

Indira Gandhi University

Meerpur, Rewari



Scheme of Examination and Syllabus for

Under-Graduate Programme

Subject: Zoology

**Under Multiple Entry-Exit, Internship and CBCS-LOCF in
accordance to NEP-2020 w.e.f. 2024-25 (in phased manner)**

Department of Zoology, Indira Gandhi University, Meerpur, Rewari
Scheme of Examination for Under-Graduate Programme
Under Multiple Entry-Exit, Internship and CBCS-LOCF in accordance to NEP-2020 w.e.f. 2024-25
(in phased manner)

Semester-I									
Remarks	Course Type	Course Code	Course Nomenclature	Credits	Contact hours per week	Internal assessment	End term Marks	Maximum Marks	Exam Duration (Hours)
Scheme A, B & C	CC-1 MCC-1 4 credit	24L4.5-ZOO-101	Diversity of Non-Chordates	3	3	20	50	70	3
			Practical	1	2	10	20	30	4
Scheme C only	MCC-2 4 credit	24L4.5-ZOO-102	Type study of Non-chordates	3	3	20	50	70	3
			Practical	1	2	10	20	30	4
Scheme A & B	*CC-M1 2 credit	24L4.5-ZOO-103	Introduction of Non-Chordates	1	1	10	20	30	3
			Practical	1	2	5	15	20	4
Scheme A, B, C & D	MDC-1 3 credit	From Available pool of Multidisciplinary Courses from a subject of different discipline as per NEP							
Scheme C only	CC-M1 4 credit	From Available CC-M1 of 4 credits as per NEP							
Scheme A, B & C	AEC-1 2 credit	From Available pool of Ability Enhancement Courses as per NEP							
	SEC-1 3 credit	From Available pool of Skill Enhancement Courses as per NEP							
	VAC-1 2 credit	From Available pool of Value-Added Courses as per NEP							

MCC- Major Core Course

AEC- Ability Enhancement course

DSEC- Discipline Skill Enhancement Course

CC-M- Minor Course

SEC- Skill Enhancement Course

MDC- Multi Disciplinary Course

VAC- Value Added Course

***For Students who opt Zoology as a minor subject**

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Semester-II									
Remarks	Course Type	Course Code	Course Nomenclature	Credits	Contact hours per week	Internal assessment	End term Marks	Maximum Marks	Exam Duration (Hours)
Scheme A, B & C	CC-2 MCC-3 4 credit	24L4.5-ZOO-201	Diversity of Chordates	3	3	20	50	70	3
			Practical	1	2	10	20	30	4
Scheme C only	DSEC-1 4 credit	24L4.5-ZOO-202	Applied Zoology	3	3	20	50	70	3
			Practical	1	2	10	20	30	4
Scheme A & B	*CC-M2 2 credit	24L4.5-ZOO-203	Introduction of Chordates	1	1	10	20	30	3
			Practical	1	2	5	15	20	4
Scheme A,B,C & D	MDC-2 3 credit	From Available pool of Multidisciplinary Courses from a subject of different discipline as per NEP							
Scheme A, B & C	Internship	24L4.5-ZOO-204	Internship of 4 credits of 4-6 weeks duration after 2 nd Semester (Mandatory in case of exit)						
Scheme C only	CC-M2 4 credit	From Available CC-M2 of 4 credits as per NEP							
Scheme A, B & C	AEC-2 2 credit	From Available pool of Ability Enhancement Courses as per NEP							
	SEC-2 3 credit	From Available pool of Skill Enhancement Courses as per NEP							
	VAC-2 2 credit	From Available pool of Value-Added Courses as per NEP							

MCC- Major Core Course

AEC- Ability Enhancement course

DSEC- Discipline Skill Enhancement Course

CC-M- Minor Course

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MDC- Multi Disciplinary Course

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***For Students who opt Zoology as a minor subject**

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Semester-III									
Remarks	Course Type	Course Code	Course Nomenclature	Credits	Contact hours per week	Internal assessment	End term Marks	Maximum Marks	Exam Duration (Hours)
Scheme A, B & C	CC-3 MCC-4 4 credit	24L5.0-ZOO-301	Cell Biology and Animal Genetics	3	3	20	50	70	3
			Practical	1	2	10	20	30	4
Scheme B & C	MCC-5 4 credit	24L5.0-ZOO-302	Type study of chordates	3	3	20	50	70	3
			Practical	1	2	10	20	30	4
Scheme B only	MCC-2 4 credit	24L5.0-ZOO-102	Type study of Non-chordates	3	3	20	50	70	3
			Practical	1	2	10	20	30	4
Scheme A, B, C & D	MDC-3 3 credit	From Available pool of Multidisciplinary Courses from a subject of different discipline as per NEP							
Scheme A & C only	CC-M3 4 credit	From Available CC-M3 of 4 credits as per NEP							
Scheme B only	CC-M3(V) 4 credit	From Available pool of Minor (Vocational) courses VOC-1							
Scheme A, B & C	AEC-3 2 credit	From Available pool of Ability Enhancement Courses as per NEP							
	SEC-3 3 credit	From Available pool of Skill Enhancement Courses as per NEP							
Scheme C only	VAC-3 2 credit	From Available pool of Value-Added Courses as per NEP							

