Department of Zoology

Scheme of Examination and Syllabus for
Under Graduate Programme

Under Multiple Entry and Exit, Internship and
CBCS-LOCF as per NEP-2020
w.e.f. session 2024-25 (in phased manner)

Subject: Zoology

Guru Jambheshwar University of Science &Technology
Hisar-125001, Haryana
(A+ NAAC Accredited State Govt. University)

Guru Jambheshwar University of Science and Technology
Hisar-125001, Haryana
('A+' NAAC Accredited State Govt. University)

Scheme of Examination and Syllabus for Under-Graduate Programme
For Affiliated Degree Colleges
According to National Education Policy-2020
(w.e.f. Session 2024-25)
Subject: Zoology
SEMESTER – I

Type of Course	Course Code	Nomenclature of Paper/Course	Credits	Contact Hours/Week	External Marks	Internal Marks	Total Marks	Duration of Exam (Hrs)
Discipline Specific Course (DSC)	C24ZOO101T/ C24MIN143T	Animal Diversity-I	3	3	50	20	70	2.5
	C24ZOO101P/ C24MIN143P	Animal Diversity-I Lab	1	2	20	10	30	3
Minor Course (MIC)	C24MIC143T	Introduction of Non-Chordates	2	2	35	15	50	2
Minor Course#	**C24MIN143T/ C24ZOO101T**	**Animal Diversity-I**	**3**	**3**	**50**	**20**	**70**	**2.5**
	C24MIN143P/ C24ZOO101P	**Animal Diversity-I Lab**	**1**	**2**	**20**	**10**	**30**	**3**
Multidisciplinary Course (MDC)	C24MDC129T	Basics of Zoology-I	2	2	35	15	50	2
	C24MDC129T	Basics of Zoology-I Lab	1	2	15	10	25	3
Skill Enhancement Course (SEC)	C24SEC131T	Apiculture	2	2	35	15	50	2
	C24SEC131P	Apiculture Lab	1	2	15	10	25	3
Value Added Course (VAC)	C24VAC105T	Biodiversity and Wildlife Management	2	2	35	15	50	2

SEMESTER – II

Type of Course	Course Code	Nomenclature of Paper/Course	Credits	Contact Hours/Week	External Marks	Internal Marks	Total Marks	Duration of Exam (Hrs)
Discipline Specific Course (DSC)	C24ZOO201T/ C24MIN243T	Animal Diversity-II	3	3	50	20	70	2.5
	C24ZOO201P/ C24MIN243P	Animal Diversity-II Lab	1	2	20	10	30	3
Minor Course (MIC)	C24MIC243T	Introduction of Chordates	2	2	35	15	50	2
Minor Course#	**C24MIN243T/ C24ZOO201T**	**Animal Diversity-II**	**3**	**3**	**50**	**20**	**70**	**2.5**
	C24MIN243P/ C24ZOO201P	**Animal Diversity-II Lab**	**1**	**2**	**20**	**10**	**30**	**3**
Multidisciplinary Course (MDC)	C24MDC129T	Basics of Zoology-II	2	2	35	15	50	2
	C24MDC129T	Basics of Zoology-II Lab	1	2	15	10	25	3
Skill Enhancement Course (SEC)	C24SEC231T	Fish Farming	2	2	35	15	50	2
	C24SEC231P	Fish Farming Lab	1	2	15	10	25	3
Value Added Course (VAC)	C24VAC105T	Biodiversity and Wildlife Management	2	2	35	15	50	2

#for Scheme C only

Programme Outcomes (PO)

PO1 Comprehensive understanding of the principles and practices of zoology which will make them able to work in the areas of research and development.

PO2 Students will gain knowledge to develop acquaintance of animal species around them and variations in their life cycles/biology and their interaction with the environment.

PO3 Students will be capable of using knowledge of subject and analytical methods in identifying and solving various complex situations of living forms and environment taking into consideration ethics and responsibilities.

PO4 Young students will be also be apprised about likeness between the physiological processes at the cellular and organismic levels.

PO5 Subject deals with animal kingdom, its structure, classification, habits & distribution of animals.

PO6 Understand the nature and basic concepts of cell biology, genetics, taxonomy, physiology, ecology and applied zoology etc.

PO7 Studying the subject, students will be able to understand how we function & interact with the world around us.

PO8 It also inculcates the spirit of resource conservation and love for nature that leads to save biodiversity and environment that is the need of the hour.

PO9 It induces entrepreneurship skills among students by imparting Knowledge of fish farming, apiculture, vermiculture and many more.

