Demonstration/Viva-voce/Lab records etc.: 10 •Mid-Term Exam: NA	

Learning Resources

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

ZOOLOGY: SEMESTER-4

Remarks	Course Type	Course Code	Name of the Course	Credit	Contact Hours/ Week	Internal Assessment marks	End Term Marks	Max. Marks	Exam Duration
Scheme B & C	MCC-7 4 credit	B23-ZOO-402	Aquaculture	3	3	20	50	70	3 hrs.
			Practical	1	2	10	20	30	4 hrs.

Level of the course: 200-299

Pre-requisite for the course (ifany): 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 crafts and 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. 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 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, Molluscs and their culture. Traits of important cultivable fish and shellfish and their culture methods – Indian major carps, exotic carps, air breathing fishes, cold water fishes, freshwater 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; poly culture. Culture technology: Induced breading in fishes, techniques and hormones; Fish Biotechnology (Transgenesis and Cryopreservation of gametes).	11
V Practical	1. Identification of *Catlacatla, Labeorohita, L. calbasu, Cirrhinus, mrigala, Puntius sarana, Channa punctatus, C. marulius, C. stariatus, Trichogasterfasciata, Mystusseenghala, M. cavasius, M. tengra, Callichrouspabola, C. bimaculatus, Wallago attu,* Prawns, Crabs, 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. A visit to lake/reservoir/fish breeding centre.	30

Suggested Evaluation Methods

InternalAssessment:

- **Theory**
  - Class Participation: 5
  - Seminar/presentation/assignment/quiz/class test etc.: 5
  - Mid-Term Exam: 10
- **Practicum**
  - Class Participation: NA
  - Seminar/Demonstration/Viva-voce/Lab records etc.: 10
  - Mid-Term Exam: NA

End Term Examination:

- **Theory**
  - Written Examination: 50
- **Practicum**
  Practical Examination: 20

Learning Resources

1. Arumugam N. (2014). Aquaculture and Fisheries, Saras Publication
2. Bardach, JE, Ryther & McLarney, Wo (1972) Aquaculture, New York: Wiley-Interscience. 896pp.
3. Lagler, KF, Bardach, JE, Miller, RR & Passino, DRM (1977) Ichthyology, 21nd Edition, New York, Wiley, 506 pp.
4. Khanna S S, & Singh H R (2014). Textbook of Fish Biology and Fisheries 3rd edn. Narendra Publishing House

ZOOLOGY: SEMESTER-4

Remarks	Course Type	Course Code	Name of the Course	Credit	Contact Hours/ Week	Internal Assessment marks	End Term Marks	Max. Marks	Exam Duration
Scheme B & C	MCC-8 4 credit	B23-ZOO-403	Pest Management	3	3	20	50	70	3 hrs.
			Practical	1	2	10	20	30	4 hrs.

Level of the course: 200-299

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

Course Learning Outcomes (CLO)

1. Students will able to understand ecologically important and harmful insects.
2. 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. 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	Study of important insect pests of crops and vegetables: **Sugarcane:** (With their systematic position, habits and nature of damage caused. (a) Sugarcane leaf-hopper *(Pyrillaperpusilla)* (b) Sugarcane Whitefly *(Aleurolobusbarodensis)* (c) Sugarcane top borer *(Sciropophaganivella)* (d) Sugarcane root borer *(Emmaloceradepresella)* (e) Gurdaspur borer *(Bissetiasteniellus)* Life cycle and control of *Pyrillaperpusilla*only. **Cotton:** (With their systematic position, habits and nature of damage caused. (a) Pink bollworm (*Pestinophoragossypfolla)* (b) Red cotton bug *(Dysdercuscingulatus)* (c) Cotton grey weevil (*Myllocerusundecimpustulatus)* (d) Cotton Jassid (*Amrascadevastans)* Life cycle and control of *Pectinophoregossypiella*	12
II	**Wheat**: Wheat stem borer (*Sesamiainferens)* with its systematics 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 (*Leptocorisa acuta)* (b) Rice grasshopper *(Hieroglyphus banian)* (c) Rice stem borer *(Scirpophagaincertullus)* (d) Rice Hispa*(Diceladispaarmigera)* Life cycle and control of *Loptocorisa acuta* only	11
III	**Vegetables:** (Their systematics position, habits and nature of damage caused. (a)*Aulacophorafaveicollis*– The Red pumpkin beetle. (b)*Dacus cucurbitas*– The pumpkin fruit fly. (c)*Tetranychustecarius*– The vegetable mite. (d)*Epilachna* – The Hadda beetle Life cycle and control of *Aulacophorafaveicollis* **Stored grains:** (Their systematic position, habits and nature of damage caused. (a) Pulse beetle *(Callosobruchus maculatus)* (b) Rice weevil *(Sitophilus oryzae)* (c) Wheat weevil *(Trogoderma granarium)* (d) Rust Red Flour beetles *(Triboliumcastaneum)* (e) Lesser grain borer *(Rhizoperthadominica)* (f) Grain & Flour moth *(Sitotrogacerealella)* Life cycle and control of *Trogoderma granarium*)	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**: Sugarcane leaf-hopper, Sugarcance whitefly, Sugarcance top borer, Sugarcane root borer,	30