MCC- Major Core Course

AEC- Ability Enhancement course

DSEC- Discipline Skill Enhancement Course

CC-M (V)- Minor (Vocational) Course

SEC- Skill Enhancement Course

MDC- Multi Disciplinary Course

VAC- Value Added Course

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Semester-IV									
Remarks	Course Type	Course Code	Course Nomenclature	Credits	Contact hours per week	Internal assessment	End term Marks	Maximum Marks	Exam Duration (Hours)
Scheme A, B & C	CC-4 MCC-6 4 credit	24L5.0-ZOO-401	Biomolecules and Mammalian Physiology	3	3	20	50	70	3
			Practical	1	2	10	20	30	4
Scheme B & C	MCC-7 4 credit	24L5.0-ZOO-402	Aquaculture	3	3	20	50	70	3
			Practical	1	2	10	20	30	4
Scheme B & C	MCC-8 4 credit	24L5.0-ZOO-403	Pest Management	3	3	20	50	70	3
			Practical	1	2	10	20	30	4
Scheme B & C	DSE-1 4 credit (Select one option)	24L5.0-ZOO-404	Biodiversity and Wildlife Management	3	3	20	50	70	3
			Practical	1	2	10	20	30	4
		24L5.0-ZOO-405	Cytogenetics	3	3	20	50	70	3
			Practical	1	2	10	20	30	4
Scheme A, B & C	Internship	24L5.0-ZOO-406	Internship of 4 credits of 4-6 weeks duration after 4 th Semester (Mandatory in case of exit if not done in 2 nd Semester)						
Scheme A, B & C	CC-M4 (V) 4 credit	From Available pool of Minor (Vocational) courses VOC-2							
	AEC-4 2 credit	From Available pool of Ability Enhancement Courses as per NEP							
Scheme C only	VAC-4 2 credit	From Available pool of Value-Added Courses as per NEP							
Scheme A & B	VAC-3 2 credit	From Available pool of Value-Added Courses as per NEP							

MCC- Major Core Course
VAC- Value Added Course

CC-M (V) – Minor (Vocational) Course
DSE- Discipline Specific Elective Course

AEC- Ability Enhancement course

*** Note: - Internship of 4 credits of 4-6 weeks duration after 4th Semester if not done in 2nd Semester
(If want to exit) Under Graduate Diploma in Basic Life-Sciences/ Basic Zoology with 96 credits (Scheme A), 100 credits (Scheme B) and 94 credits (Scheme C)**

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Semester-V									
Remarks	Course Type	Course Code	Course Nomenclature	Credits	Contact hours per week	Internal assessment	End term Marks	Maximum Marks	Exam Duration (Hours)
Scheme A, B & C	CC-5 MCC-9 4 credit	24L5.5-ZOO-501	Ecology and Environment	3	3	20	50	70	3
			Practical	1	2	10	20	30	4
Scheme B & C	MCC-10 4 credit	24L5.5-ZOO-502	Animal Taxonomy	3	3	20	50	70	3
			Practical	1	2	10	20	30	4
Scheme B & C	DSE-2 4 credit (Select one option)	24L5.5-ZOO-503	Animal Behaviour and chronobiology	3	3	20	50	70	3
			Practical	1	2	10	20	30	4
		24L5.5-ZOO-504	Comparative Anatomy of Vertebrates	3	3	20	50	70	3
			Practical	1	2	10	20	30	4
Scheme B & C	DSE-3 4 credit (Select one option)	24L5.5-ZOO-505	Biology of Insects	3	3	20	50	70	3
			Practical	1	2	10	20	30	4
		24L5.5-ZOO-506	Parasitology	3	3	20	50	70	3
			Practical	1	2	10	20	30	4
Scheme A, B & C	Internship 4 credit	24L5.5-ZOO-507	Internship of 4 credits of 4-6 weeks duration after 4 th Semester (if not done in 2 nd Semester 4 th Semester)						
Scheme A & C	CC-M5 (V) 4 credit	From Available pool of Minor (Vocational) courses VOC-1							

MCC- Major Core Course

CC-M (V) – Minor (Vocational) Course

DSE- Discipline Specific Elective Course

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Semester-VI									
Remarks	Course Type	Course Code	Course Nomenclature	Credits	Contact hours per week	Internal assessment	End term Marks	Maximum Marks	Exam Duration (Hours)
Scheme A, B & C	CC-6 MCC-11 4 credit	24L5.5-ZOO-601	Developmental Biology and Evolution	3	3	20	50	70	3
			Practical	1	2	10	20	30	4
Scheme B & C	MCC-12 4 credit	24L5.5-ZOO-602	Basics of Endocrinology and Immunology	3	3	20	50	70	3
			Practical	1	2	10	20	30	4
Scheme B & C	DSE-4 4 credit (Select one option)	24L5.5-ZOO-603	Reproductive Physiology	3	3	20	50	70	3
			Practical	1	2	10	20	30	4
		24L5.5-ZOO-604	Neurophysiology	3	3	20	50	70	3
			Practical	1	2	10	20	30	4
Scheme B & C	DSE-5 4 credit (Select one option)	24L5.5-ZOO-605	Molecular Biology	3	3	20	50	70	3
			Practical	1	2	10	20	30	4
		24L5.5-ZOO-606	Forensic Biology	3	3	20	50	70	3
			Practical	1	2	10	20	30	4
Scheme A only	CC-M6 4 credit	From Available CC-M6 of 4 credits as per NEP							
Scheme B only	CC-M5(V) 4 credit	From Available pool of Minor (Vocational) courses VOC-3							
Scheme C only	CC-M6 (V) 4 credit	From Available pool of Minor (Vocational) courses VOC-3							
Scheme A only	CC-M7 (V) 4 credit	From Available pool of Minor (Vocational) courses VOC-3							
Scheme C only	SEC-4 2 credit	From Available pool of Skill Enhancement Courses as per NEP							