PO10 By studying Zoology, the students can be employed as life science scientist, marine biologists, educationists, wild life scientists, agriculture, forensic science and many more

Zoology
Discipline specific Course (DSC)
Animal Diversity-I (Semester-1)

Paper Code: C24ZOO101T/C24MIN143T
45 Hrs (3 Hrs/week) **External Marks: 50**
Credits: 3 **Internal Marks: 20**
Exam. Time: 2.5 Hrs **Total Marks: 70**

Note: The examiner is required to set nine questions in all. The first question will be compulsory consisting of five short questions covering the entire syllabus consisting of 2 marks each. In addition to this, eight more questions (each question of at least 2 parts) will be set consisting of two questions from each unit. The student/candidate is required to attempt five questions in all selecting one question from each unit in addition to compulsory Question No. 1. All questions will carry equal marks**.**

Unit-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*.

Unit-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*).

Unit-III

Phylum Annelida: General characters and classification up to class level, Type study of Earthworm (*Pheretima posthuma*).
Phylum Arthropoda: General characters and classification up to class level, Type study of Cockroach (*Periplaneta americana*).

Unit-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 Sea star (*Asterias*).
Phylum Hemichordata: General characters of Hemichordates.

Animal Diversity-I Lab

Paper Code: C24ZOO101P/C24MIN143P
30 Hrs (2Hrs/week) **External Marks: 20**
Credits: 1 **Internal Marks:10**
Exam Time: 3 Hrs **Total Marks: 30**
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, Paramecium* (binary fission and conjugation), *Opalina, Vorticella, Balantidium*.
2. Parazoa (Porifera): *Sycon, Grantia, Euplectella, Hyalonema, Spongilla*and *Euspongia*.
3. Coelenterata: *Porpita, Valella, Physalia, Aurelia, Rhizostoma, Metridium, Millipora, Alcyonium, Tubipora, Madrepora, Favia, Fungia, and Astrea.* Permanent prepared slides: *Hydra* (W.M.), Hydra with buds, *Obelia* (colony and medusa), *Sertularia, Plumularia, Tubularia, Bougainvillea*and *Aurelia*.
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*and *Meloidogyne*.
6. Annelida: *Pheretima, Polynoe, Aphrodite, Chaetopterus*and*Tubifex*.
7. Arthropoda: *Peripatus, Palaemon* (Prawn), *Lobster, Cancer* (crab), *Lepas, Cyclops, Lepisma, Periplaneta* (cockroach), *Poecilocerus* (ak hopper), *Gryllus* (cricket), *Mantis* (praying mantis), *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) and *Limulus* (king crab).
8. Mollusca: *Mytilus, Ostrea, Pholas, Solen* (razor/Fish), *Pecten, Patella, Aplysia, Doris, Limax, Loligo, Sepia*and*Octopus.*
9. Echinodermata: *Asterias, Echinus, Cucumaia, Ophiothrix, Antedon* and *Asterophyton.*
11. Study of slides of non-chordates phyla; Staining of *Obelia* and *Sertularia*.

Note: Students/Candidates are required to obtain minimum passing marks separately in practical component and theory as per the University rules.

Suggested Readings:

1. Jordan, E.L and Verma, P.S. 2009. Invertebrate Zoology, S.Chand and Co. Ltd. New Delhi.
2. Ayyar, E.K and Ananthakrishnan, T.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., Arumugam, N., Soundarapandian, N., Murugan, T.and Leelavathy, S.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. and Barnes (1994). Invertebrate Zoology; Saunders College Pub.

Course Outcomes (CO):

At the end of the course, the students would be able to:

CO1 Describe unique characters and recognize life forms of phylum Protozoa and Porifera.
CO2 Describe unique characters and recognize life forms of phylum Coelenterata and Helminthes.
CO3 Describe unique characters and recognize life forms of phylum Annelida and Arthropoda
CO4 Describe unique characters and recognize life forms of phylum Mollusca, Echinodermata and Hemichordates
CO5 Identify the characters and classification of Non-Chordates.

Mapping: C24ZOO101T/C24MIN143T and C24ZOO101P/C24MIN143P

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**
CO1	S	S	M	S	M	S	M	S	W	M
CO2	S	M	S	M	S	S	W	S	M	M
CO3	S	S	M	M	S	S	S	S	S	S
CO4	S	S	M	S	S	M	M	M	M	S
CO5	M	S	M	M	S	S	M	S	S	S

S= strong M= medium W= weak

Zoology
Minor Course (MIC)
Introduction of Non-Chordates (Semester-1)

Paper Code: C24MIC143T

3 Hrs (2 Hrs/week) **External Marks: 35**
Credits: 2 **Internal Marks: 15**
Exam. Time: 2 Hrs **Total Marks: 50**

Note: The examiner is required to set five questions in all. The first question will be compulsory consisting of five short questions covering the entire syllabus consisting of 3 marks each. In addition to this, four more questions (each question may be of 2 parts) will be set consisting of two questions from each unit. The student/candidate is required to attempt three questions in all selecting one question from each unit consisting of 10 marks each in addition to compulsory Question No. 1.

UNIT- 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.
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.

UNIT- II

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.
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.