	Gurdaspur borer (any two). (ii) **Cotton**: Red Cotton bug (iii) **Wheat**: Wheat stem borer (iv) **Paddy**: Gundhi bug, Rice grasshopper, Rice stem borer, Rice hispa (any one). (v) **Vegetables**: *Aulocophorafaveicollis, Dacus cucurbitas, Tetranychustecarious, Epilachna*(any three). (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 honey bee. 3. Preparation of permanent/temporary slides for identification of mosquitoes	

Suggested Evaluation Methods

InternalAssessment:	**End Term Examination:**
➢ **Theory** •Class Participation: 5 •Seminar/presentation/assignment/quiz/class test etc.:5 •Mid-Term Exam:10 ➢ **Practicum** •Class Participation: NA •Seminar/Demonstration/Viva-voce/Lab records etc.: 10 •Mid-Term Exam: NA	➢ **Theory** •Written Examination: 50 ➢ **Practicum** Practical Examination: 20

Learning Resources

1. David Dent , Richard Binks (2020). Insect Pest Management CABI Publishing; 3rd edition
2. Larry P Pedigo , Marlin E. Rice (2014) Entomology and Pest Management. Waveland Pr Inc; 6th edition
3. John R. Ruberson (2019) Handbook of Pest Management, CRC Press; 1st edition
4. Kalatia M.K. (2021) Introduction to principles of pest and disease management; Walnut Publication
5. Smith K M (2013) A Textbook of Agricultural Entomology by Hill, Cambridge University Press

ZOOLOGY: SEMESTER-4

Remarks	Course Type	Course Code	Name of the Course	Credit	Contact Hours/ Week	Internal Assessment marks	End Term Marks	Max. Marks	Exam Duration
Scheme B & C	DSE-1 4 credit Select one option	B23-ZOO-404	Biodiversity and Wildlife Management	3	3	20	50	70	3 hrs.
			Practical	1	2	10	20	30	4 hrs.

Level of the course: 200-299

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

Course Learning Outcomes (CLO)

1. Students will be able to understand about wildlife zones of India
2. Students will be able to explain the concept of Protected area system
3. It will make the students understand 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. 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	Concept of Bio-Diversity and Wildlife, Levels of Biodiversity Pattern and distribution of Wildlife in India, Wildlife 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 (Biosphere reserve, National Park & Wildlife sanctuaries)	11
III	Red Data Book and its uses IUCN Categories of wildlife species Climate change and loss of biodiversity	11
IV	Threats to biodiversity: habitat loss, poaching of wildlife, man-wildlife conflicts Wildlife Tourism Biosphere Reserves concept and Indian Biosphere Reserves; Location & Significance	11
V Practical	1. Study of biodiversity among various organisms (Listing of all 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. Visits to a local animal park or zoo to identify and study the captive fauna and preparation of report. 4. Study of adaptive characteristics of various vertebrates in different climate. 5. Study of biodiversity in grassland and pond water by using Shannon -Weiner index. 6. Comparison of two species of birds belonging to same genus (Interspecific difference).	30

Suggested Evaluation Methods

InternalAssessment:

- **Theory**
  - Class Participation: 5
  - Seminar/presentation/assignment/quiz/class test etc.: 5
  - Mid-Term Exam: 10
- **Practicum**
  - Class Participation: NA
  - Seminar/Demonstration/Viva-voce/Lab records etc.: 10
  - Mid-Term Exam: NA

End Term Examination:

- **Theory**
  - Written Examination: 50
- **Practicum**
  Practical Examination: 20

Learning Resources
1. Trends in wildlife biodiversity conservation and management. B.B. Hosetti and M. Venkateshwarlu.
2. Wildlife conservation and management. Reena Mathur.
3. Concepts of Wildlife management. B.B.Hosetti.
4. Techniques for wildlife Census in India by W.A. Rogers (A field manual); 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. Handbook 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. Wildlife in India by V.B. Saharia Natraj Publishers, Dehradun.
9. E.P. Gee, The Wildlife of India.

ZOOLOGY: SEMESTER-4

Remarks	Course Type	Course Code	Name of the Course	Credit	Contact Hours/ Week	Internal Assessment marks	End Term Marks	Max. Marks	Exam Duration
Scheme B & C	DSE-1 4 credit Select one option	B23-ZOO-405	Cytogenetics	3	3	20	50	70	3 hrs.
			Practical	1	2	10	20	30	4 hrs.

Level of the course: 200-299

Pre-requisite for the course (ifany): Biology as a Subject at 4.0 Level (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 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	**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. **Chromosome Banding Techniques:** 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. **Gene Mutations:** 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 of Cell Cycle:** 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), Variable chromosome 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 chromosomal syndromes – Turner syndrome, Klinefelter syndrome, XYY,True and Pseudo-hermaphroditism. **The mechanisms which contribute to cytogenetic alterations:** Polyploidy, Aneuploidy, Duplications, deletions, inversions, translocations.	11
IV	**Molecular Cytogenetic Techniques:** FISH, Chromosome painting, automated karyotyping, Flow cytometery, 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. Life in the post genomic era.	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/bone marrow of suitable animals (invertebrate/vertebrate) and preparation of karyotype and idiogram. 4. Making karyological preparations from testicular material of suitable animals (invertebrate/vertebrate) to study the structure and behaviour of chromosomes duringmeiosis. 5. Nuclear sexing from polymorphonuclear leucocytes. 6. Preparation of human buccal smear to study sex chromatin. 7. Micronucleus test for genetic damage. 8. Preparation of pedigrees and pedigree analysis. 9. Demonstration of banding techniques. 10. PCR: Introduction and demonstration. 11. Isolation of genomic DNA. 12. A Survey/Project report for the study of: a) ABO and Rh blood groups b) Some morphogenetic and behavioural traits. c) Some biochemical traits.	30

Suggested Evaluation Methods	
InternalAssessment: ➢ **Theory** •Class Participation: 5 •Seminar/presentation/assignment/quiz/class test etc.: 5 •Mid-Term Exam: 10 ➢ **Practicum** •Class Participation: NA •Seminar/Demonstration/Viva-voce/Lab records etc.: 10 •Mid-Term Exam: NA	**End Term Examination:** ➢ **Theory** •Written Examination: 50 ➢ **Practicum** Practical Examination: 20

Learning Resources

1. Atherly, A.C., J.R. Girton and J.F. McDonald. The Science of Genetics. Sauders CollegePublishing, Harcort Brace College Publishers, NY.
2. Brooker, R.J. Genetics: Analysis and Principles. Benjamin/Cummings, Longman Inc.
3. Fairbanks, D.J. and W.R. Anderson. Genetics – The Continuity of Life. Brook/ColePublishing Company ITP, NY, Toronto.
4. Gardner, E.J., M.J. Simmons and D.P. Snustad. Principles of Genetics. John Wiley andSons. 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. W.H. Freeman and company, NY.
6. Lewin, B. Genes. VI. Oxford University Press, Oxford, New York, Tokyo.
7. Snustad, D.P. and M.J. Simmons. Principles of Genetics. John Wiley and Sons. Inc., NY.
8. Watson, J.D., N.H. Hopkins, J.W. Roberts, J.A. Steitz and 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 Publishing2004, London