MCC- Major Core Course

CC-M (V) – Minor (Vocational) Course

SEC- Skill Enhancement Course

DSE- Discipline Specific Elective Course

Department of Zoology, Indira Gandhi University, Meerpur, Rewari
Scheme of Examination for Under-Graduate Programme
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Semester-VII (For Honours/Honours with Research in Zoology)									
Remarks	Course Type	Course Code	Course Nomenclature	Credits	Contact hours per week	Internal assessment	End term Marks	Maximum Marks	Exam Duration (Hours)
For Honours in Zoology/Honours with Research in Zoology Scheme B & C	CC-H1 4 credit	24L6.0-ZOO-701	Advances of Cell Biology	4	4	30	70	100	3
	CC-H2 4 credit	24L6.0-ZOO-702	Biochemistry and Biotechniques	4	4	30	70	100	3
	CC-H3 4 credit	24L6.0-ZOO-703	Structure and Function of Invertebrates	4	4	30	70	100	3
	DSE-H1 4 credit Select one option	24L6.0-ZOO-704	Biosystematics and Biostatistics	4	4	30	70	100	3
		24L6.0-ZOO-705	Computational Biology	4	4	30	70	100	3
	PC-H1 4 credit	24L6.0-ZOO-706	Practical Based on B24-ZOO-701 to B24-ZOO-703 and any one out of B24-ZOO-704 & 705	4	8	30	70	100	6
	CC-HM1 4 credit	From Available Core Courses in Minor Subject of 4 credits as per NEP							

CC-H- Core Course (Honours) PC-H- Practical (Honours)
CC-HM- Core Course (Honours Minor)

DSE-H- Discipline Specific Elective Course (Honours)

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Semester-VIII (For Honours in Zoology)									
Remarks	Course Type	Course Code	Course Nomenclature	Credits	Contact hours per week	Internal assessment	End term Marks	Maximum Marks	Exam Duration (Hours)
Honours in Zoology Scheme B & C	CC-H4 4 credit	24L6.0-ZOO-801	Structure and Function of Vertebrates	4	4	30	70	100	3
	CC-H5 4 credit	24L6.0-ZOO-802	Comparative Physiology	4	4	30	70	100	3
	CC-H6 4 credit	24L6.0-ZOO-803	Population Genetics & Evolution	4	4	30	70	100	3
	DSE-H2 4 credit Select one option	24L6.0-ZOO-804	Population and Community Ecology	4	4	30	70	100	3
		24L6.0-ZOO-805	Environment and Public Health	4	4	30	70	100	3
	PC-H2 4 credit	24L6.0-ZOO-806	Practical Based on B24-ZOO-801 to B24-ZOO-803 and any one out of B24-ZOO-804 & 805	4	8	30	70	100	6
	CC-HM2 4 credit	From Available CC-HM of 4 credits as per NEP							

CC-H- Core Course (Honours)

PC-H- Practical (Honours)

DSE- Discipline Specific Elective Course

CC-HM- Core Course (Honours Minor)

Semester-VIII (For Honours with Research in Zoology)									
Remarks	Course Type	Course Code	Course Nomenclature	Credits	Contact hours per week	Internal assessment	End term Marks	Maximum Marks	Exam Duration (Hours)
Honours with Research in Zoology Scheme B & C	CC-H4 4 credit	24L6.0-ZOO-801	Structure and Function of Vertebrates	4	4	30	70	100	3
	CC-H5 4 credit	24L6.0-ZOO-802	Comparative Physiology	4	4	30	70	100	3
	Project/ Dissertation 12 credit	24L6.0-ZOO-807	Project/Dissertation	8+4	-	-	-	-	-
	CC-HM2 4 credit	From Available CC-HM of 4 credits as per NEP							

CC-H- Core Course (Honours)

CC-HM- Core Course (Honours Minor)

Scheme of Examination for *VAC/VOC/SEC/ MDC* Courses Offered by Department of Zoology

(Subject to change as per university norms)

Semester	Scheme	Course Type	Course Code	Nomenclature of Paper	Credits (L+T+P)	Contact Hours	Total Marks (Int+Ext)	Max. Marks	Duration of exam (Hrs)
3 rd	Scheme C only	VAC-3	24L5.0-VAC-ZOO-301	India Biodiversity	2+0+0	2	15+35	50	3
4 th	Scheme A & B	VAC-3	24L5.0-VAC-ZOO-301	India Biodiversity	2+0+0	2	15+35	50	3
	Scheme C only	VAC-4	24L5.0-VAC-ZOO-401	Ecology and Environment	2+0+0	2	15+35	50	3
3 rd	Scheme B only	VOC-1	24L5.0-VOC-ZOO-301	Apiculture	2+0+2	2	15+35	50	3
						4	15+35	50	4
4 th	Scheme A, c & D	VOC-1	24L5.0-VOC-ZOO-401	Vermicomposting	2+0+2	2	15+35	50	3
	Scheme B	VOC-2				4	15+35	50	4
5 th	Scheme A/C/D	VOC-2	24L5.5-VOC-ZOO-501	Apiculture	2+0+2	2	15+35	50	3
						4	15+35	50	4
6 th	Scheme A/B/C/D	VOC-3	24L5.5-VOC-ZOO-601	Poultry Farming	2+0+2	2	15+35	50	3
						4	15+35	50	4

			24L5.5-VOC-ZOO-602	Fish Farming	2+0+2	2	15+35	50	3
						4	15+35	50	4
2nd	Scheme A, B & C	SEC-2	24L4.5-SEC-ZOO-201	Taxidermy	2+0+1	2	15+35	50	3
						2	5+20	25	4
			24L4.5-SEC-ZOO-202	Techniques in Bird Watching	2+0+1	2	15+35	50	3
						2	5+20	25	4
			24L4.5-SEC-ZOO-203	Camera Trapping in Wildlife Studies	2+0+1	2	15+35	50	3
						2	5+20	25	4
3rd	Scheme A, B & C	SEC-3	24L5.0-SEC-ZOO-301	Microtomy	2+0+1	2	15+35	50	3
						2	5+20	25	4
1st	Scheme A, B,C & D	MDC-1	24L4.5-MDC-ZOO101	Basics of Zoology-I	2+0+1	2	15+35	50	3
						2	5+20	25	4
2nd	Scheme A, B,C & D	MDC-2	24L4.5-MDC-ZOO201	Basics of Zoology-II	2+0+1	2	15+35	50	3
						2	5+20	25	4
3rd	Scheme A, B,C & D	MDC-3	24L4.5-MDC-ZOO301	Basics of Zoology-III	2+0+1	2	15+35	50	3
						2	5+20	25	4