Suggested Readings:

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

Course Outcomes (CO):

At the end of the course, the students would be able to:
CO1 Understand about phylum Protozoa and Porifera
CO2 Understand about phylum Coelenterata and Helminthes
CO3 Understand about phylum Annelida and Arthropoda
CO4 Understand about phylum Mollusca, Echinodermata and Hemichordates.
CO5 Identifying the characters and classification of Non-Chordates

Mapping: C24MIC143T

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	S	M	S	M	S	M	M	S	W	M
CO2	M	S	M	S	S	M	M	S	M	M
CO3	S	S	S	M	S	S	S	S	S	S
CO4	S	M	S	M	S	M	M	S	M	S
CO5	S	S	M	M	M	M	W	M	S	S

S= strong M= medium W= weak

Zoology
Minor Course (MIN)
Animal Diversity-I (Semester-1)

Paper Code: C24MIN143T/C24ZOO101T

45 Hrs (3 Hrs/week)	**External Marks: 50**
Credits: 3	**Internal Marks: 20**
Exam. Time: 2.5 Hrs	**Total Marks: 70**

Note: The examiner is required to set nine questions in all. The first question will be compulsory consisting of five short questions covering the entire syllabus consisting of 2 marks each. In addition to this, eight more questions (each question of at least 2 parts) will be set consisting of two questions from each unit. The student/candidate is required to attempt five questions in all selecting one question from each unit in addition to compulsory Question No. 1. All questions will carry equal marks.

Unit-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*.

Unit-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*).

Unit-III

Phylum Annelida: General characters and classification up to class level, Type study of Earthworm (*Pheretima posthuma*).
Phylum Arthropoda: General characters and classification up to class level, Type study of Cockroach (*Periplaneta americana*).

Unit-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 Sea star (*Asterias*).
Phylum Hemichordata: General characters of Hemichordates.

Animal Diversity-I Lab

Paper Code: C24MIN143P/C24ZOO101P

30 Hrs (2Hrs/week)	**External Marks: 20**
Credits:1	**Internal Marks 10**
Exam Time: 3 Hrs	**Total Marks: 30**

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, Paramecium* (binary fission and conjugation), *Opalina, Vorticella, Balantidium*.
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3. Coelenterata: *Porpita, Valella, Physalia, Aurelia, Rhizostoma, Metridium, Millipora, Alcyonium, Tubipora, Madrepora, Favia, Fungia, and Astrea.* Permanent prepared slides: *Hydra* (W.M.), Hydra with buds, *Obelia* (colony and medusa), *Sertularia, Plumularia, Tubularia, Bougainvillea*and *Aurelia*.

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8. Mollusca: *Mytilus, Ostrea, Pholas, Solen* (razor/Fish), *Pecten, Patella, Aplysia, Doris, Limax, Loligo, Sepia*and*Octopus.*
9. Echinodermata: *Asterias, Echinus, Cucumaia, Ophiothrix, Antedon* and *Asterophyton*.
11. Study of slides of non-chordates phyla; Staining of *Obelia* and *Sertularia*.

Note: Students/Candidates are required to obtain minimum passing marks separately in practical component and theory as per the University rules.

Suggested Readings:

1. Jordan, E.L and Verma,P.S. 2009. Invertebrate Zoology, S.Chand and Co. Ltd. New Delhi.
2. Ayyar, E.K and Ananthakrishnan, T.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., Arumugam, N., Soundarapandian, N., Murugan, T.and Leelavathy, S.2010. A textbook of Invertebrates. Saras Publication, Nagercoil.
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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. and Barnes (1994). Invertebrate Zoology; Saunders College Pub.

Course Outcomes (CO):

At the end of the course, the students would be able to:

CO1 Describe unique characters and recognize life forms of phylum Protozoa and Porifera.
CO2 Describe unique characters and recognize life forms of phylum Coelenterata and Helminthes.
CO3 Describe unique characters and recognize life forms of phylum Annelida and Arthropoda
CO4 Describe unique characters and recognize life forms of phylum Mollusca, Echinodermata and Hemichordates
CO5 Identify the characters and classification of Non-Chordates.

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**
CO1	S	S	M	S	M	S	M	S	W	M
CO2	S	M	S	M	S	S	W	S	M	M
CO3	S	S	M	M	S	S	S	S	S	S
CO4	S	S	M	S	S	M	M	M	M	S
CO5	M	S	M	M	S	S	M	S	S	S

S= strong M= medium W= weak

Zoology
Skill Enhancement Course (SEC)
Apiculture (Semester-1)

Paper Code: C24SEC131T
30 Hrs (2 Hrs/week) **External Marks: 35**
Credits: 2 **Internal Marks: 15**
Exam time: 2 Hrs **Total Marks: 50**

Note: The examiner is required to set five questions in all. The first question will be compulsory consisting of five short questions covering the entire syllabus consisting of 3 marks each. In addition to this, four more questions (each question may be of 2 parts) will be set consisting of two questions from each unit. The student/candidate is required to attempt three questions in all selecting one question from each unit consisting of 10 marks each in addition to compulsory Question No. 1.