VAC-VALUE ADDED COURSE

SEC-SKILL ENHANCEMENT COURSE

VOC-VOCATIONAL COURSE

MDC – MULTIDISCIPLINARY COURSE

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, B & C	CC-1 MCC-1 4 credit	24L4.5-ZOO-101	Diversity ofNon-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 (if any): 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 <i>Plasmodium</i> Phylum Porifera: General characters and classification up to class level, Type study of <i>Sycon</i>							12	
II	Phylum – Coelentrata: General characters and classification up to class level Type Study of <i>Obelia</i> Phylum – Platyhelminthes and Aschelminthes: General characters and classification up to class level, Type study of Liver Fluke, <i>Fasciola hepatica</i>							11	
III	Phylum – Annelida: General characters and classification up to class level, Type study of Earthworm, <i>Pheretima posthuma</i> (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, <i>Periplaneta americana</i> (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 <i>Pila</i> Phylum – Echinodermata: General characters and classification up to class level, Type study of <i>Asterias</i> (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 <i>Amoeba</i> , <i>Euglena</i> and <i>Paramecium</i> ; permanent prepared slides: <i>Amoeba</i> , <i>Euglena</i> , <i>Trypanosoma</i> , <i>Noctiluca</i> , <i>Eimeria</i> , <i>Paramecium</i> (binary fission and conjugation), <i>Opalina</i> , <i>Vorticella</i> , <i>Balantidium</i> , <i>Nyctotherus</i> , radiolarian and formaniferan ooze. 2. Parazoa (Porifera): <i>Sycon</i> , <i>Grantia</i> , <i>Euplectella</i> , <i>Hyalonema</i> , <i>Spongilla</i> , <i>Euspongia</i> 3. Coelenterata: <i>Porpiita</i> , <i>Valella</i> , <i>Physalia</i> , <i>Aurelia</i> , <i>Rhizostoma</i> , <i>Metridium</i> , <i>Millipora</i> , <i>Alcyonium</i> , <i>Tubipora</i> , <i>Zoanthus</i> , <i>Madrepora</i> , <i>Favia</i> , <i>Fungia</i> , and <i>Astrea</i> . Permanent prepared slides: <i>Hydra</i> (W.M.), <i>Hydra</i> with buds, <i>Obelia</i> (colony and medusa), <i>Sertularia</i> , <i>Plumularia</i> , <i>Tubularia</i> , <i>Bougainvillea</i> , <i>Aurelia</i> (sense organs and stages of life history). 4. Playhelminthes: <i>Dugesia</i> , <i>Fasciola</i> , <i>Taenia</i> , <i>Echinocoecus</i> . Permanent prepared slides: <i>Miracidium</i> , <i>Sporocyst</i> , <i>Redia</i> , <i>Cercaria</i> , <i>Scolex</i> and <i>Proglotttids of Taenia</i> (mature and gravid). 5. Aschelminthes: <i>Ascaris</i> (male and female), <i>Trichinella</i> , <i>Ancylostoma</i> , <i>Meloidogyne</i> 6. Annelida: <i>Pheretima</i> , <i>Heteronereis</i> , <i>Polynoe</i> , <i>Aphrodite</i> , <i>Chaetopterus</i> , <i>Arenicola</i> , <i>Tubifex</i> and <i>Pontobdella</i> 7. Arthropoda: <i>Peripatus</i> , <i>Palaemon</i> (Prawn), <i>Lobster</i> , <i>Cancer</i> (crab), <i>Sacculina</i> , <i>Eupagurus</i> (hermit crab), <i>Lepas</i> , <i>Balanus</i> , <i>Cyclops</i> , <i>Daphnia</i> , <i>Lepisma</i> , <i>Periplaneta</i> (cockroach), <i>Schistocerca</i> (locust), <i>Poecilocerus</i> (ak-							30	

	hopper), <i>Gryllus</i> (cricket), <i>Mantis</i> (praying mantis), <i>Cicada</i>, <i>Forticula</i> (earwig), Dragon fly, termite queen, bug, moth, beetle, <i>Polistes</i> (wasp), <i>Apis</i> (honey bee), <i>Bombyx</i> (silk moth), <i>Cimex</i> (beg bug), <i>Pediculus</i> (body louse), <i>Millipede</i>, <i>Scolopendra</i> (centipede), <i>Palamnaeus</i> (scorpion), <i>Aranea</i> (spider), <i>Limulus</i> (king crab) 8. Mollusca: <i>Mytilus</i>, <i>Ostrea</i>, <i>Cardium</i>, <i>Pholas</i>, <i>Solen</i> (razor/Fish), <i>Pecten</i>, <i>Holiotis</i>, <i>Patella</i>, <i>Aplysia</i>, <i>Doris</i>, <i>Limax</i>, <i>Loligo</i>, <i>Sepia</i>, <i>Octopus</i>, <i>Nautilus</i> (complete and T.S.), <i>Chiton</i> and <i>Dentalium</i> 9. Echinodermata: <i>Asterias</i>, <i>Echinus</i>, <i>Cucumaia</i>, <i>Ophiothrix</i>, <i>Antedon</i> and <i>Asterophyton</i> 10. Hemichordata: <i>Balanoglossus</i> 11. Study of slides of Non-Chordates phyla; Staining of <i>Obelia</i> and <i>Sertularia</i>	
Suggested Evaluation Methods		
Internal Assessment: ➤ 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. 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	24L4.5-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 (if any): 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 <i>Paramecium</i> 2. Student will be able to describe Type study of <i>Ascaris</i> 3. Student will be able to describe about Annelids and Arthropods 4. Student will be able to describe Type study of <i>Balanoglossus</i> 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: Biodiversity and economic importance of Protozoans; Type study of <i>Amoeba</i> , <i>Paramecium</i> 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 <i>Ascaris lumbricoides</i> 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 <i>Peripatus</i>							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 <i>Balanoglossus</i>							11	
V Practical	Study of the following permanent stained preparations: 1. L.S. and T.S. <i>Sycon</i> ; gemmules, spicules and spongin fibres of <i>Sycon</i> , canal system of sponges 2. T.S. <i>Hydra</i> (testis and ovary region) 3. T.S. <i>Fasciola</i> (different regions) 4. T.S. <i>Ascaris</i> (male and female) 5. T.S. <i>Pheretima</i> (pharyngeal and typhlosolar regions), Setae, septal nephridia and spermathecae of <i>Pheretima</i> . 6. Trachea and mouthparts of cockroach. 7. Statocyst of <i>Palaemon</i> . 8. Glochidium larva of <i>Anodonta</i> ; radula and osphradium of <i>Pila</i> . 9. T.S. Star fish (arm). 10. T.S. <i>Balanoglossus</i> (through various regions).							30	