Unit-I

Apiculture meaning, definition, scope and history, Status of Apiculture Industry in India, Classification and Life Cycle of Honey Bee, Identification of Indigenous and exotic Honey bee species.

Cultivable species of Honey Bee with reference to India, Social organization of honey bees: the castes- queen, drone and workers, Nesting behavior of Honey bees, Bee foraging, Seasonal management, swarming in Honey bees, waggle dance, defense in honey bees, Diseases and Enemies of Bees, Control and Preventive measures.

Unit-II

Role of Bees in cross pollination in horticulture and agriculture, Methods of Artificial Bee keeping, Equipments used in Bee keeping Industry, Methods of extraction of Honey and other products.

Products of Apiculture Industry and their Uses (Honey, Bee Wax, Royal Jelly, Bee Venom, Propolis and Pollen), Bee Keeping Industry: Present and future Prospects of apiculture as self-employment venture, Economics of Apiculture: Expenditure, Net Income, and Additional benefits.

Apiculture Lab

Paper Code: C24SEC131P
30 Hrs (2Hrs/week) **External Marks: 20**
Credits: 1 **Internal Marks 10**
Exam Time: 3 Hrs **Total Marks: 30**

Practical

1. Identification of different bee species
2. Training of Bee keeping in artificial boxes
3. Demonstration of Modern Bee Keeping Equipment and Methods.
4. Training of methods of Extraction of Honey (Indigenous and Modern)
5. Field visit to Honey Bee farm/Unit
6. Report of field visit,

Note: Students/Candidates are required to obtain minimum passing marks separately in practical component and theory as per the University rules.

Suggested Reading:

1. Prost P. J. (1962). Apiculture. Oxford and IBH, New Delhi.
2. Bisht D.S. (2004). Agricultural Development in India, Anmol Pub. Pvt. Ltd.
3. SinghS. (1964). Beekeeping in India, Indian council of Agricultural Research, New Delhi
4. Mehrotra, K.N. and Bisht, D.S. (1981). Twenty-five years of apiculture research at IARI. I. Apiculture in relation to agriculture.
5. The Social Behavior of the Bees, 1974: By Missioner C.D.

Course Outcomes (CO):

At the end of the course, the students would be able to:

CO1 Understand the significance of honey bees and Apiculture

CO2 Acquire knowledge about different species and castes of the honey bees

CO3 Manage beehives for honey production and pollination, and learn various products of honey bees and value addition in these products,

CO4 Aware about economic importance of honey bees, and use of Apiculture for employment, self-employment and conservation of nature

CO5 Gain practical knowledge about various methods of bee keeping and extraction of honey thus create scope for entrepreneurship.

Mapping: C24SEC131T and C24SEC131P

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**
CO1	S	S	S	W	S	S	M	S	M	S
CO2	S	S	W	M	S	M	M	M	S	M
CO3	M	M	M	W	M	W	W	S	S	W
CO4	S	M	S	W	M	M	W	S	S	M
CO5	S	M	S	W	W	W	W	S	S	M

S= strong M= medium W= weak

Zoology
Multidisciplinary Course (MDC)
Basics of Zoology-I (Semester-1

Paper Code: C24MDC129T
30Hrs (2Hrs/week) **External Marks: 35**
Credits: 2 **Internal Marks: 15**
Exam time: 2Hrs **Total Marks: 50**

Note: The examiner is required to set five questions in all. The first question will be compulsory consisting of five short questions covering the entire syllabus consisting of 3 marks each. In addition to this, four more questions (each question may be of 2 parts) will be set consisting of two questions from each unit. The student/candidate is required to attempt three questions in all selecting one question from each unit consisting of 10 marks each in addition to compulsory Question No. 1

Unit-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.

General characters of Coelenterata and Annelida, Ecological importance of corals, Morphology of earthworm and its ecological role, Economic importance of Leech.

Unit-II

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.

General characters of Echinodermata, Study of basic characters of Star fish with reference to its role in ecosystem, Economic importance of Star Fish.

Basics of Zoology-I Lab

Paper Code: C24MDC129P
30Hrs (2Hrs/week) **External Marks: 15**
Credit: 1 **Internal Marks: 10**
Exam time: 3 Hrs **Total Marks: 25**

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

Note: Students/Candidates are required to obtain minimum passing marks separately in practical component and theory as per the University rules.

Suggested Reading:

1. Jordan, E.L and Verma, P.S. 2009. Invertebrate Zoology, S.Chand and Co. Ltd. New Delhi.
2. Ayyar, E.K and Ananthakrishnan, T.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. RastogiV.B. 2021. Invertebrate Zoology. Kedar Nath Ram Nath, Meerut
5. Lal S. S. (2019) Practical Zoology Invertebrates. Rastogi Publications, Meerut

Course Outcomes (CO):

At the end of the course, the students would be able to:

CO1 Learn about Kingdom Animalia

CO2 Learn about non-chordates

CO3 Describe unique characters and recognize life functions of phylum Annelida and Arthropoda

CO4 Describe unique characters and recognize life functions of phylum Mollusca, Echinodermata and Hemichordates

CO5 Understand the role of non-chordates in their surroundings.