	Preparation of the following slides: 1. Temporary preparation of <i>Volvo</i>, <i>Paramecium</i>, Gemmules and spicules of <i>Sycon</i>; mouth parts and trachea of <i>Periplaneta</i> (cockroach). 2. Preparation of permanent stained whole mounts of <i>Hydra</i>, <i>Obelia</i>, <i>Sertularia</i>, <i>Plumularia</i> and <i>Bougainvillea</i>. 3. Preparation of mouth parts of Mosquito, House fly and cockroach. Study of Internal Anatomy 1. Computer, simulated study/ model of: (i) <i>Earthworm</i>: Digestive, reproductive and nervous systems (ii) <i>Pila</i> : Pallial complex, digestive and nervous system 2. Demonstration of internal anatomy of cockroach: Digestive, reproductive and nervous systems	
Suggested Evaluation Methods		
Internal Assessment: ➤ 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. 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 & B	CC-M1 2 credit	24L4.5-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 (if any): NA									
Course Learning Outcomes (CLO) 1. Student will be able to understand about phylum Protozoa and Porifera 2. Student will be able to understand about phylum Coelenterata and Helminthes 3. Student will be able to understand about phylum Annelida and Arthropoda 4. Student will be able to understand about phylum Mollusca, Echinodermata and Hemichordates 5. Students will be capable of identifying the characters and classification of Non-Chordates									
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: <i>Amoeba</i> , <i>Euglena</i> , <i>Trypanosoma</i> , <i>Noctiluca</i> , <i>Eimeria</i> , <i>Paramecium</i> (binary fission and conjugation), <i>Opalina</i> , <i>Vorticella</i> , <i>Balantidium</i> , <i>Nyctotherus</i> , radiolarian and formaniferan ooze. 2. Porifera: <i>Sycon</i> , <i>Grantia</i> , <i>Euplectella</i> , <i>Hyalonema</i> , <i>Spongilla</i> , <i>Euspongia</i> 3. Coelenterata: <i>Porpita</i> , <i>Valella</i> , <i>Physalia</i> , <i>Aurelia</i> , <i>Rhizostoma</i> , <i>Metridium</i> , <i>Millipora</i> , <i>Alcyonium</i> , <i>Tubipora</i> , <i>Zoanthus</i> , <i>Madrepora</i> , <i>Favia</i> , <i>Fungia</i> , and <i>Astrea</i> . Permanent slides of <i>Hydra</i> (W.M.), <i>Hydra</i> with buds, <i>Obelia</i> (colony and medusa), <i>Sertularia</i> , <i>Plumularia</i> , <i>Tubularia</i> , <i>Bougainvillea</i> , <i>Aurelia</i> . 4. Playhelminthes: <i>Dugesia</i> , <i>Fasciola</i> , <i>Taenia</i> , <i>Echinocoecus</i> . Permanent prepared slides: <i>Miracidium</i> , <i>Sporocyst</i> , <i>Redia</i> , <i>Cercaria</i> , <i>Scolex</i> and <i>Proglottids of Taenia</i> (mature and gravid). Aschelminthes: <i>Ascaris</i> (male and female), <i>Trichinella</i> , <i>Ancylostoma</i> , <i>Meloidogyne</i> 5. Annelida: <i>Pheretima</i> , <i>Heteronereis</i> , <i>Polynoe</i> , <i>Aphrodite</i> , <i>Chaetopterus</i> , <i>Arenicola</i> , <i>Tubifex</i> and <i>Pontobdella</i> 6. Arthropoda: <i>Peripatus</i> , <i>Palaemon</i> (Prawn), <i>Lobster</i> , <i>Cancer</i> (Crab), <i>Sacculina</i> , <i>Eupagurus</i> (Hermit crab), <i>Lepas</i> , <i>Balanus</i> , <i>Cyclops</i> , <i>Daphnia</i> , <i>Lepisma</i> , <i>Periplaneta</i> (cockroach), <i>Schistocerca</i> (Locust), <i>Poecilocerus</i> (ak- hopper), <i>Gryllus</i> (cricket), <i>Mantis</i> (praying mantis), <i>Cicada</i> , <i>Forticula</i> (earwig), Dragon fly, termite queen, bug, moth, beetle, <i>Polistes</i> (wasp), <i>Apis</i> (Honey bee), <i>Bombyx</i> (Silk moth), <i>Cimex</i> (Bed bug), <i>Pediculus</i> (Head louse), <i>Millipede</i> , <i>Scolopendra</i> (centipede), <i>Palamnaeus</i> (scorpion), <i>Aranea</i> (spider), <i>Limulus</i> (king crab) 7. Mollusca: <i>Mytilus</i> , <i>Ostrea</i> , <i>Cardium</i> , <i>Pholas</i> , <i>Solen</i> (razor / Fish), <i>Pecten</i> , <i>Holiotis</i> , <i>Patella</i> , <i>Aplysia</i> , <i>Doris</i> , <i>Limax</i> , <i>Loligo</i> , <i>Sepia</i> , <i>Octopus</i> , <i>Nautilus</i> (complete and T.S.), <i>Chiton</i> and <i>Dentalium</i> 8. Echinodermata: <i>Asterias</i> , <i>Echinus</i> , <i>Cucumaia</i> , <i>Ophiothrix</i> , <i>Antedon</i> and <i>Asterophyton</i> 9. Hemichordata: <i>Balanoglossus</i>							30	
Suggested Evaluation Methods									
Internal Assessment: ➤ 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-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,B & C	CC-2 MCC-3 4 credit	24L4.5-ZOO-201	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 (if any): 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 <i>Labeo</i>							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, <i>Archaeopteryx</i> 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: <i>Molqula</i>, <i>Hetryllus</i>, <i>Pyrosoma</i>, <i>Doliolum</i>, <i>Olikopleura</i>, and <i>Amphioxus</i>. • Cyclostomata: <i>Myxine</i>, <i>Petromyzon</i> and <i>Ammocoetus</i> larva. • Chondrichthyes: <i>Zygaena</i>, <i>Pristis</i>, <i>Narcine</i> (electric ray), <i>Trygon</i>, <i>Rhinobatus</i>, <i>Raja</i> and <i>Chimaera</i>. • Osteichthyes: <i>Acipenser</i>, <i>Lepidosteus</i>, <i>Muraena</i>, <i>Mystus</i>, <i>Catla</i>, <i>Hippocampus</i>, <i>Syngnathus</i>, <i>Exocoetus</i>, <i>Anabas</i>, <i>Diodon</i>, <i>Ostracion</i>, <i>Tetradon</i>, <i>Echinus</i>, <i>Lophius</i>, <i>Solea</i> and <i>Polypterus</i>. Any of the Lung Fishes. • Amphibia: <i>Necturus</i>, <i>Proteus</i>, <i>Amphiuma</i>, <i>Salamandra</i>, <i>Ambystoma</i>, <i>Axolotl</i> larva, <i>Alytes</i>, <i>Bufo</i>, <i>Rana</i>. • Reptilia: <i>Hemidactylus</i>, <i>Calotes</i>, <i>Draco</i>, <i>Varanus</i>, <i>Phrynosoma</i>, <i>Chamaeleon</i>, <i>Typhlops</i>, <i>Python</i>, <i>Eryx</i>, <i>Ptyas</i>, <i>Bungarus</i>, <i>Naja</i>, <i>Hydrus</i>, <i>Viper</i>, <i>Crocodilus</i>, <i>Gavialis</i>, <i>Chelone</i> (Turtle) and <i>Testudo</i> (Tortoise). • Aves: <i>Casuaris</i>, <i>Arden</i>, <i>Anas</i>, <i>Milvus</i>, <i>Pavo</i>, <i>Eudynamis</i>, <i>Tyto</i>, <i>Alcedo</i>, <i>Halcyon</i> • Mammalia: <i>Ornithorhynchus</i>, <i>Echidna</i>, <i>Didelphis</i>, <i>Macropus</i>, <i>Loris</i>, <i>Macaque</i>, <i>Hystrix</i>, <i>Funambulus</i>, <i>Felix</i>, <i>Panthera</i>, <i>Canis</i>, <i>Herpestes</i>, <i>Capra</i>, <i>Pteropus</i>. 2. Study of the skeleton of <i>Scoliodon</i> , <i>Labeo</i> , <i>Rana</i> (Frog), <i>Varanus</i> , Pigeon or Gallus and <i>Orcyctolagus</i> /rat. 3. Study of the following permanent slides: Tornaria larva, T.S. <i>Amphioxus</i> (through different regions). Oikopleura, Histology of rat (compound tissues), different types of scales. 4. Make permanent stained preparations of the following: <i>Salpa</i> , Spicules, and Pharynx of <i>Herdmania</i> , <i>Amphioxus</i> , Cycloid scales 5. Field Visit to Protected areas/National Park/Wildlife Sanctuary or Zoo.							30	
Suggested Evaluation Methods									
Internal Assessment: ➤ 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, Edinburgh. 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	24L4.5-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 (if any): 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									
Internal Assessment: ➤ 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 & B	CC-M2 2 credit	24L4.5-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 (if any): NA									