Mapping: C24MDC129T and C24MDC129P

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**
CO1	S	S	M	M	S	S	M	S	M	S
CO2	S	M	S	M	S	S	W	M	M	S
CO3	M	S	M	M	S	S	M	S	S	S
CO4	M	S	M	M	S	M	M	S	M	M
CO5	S	M	S	W	M	M	S	S	S	S

S= strong M= medium W= weak

Zoology
Value added course (VAC)
Biodiversity and Wildlife Management (Semester-I/II)

Paper Code: C24VAC105T
30 Hrs (2Hrs/week) **External Marks: 35**
Credit: 2 **Internal Marks: 15**
Exam time: 2Hrs **Total Marks: 50**

Note: The examiner is required to set five questions in all. The first question will be compulsory consisting of five short questions covering the entire syllabus consisting of 3 marks each. In addition to this, four more questions (each question may be of 2 parts) will be set consisting of two questions from each unit. The student/candidate is required to attempt three questions in all selecting one question from each unit consisting of 10 marks each in addition to compulsory Question No. 1.

Unit-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).
Conservation of biodiversity: in-situ and ex-situ, Concept of Protected Area Systems, Important Protected Areas of India (Biosphere reserve, National Park & Wildlife sanctuaries).

Unit-II

Red Data Book and its uses, IUCN Categories of wildlife species, Climate change and loss of biodiversity.
Threats to biodiversity: habitat loss, poaching of wildlife, man-wildlife conflicts, Wildlife Tourism, Biosphere Reserves concept and Indian Biosphere Reserves, Location & Significance.

Suggested Readings:

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

Course Outcomes (CO):

At the end of the course, the students would be able to:
CO1 Understand about wildlife zones of India.
CO2 Explain the concept of protected area system.
CO3 Understand about IUCN categories.
CO4 Explain the mechanism of biodiversity threats.
CO5 Understand about understanding of wildlife management methods.

Mapping C24VAC105T

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**
CO1	S	S	S	W	S	M	M	S	M	S
CO2	M	M	S	W	S	W	W	S	M	S
CO3	W	M	S	W	M	W	M	S	W	M
CO4	M	M	S	W	S	W	M	S	M	M
CO5	S	M	S	W	M	W	S	S	S	S

S= strong M= medium W= weak

Zoology
Discipline Specific Course (DSC)
Animal Diversity-II (Semester-II)

Paper Code: C24ZOO201T/C24MIN243T
45 Hrs (3 Hrs/week) **External Marks: 50**
Credit: 3 **Internal Marks: 20**
Exam time: 2.5 Hrs **Total Marks: 70**

Note: The examiner is required to set nine questions in all. The first question will be compulsory consisting of five short questions covering the entire syllabus consisting of 2 marks each. In addition to this, eight more questions (each question of at least 2 parts) will be set consisting of two questions from each unit. The student/candidate is required to attempt five questions in all selecting one question from each unit in addition to compulsory Question No. 1. All questions will carry equal marks.

UNIT I

Chordates: Salient features of chordates, general characters of Protochordates and Urochordates.
Pisces: General characters and classification up to orderlevel, Scales & Fins, Type study of *Labeo*.

UNIT II

Amphibia: General characters and Classification upto order level, Type study of *Rana tigrana*, Parental Care in Amphibia.
Reptilia: General characters and Classification upto order level, Type study of *Hemidactylus*, Poison Apparatus and Biting mechanism of snakes, Key for the identification of Poisonous and Non- Poisonous snakes.

UNIT III

Aves: General characters and Classifications up to order level. Type study of *Columba livia*.

UNIT IV

Mammalia: General characters and classification up to order level; Type study of *Rattus rattus*.

Animal Diversity-II Lab

Paper Code: C24ZOO201P/C24MIN243P
30 Hrs (2 Hrs/week) **External Marks: 20**
Credit: 1 **Internal Marks: 10**
Exam time: 3 Hrs **Total Marks: 30**

Practical

1. Classification upto orders, habit, habitats, external characters and economic importance (if any):

- Protochordata: *Pyrosoma, Doliolum, Olikopleura,* and *Amphioxus*.
- Cyclostomata: *Myxine, Petromyzon* and *Ammocoetus* larva.
- Chondrichthyes: *Zygaena, Pristis, Narcine* (electric ray), *Trygon, Rhinobatus, Raja* and *Chimaera*.
- Osteichthyes: *Mystus, Catla, Hippocampus, Syngnathus, Exocoetus, Anabas, Diodon, Ostracion, Tetradon, Echinus, Lophius, Solea* and *Polypterus*.
- Amphibia: *Necturus, Proteus, Amphiuma, Salamandra, Ambystoma,* Axolotl larva, *Alytes, Bufo, Rana*.
- Reptilia: *Hemidactylus, Calotes, Draco, Varanus, 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*and*Halcyon.*
- Mammalia: *Ornithorhynchus, Echidna, Didelphis, Macropus, Loris, Macaque, Hystrix, Funambulus, Felix, Panthera, Canis, Herpestes, Capra*and*Pteropus.*

2. Study of the skeleton of *Scoliodon, Labeo, Rana* (Frog), *Varanus,* Pigeon and rat.

3. Study of the following permanent slides: *Tornaria* larva. Oikopleura, Histology of rat (compound tissues), different types of scales.

Note: Students/Candidates are required to obtain minimum passing marks separately in practical component and theory as per the University rules.

Suggested Readings:

1. KotpalR.L.Modern Textbook of Zoology
2. Jordan, E.L. and Verma. Chordate Zoology.
3. BarringtonE.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. Lal S. S. Practical Zoology Vertebrate

Course Outcomes (CO):

At the end of the course, the students would be able to:

At the end of the course, the students would be able to:

CO1 Describe unique characters and recognize life functions of Urochordates
CO2 Describe unique characters and recognize life functions of Pisces
CO3 Describe unique characters and recognize life functions of Amphibians & Reptiles
CO4 Describe unique characters and recognize life functions of Birds & Mammals
CO5 Identify the characters and classification of Chordates.

Mapping of CO's with PO's for **C24MIN243T/C24ZOO201 and C24MIN243P/C24ZOO201P**

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**
CO1	S	S	M	M	S	S	M	S	W	M
CO2	M	S	M	S	S	S	W	M	S	S
CO3	M	S	M	M	S	S	M	S	M	M
CO4	S	M	S	M	S	S	S	S	W	S
CO5	S	S	M	M	S	S	M	S	M	S

S= strong M= medium W= weak

Zoology
Minor course (MIC)
Introduction of Chordates (Semester-II)

Paper Code: C24MIC243T
30 Hrs (2Hrs/week) **External Marks: 35**
Credit: 2 **Internal Marks: 15**
Exam time: 2Hrs **Total Marks: 50**

Note: The examiner is required to set five questions in all. The first question will be compulsory consisting of five short questions covering the entire syllabus consisting of 3 marks each. In addition to this, four more questions (each question may be of 2 parts) will be set consisting of two questions from each unit. The student/candidate is required to attempt three questions in all selecting one question from each unit consisting of 10 marks each in addition to compulsory Question No. 1.

UNIT 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.

Cyclostomata: General characters and classification upto order level, Ecological significance of cyclostomes.

Pisces: General characters and classification up to sub-classes with examples emphasizing their biodiversity, Scales & Fins.

UNIT- II

Amphibia: General Characters and Classification upto order level, Parental Care and Neoteny in Amphibia.

Reptilia: General Characters and Classification upto order level, Extinct reptiles, Poisonous apparatus in snakes.

Aves: General Characters and classifications upto order level. Flight/Aerial adaptation in birds, Archaeopteryx as missing link.

Mammals: General Characters and classification up to order level, Adaptive radiations of mammals, dentition in mammals.

Suggested Readings:

1. Kotpal R. L. Modern Textbook of Zoology
2. Jordan, E.L. 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. Lal S. S. Practical Zoology Vertebrate.

Course Outcomes (CO):

At the end of the course, the students would be able to:

CO1 Describe unique characters of Protochordates.
CO2 Describe unique characters of Pisces.
CO3 Describe unique characters of Amphibians & Reptiles.
CO4 Describe unique characters of Birds & Mammals.
CO5 Identifying the characters and classification of Chordates.

Mapping: C24MIC243T

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**
CO1	S	M	S	M	S	M	M	S	W	M
CO2	M	S	M	S	S	M	M	S	S	S
CO3	S	S	S	M	S	S	S	S	M	M
CO4	S	M	S	M	S	M	M	S	W	S
CO5	S	S	M	M	M	M	W	M	M	S

S= strong M= medium W= weak

Zoology
Minor Course (MIN)
Animal Diversity-II (Semester-II)

Paper Code: C24MIN243T/C24ZOO201T

45 Hrs (3 Hrs/week) **External Marks: 50**
Credit: 3 **Internal Marks: 20**
Exam time: 2.5 Hrs **Total Marks: 70**

Note: The examiner is required to set nine questions in all. The first question will be compulsory consisting of five short questions covering the entire syllabus consisting of 2 marks each. In addition to this, eight more questions (each question of at least 2 parts) will be set consisting of two questions from each unit. The student/candidate is required to attempt five questions in all selecting one question from each unit in addition to compulsory Question No. 1. All questions will carry equal marks.