Course Learning Outcomes (CLO) 1. Student will be able to describe unique characters of Protochordates 2. Student will be able to describe unique characters of Pisces 3. Student will be able to describe unique characters of Amphibians & Reptiles 4. Student will be able to describe unique characters of Birds & Mammals 5. Students will be capable of identifying the characters and classification of Chordates									
Instructions for Paper-Setter 1. Nine questions will be set in all. All questions will carry equal marks. 2. Question No. 1, which will be short answer type covering the entire syllabus, will be compulsory. The remaining eight questions will be set unit wise selecting two questions from each Unit I to IV. The candidate will be required to attempt question No. 1 and four more questions selecting one question from each unit.									
UNIT	TOPICS							CONTACT HOURS	
I	Chordates: Salient features of chordates; Principles of classification; Origin and evolutionary tree of chordates Protochordates: Urochordata & Cephalochordates: Systematic position, distribution, ecology, morphology and affinities							4	
II	Cyclostomata: General characters and classification 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, <i>Archaeopteryx</i> 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: <i>Molgula</i>, <i>Hetryllus</i>, <i>Pyrosoma</i>, <i>Doliolum</i>, <i>Olikopleura</i>, and <i>Amphioxus</i>. - Cyclostomata: <i>Myxine</i>, <i>Petromyzon</i> and <i>Ammocoetus</i> larva. - Chondrichthyes: <i>Zygaena</i>, <i>Pristis</i>, <i>Narcine</i> (electric ray), <i>Trygon</i>, <i>Rhinobatus</i>, <i>Raja</i> and <i>Chimaera</i>. - Osteichthyes: <i>Acipenser</i>, <i>Lepidosteus</i>, <i>Muraena</i>, <i>Mystus</i>, <i>Catla</i>, <i>Hippocampus</i>, <i>Syngnathus</i>, <i>Exocoetus</i>, <i>Anabas</i>, <i>Diodon</i>, <i>Ostracion</i>, <i>Tetradon</i>, <i>Echinus</i>, <i>Lophius</i>, <i>Solea</i> and <i>Polypterus</i>. Any of the Lung Fishes. - Amphibia: <i>Necturus</i>, <i>Proteus</i>, <i>Amphiuma</i>, <i>Salamandra</i>, <i>Amblystoma</i>, <i>Axolotl</i> larva, <i>Alytes</i>, <i>Bufo</i>, <i>Rana</i>. - Reptilia: <i>Hemidactylus</i>, <i>Calotes</i>, <i>Draco</i>, <i>Varanus</i>, <i>Phrynosoma</i>, <i>Chamaeleon</i>, <i>Typhlops</i>, <i>Python</i>, <i>Eryx</i>, <i>Ptyas</i>, <i>Bungarus</i>, <i>Naja</i>, <i>Hydrus</i>, <i>Viper</i>, <i>Crocodilus</i>, <i>Gavialis</i>, <i>Chelone</i> (Turtle) and <i>Testudo</i> (Tortoise). - Aves: <i>Casuaris</i>, <i>Arden</i>, <i>Anas</i>, <i>Milvus</i>, <i>Pavo</i>, <i>Eudynamis</i>, <i>Tyto</i>, <i>Alcedo</i>, <i>Halcyon</i> - Mammalia: <i>Ornithorhynchus</i>, <i>Echidna</i>, <i>Didelphis</i>, <i>Macropus</i>, <i>Loris</i>, <i>Macaque</i>, <i>Hystrix</i>, <i>Funambulus</i>, <i>Felix</i>, <i>Panthera</i>, <i>Canis</i>, <i>Herpestes</i>, <i>Capra</i>, <i>Pteropus</i>. 2. Study of the skeleton of <i>Scoliodon</i> , <i>Labeo</i> , <i>Rana</i> (Frog), <i>Varanus</i> , Pigeon or <i>Gallus</i> and <i>Orcyctolagus</i> /rat, Palates of birds, skulls of dog & rabbit. 3. Study of the following prepared slides: Tornaria larva, T.S. <i>Amphioxus</i> (through different regions). Oikopleura, Histology of rat (compound tissues), different types of scales. 4. Make permanent stained preparations of the following: <i>Salpa</i> , Spicules, and Pharynx of <i>Herdmania</i> , <i>Amphioxus</i> , Cycloid scales 5. Field Visit to National Park or Zoo.							30	
Suggested Evaluation Methods									
Internal Assessment: ➤ 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, Edinburgh. 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	24L5.0-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 (if any): 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 errors and other genetic disorder and will be able to give counseling to general people 4. Students will be able to explain the concept of gene interactions, Sex linked inheritance and their role in medical sciences. 5. Students will be able to conduct the morphomatric analysis of chromosomes and demonstrate cell division									
Instructions for Paper-Setter 1. Nine questions will be set in all. All questions will carry equal marks. 2. 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									
Internal Assessment: ➤ 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	24L5.0-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 (if any): 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 <i>Amphioxus</i>							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 (<i>Hemidactylus</i>): Structural & Functional morphology, Extinct reptiles; Poisonous apparatus in snakes							11	
IV	Aves: Type study of Pigeon (<i>Columba livia</i>); 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: <i>Molgula</i>, <i>Hetryllus</i>, <i>Pyrosoma</i>, <i>Doliolum</i>, <i>Olikopleura</i>, and <i>Amphioxus</i>. • Cyclostomata: <i>Myxine</i>, <i>Petromyzon</i> and <i>Ammocoetus</i> larva. • Chondrichthyes: <i>Zygaena</i>, <i>Pristis</i>, <i>Narcine</i> (electric ray), <i>Trygon</i>, <i>Rhinobatus</i>, <i>Raja</i> and <i>Chimaera</i>. • Osteichthyes: <i>Acipenser</i>, <i>Lepidosteus</i>, <i>Muraena</i>, <i>Mystus</i>, <i>Catla</i>, <i>Hippocampus</i>, <i>Syngnathus</i>, <i>Exocoetus</i>, <i>Anabas</i>, <i>Diodon</i>, <i>Ostracion</i>, <i>Tetradon</i>, <i>Echinus</i>, <i>Lophius</i>, <i>Solea</i> and <i>Polypterus</i>. Any of the Lung Fishes. • Amphibia: <i>Necturus</i>, <i>Proteus</i>, <i>Amphiuma</i>, <i>Salamandra</i>, <i>Amblystoma</i>, <i>Axolotl</i> larva, <i>Alytes</i>, <i>Bufo</i>, <i>Rana</i>. • Reptilia: <i>Hemidactylus</i>, <i>Calotes</i>, <i>Draco</i>, <i>Varanus</i>, <i>Phrynosoma</i>, <i>Chamaeleon</i>, <i>Typhlops</i>, <i>Python</i>, <i>Eryx</i>, <i>Ptyas</i>, <i>Bungarus</i>, <i>Naja</i>, <i>Hydrus</i>, <i>Viper</i>, <i>Crocodilus</i>, <i>Gavialis</i>, <i>Chelone</i> (Turtle) and <i>Testudo</i> (Tortoise). • Aves: <i>Casuarius</i>, <i>Arden</i>, <i>Anas</i>, <i>Milvus</i>, <i>Pavo</i>, <i>Eudynamis</i>, <i>Tyto</i>, <i>Alcedo</i>, <i>Halcyon</i> • Mammalia: <i>Ornithorhynchus</i>, <i>Echidna</i>, <i>Didelphis</i>, <i>Macropus</i>, <i>Loris</i>, <i>Macaque</i>, <i>Hystrix</i>, <i>Funambulus</i>, <i>Felix</i>, <i>Panthera</i>, <i>Canis</i>, <i>Herpestes</i>, <i>Capra</i>, <i>Pteropus</i>. 2. Internal anatomy of the following animals: (i) Computer simulated model/study of : (a) <i>Herdmania</i> : General anatomy; (b) <i>Rat</i> : Digestive, arterial, venous and urinogenital systems; (c) <i>Hemidactylus</i> : Digestive, arterial, venous and urinogenital systems (ii) Demonstration & Study of Internal Anatomy of locally available fish (<i>Labeo</i>). Digestive and reproductive systems, cranial nerves, Ear ossicle 3. Study of the skeleton of <i>Scoliodon</i> , <i>Labeo</i> , <i>Rana</i> (Frog), <i>Varanus</i> , Pigeon or Gallus and <i>Orcyctolagus</i> /rat, Palates of birds, skulls of dog & rabbit. 4. Study of the following prepared slides: Tornaria larva, T.S. <i>Amphioxus</i> (through different regions). Oikopleura, Histology of rat (compound tissues), different types of scales. 5. Make permanent stained preparations of the following: <i>Salpa</i> , Spicules, and Pharynx of <i>Herdmania</i> , <i>Amphioxus</i> , Cycloid scales 6. Field Visit to National Park or Zoo.							30	
Suggested Evaluation Methods									
Internal Assessment: ➤ Theory • Class Participation: 5						End Term Examination: ➤ Theory • Written Examination: 50			