UNIT I

Chordates: Salient features of chordates, general characters of Protochordates and Urochordates.
Pisces: General characters and classification up to orderlevel, Scales & Fins, Type study of *Labeo*.

UNIT II

Amphibia: General characters and Classification upto order level, Type study of *Rana tigrana*, Parental Care in Amphibia.
Reptilia: General characters and Classification upto order level, Type study of *Hemidactylus*, Poison Apparatus and Biting mechanism of snakes, Key for the identification of Poisonous and Non- Poisonous snakes.

UNIT III

Aves: General characters and Classifications up to order level. Type study of *Columba livia*.

UNIT IV

Mammalia: General characters and classification up to order level; Type study of *Rattus rattus*.

Animal Diversity-II Lab

Paper Code: C24MIN243P/C24ZOO201P

30 Hrs (2 Hrs/week) **External Marks: 20**
Credit: 1 **Internal Marks: 10**
Exam time: 3 Hrs **Total Marks: 30**

Practical

1. Classification upto orders, habit, habitats, external characters and economic importance (if any):

- Protochordata: *Pyrosoma, Doliolum, Olikopleura,* and *Amphioxus*.
- Cyclostomata: *Myxine, Petromyzon* and *Ammocoetus* larva.
- Chondrichthyes: *Zygaena, Pristis, Narcine* (electric ray), *Trygon, Rhinobatus, Raja* and *Chimaera*.
- Osteichthyes: *Mystus, Catla, Hippocampus, Syngnathus, Exocoetus, Anabas, Diodon, Ostracion, Tetradon, Echinus, Lophius, Solea* and *Polypterus*.
- Amphibia: *Necturus, Proteus, Amphiuma, Salamandra, Ambystoma,* Axolotl larva, *Alytes, Bufo, Rana*.
- Reptilia: *Hemidactylus, Calotes, Draco, Varanus, 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*and*Halcyon.*
- Mammalia: *Ornithorhynchus, Echidna, Didelphis, Macropus, Loris, Macaque, Hystrix, Funambulus, Felix, Panthera, Canis, Herpestes, Capra*and*Pteropus.*

2. Study of the skeleton of *Scoliodon, Labeo, Rana* (Frog), *Varanus,* Pigeon and rat.

3. Study of the following permanent slides: *Tornaria* larva. Oikopleura, Histology of rat (compound tissues), different types of scales.

Note: Students/Candidates are required to obtain minimum passing marks separately in practical component and theory as per the University rules.

Suggested Readings:

1. KotpalR.L.Modern Textbook of Zoology
2. Jordan, E.L. and Verma. Chordate Zoology.
3. BarringtonE.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. Lal S. S. Practical Zoology Vertebrate

Course Outcomes (CO):

At the end of the course, the students would be able to:

CO1 Describe unique characters and recognize life functions of Urochordates
CO2 Describe unique characters and recognize life functions of Pisces
CO3 Describe unique characters and recognize life functions of Amphibians & Reptiles
CO4 Describe unique characters and recognize life functions of Birds & Mammals
CO5 Identifying the characters and classification of Chordates.

Mapping: C24MIN243T/C24ZOO201T and C24MIN243P/C24ZOO201P

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**
CO1	S	S	M	M	S	S	M	S	W	M
CO2	M	S	M	S	S	S	W	M	S	S
CO3	M	S	M	M	S	S	M	S	M	M
CO4	S	M	S	M	S	S	S	S	W	S
CO5	S	S	M	M	S	S	M	S	M	S

S= strong M= medium W= weak

Zoology
Skill Enhancement Course (SEC)
Fish Farming (Semester-II)

Paper Code: C24SEC231T
30 Hrs (2Hrs/week) **External Marks: 35**
Credit: 2 **Internal Marks: 15**
Exam time: 2Hrs **Total Marks: 50**

Note: The examiner is required to set five questions in all. The first question will be compulsory consisting of five short questions covering the entire syllabus consisting of 3 marks each. In addition to this, four more questions (each question may be of 2 parts) will be set consisting of two questions from each unit. The student/candidate is required to attempt three questions in all selecting one question from each unit consisting of 10 marks each in addition to compulsory Question No. 1.

Unit-I

General introduction: Definition of Fish, Fisheries, Aquaculture and Pisciculture, Significance of fish farming. Production, Utilization and Demand of Fish in India, General description of Capture and Culture Fisheries.

Culture fisheries and its types, Criteria for the selection of fish species for farming Important culturable Fishes in India, Identification of commercially important fish species, Basics of induced breeding in fishes.

Unit-II

Pond fish culture: Types, Design and construction of fish farming ponds, Maintenance of fish culture ponds, Ecology of Fish Pond ecosystem: Water quality (Physico-chemical and Biological) and Soil quality, Weeds of fish farming ponds and their control.

Nutrition of cultured fishes: Natural, supplementary and artificial feed, Nutrient composition and common dietary ingredients, By products of fish farming Industry, Methods of Fish harvesting and marketing, Common fish diseases and their control.

Fish Farming Lab

Paper Code: C24SEC231P
30 Hrs (2 Hrs/week) **External Marks: 15**
Credit: 2 **Internal Marks: 10**
Exam time: 3 Hrs **Total Marks: 25**

Practical

1. Identification of important fishes
2. Identification of developmental stages of fishes
3. Analysis of physical and chemical properties of water: (Temperature, pH, turbidity, salinity, total solids, dissolved oxygen, free carbon-di-oxide, hardness, Chlorides)
4. Study of aquatic weeds.
5. Study of crafts and gears.
6. Visit to fish farm and/or fish market and preparation of report.

Note: Students/Candidates are required to obtain minimum passing marks separately in practical component and theory as per the University rules.

Suggested Reading:

1. APHA (1995) Standard Methods of Examination of Water and Wastewater. American Public Health Association, AWWA, WCPF, Washington DC.
2. Bardach, J. E., Ryther and McLarney, Wo (1972) Aquaculture, New York: Wiley-Interscience. 896pp

3. Gupta, S.K. and Gupta, P.C. (2006) General & Applied Ichthyology: Fish and Fisheries. S Chand Publications, New Delhi
4. Jhingran V. G. (1983) Fish and Fisheries of India. Hindustan Publishing Corporation (India) 954 pp
5. Khanna, S.S. and Singh, H.R. (2014). Text book of Fish Biology and Fisheries 3rd ed. (PB) Narendra Publishing House, India

Course Outcomes (CO):

At the end of the course, the students would be able to:

CO1 Create awareness about food security, significance of protein in diet and will learn the skills to develop business enterprise

CO2 Learn about various methods and significance of fish farming

CO3 Learn identification of fish species using classical morphological methods

CO4 Acquainted about bye products of fish farming industry and fish health

CO5 Develop capability of identifying different species of fishes and will be trained for analysis of water quality and fish culture in ponds

Mapping: C24SEC231T and C24SEC231P

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**
CO1	W	W	M	W	W	M	W	S	S	S
CO2	S	S	S	M	S	M	M	S	S	S
CO3	S	M	M	W	S	W	W	M	M	S
CO4	M	W	S	W	W	M	M	S	S	M
CO5	M	W	S	W	M	W	M	S	S	S

S= strong M= medium W= weak

Zoology
Multi Disciplinary Course (MDC)
Basics of Zoology-II (Semester-II)

Paper Code: C24MDC229T
30 Hrs (2 Hrs/week) **External Marks: 35**
Credit: 2 **Internal Marks: 15**
Exam time: 2Hrs **Total Marks: 50**

Note: The examiner is required to set five questions in all. The first question will be compulsory consisting of five short questions covering the entire syllabus consisting of 3 marks each. In addition to this, four more questions (each question may be of 2 parts) will be set consisting of two questions from each unit. The student/candidate is required to attempt three questions in all selecting one question from each unit consisting of 10 marks each in addition to compulsory Question No. 1.

Unit-I

Basics of Chordates: Defined and Salient features of chordates, Difference between non chordates and chordates, Characteristic features of protochordates.

Pisces (Fishes): Characteristic features of freshwater and marine fishes, Edible fishes of India, Composite fish culture.

Class Amphibia: Characteristic features of amphibians, Parental care in amphibians, Role of amphibians in ecosystem, Identification of turtles and tortoise, Frog and Toad.

Unit-II

Class Reptilia: Characteristic Features of Reptiles, Common reptiles of India, Identification of Poisonous and non-poisonous snakes, Difference between Crocodile and Gharial.

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: Characteristic features and economic importance of mammals.

Basics of Zoology-II Lab

Paper Code: C24MDC229P
30Hrs (2 Hrs/week) **External Marks: 15**
Credit: 1 **Internal Marks:10**
Exam time: 3 Hrs **Total Marks:25**

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

Note: Students/Candidates are required to obtain minimum passing marks separately in practical component and theory as per the University rules.

Suggested Reading:

1. Kotpal R. L. Modern Textbook of Zoology
2. Jordan, E.L. 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. Lal S.S. Practical Zoology Vertebrate

Course Outcomes (CO):

At the end of the course, the students would be able to:

CO1 Learn the role of different groups of chordates in maintaining an equilibrium in our ecosystem

CO2 Identify local fish species and their role in the ecosystem.

CO Understand how the natural systems on which we depend function.

CO4 Give the idea about how birds are economically important.

CO5 Learn about identification of chordates.

Mapping of CO's with PO's for C24MDC229T and **C24MDC229P**

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**
CO1	S	M	S	M	S	M	M	S	W	M
CO2	S	M	M	M	S	M	M	S	S	S
CO3	S	S	S	S	S	S	S	S	M	M
CO4	M	S	S	M	S	M	M	S	W	S
CO5	S	S	M	W	M	M	W	M	M	S

S= strong M= medium W= weak