•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	➤ 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, Edinburgh. 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-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	24L5.0-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 (if any): 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	<u>Nutrition</u> : 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. <u>Muscles</u> : 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	<u>Circulation</u> : 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. <u>Respiration</u> : 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. <u>Excretion</u> : 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									
Internal Assessment: ➤ 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	24L5.0-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 (if any): Biology as a Subject at 4.0 Level (Class XII)									
Course Learning Outcomes (CLO) 1. Students will understand about fresh water fishes of India 2. Students will capable to undertake about fishing 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 breeding in fishes, techniques and hormones; Fish Biotechnology (Transgenesis and Cryopreservation of gametes).							11	
V Practical	1. Identification of <i>Catla catla</i> , <i>Labeo rohita</i> , <i>L. calbasu</i> , <i>Cirrhinus</i> , <i>mrigala</i> , <i>Puntius sarana</i> , <i>Channa punctatus</i> , <i>C. marulius</i> , <i>C. stariatus</i> , <i>Trichogaster fasciata</i> , <i>Mystus seenghala</i> , <i>M. cavasius</i> , <i>M. tengra</i> , <i>Callichrous pabola</i> , <i>C. bimaculatus</i> , <i>Wallago attu</i> , 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									
Internal Assessment: ➤ 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	24L5.0-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 (if any): 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 (<i>Pyrilla perpusilla</i>) (b) Sugarcane Whitefly (<i>Aleurolobus barodensis</i>) (c) Sugarcane top borer (<i>Scirpophaga nivella</i>) (d) Sugarcane root borer (<i>Emmalocera depresella</i>) (e) Gurdaspur borer (<i>Bissetia steniellus</i>) Life cycle and control of <i>Pyrilla perpusilla</i> only. Cotton: (With their systematic position, habits and nature of damage caused. (a) Pink bollworm (<i>Pestiphora gossypifolia</i>) (b) Red cotton bug (<i>Dysdercus cingulatus</i>) (c) Cotton grey weevil (<i>Myllocerus undecimpustulatus</i>) (d) Cotton Jassid (<i>Amrasca devastans</i>) Life cycle and control of <i>Pectinophore gossypiella</i>								12
II	Wheat: Wheat stem borer (<i>Sesamia inferens</i>) 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 (<i>Leptocorisa acuta</i>) (b) Rice grasshopper (<i>Hieroglyphus banian</i>) (c) Rice stem borer (<i>Scirpophaga incertullus</i>) (d) Rice Hispa (<i>Diceladisa armigera</i>) Life cycle and control of <i>Loptocorisa acuta</i> only								11
III	Vegetables: (Their systematics position, habits and nature of damage caused. (a) <i>Aulacophora faveicollis</i> – The Red pumpkin beetle. (b) <i>Dacus cucurbitas</i> – The pumpkin fruit fly. (c) <i>Tetranychus tecarius</i> – The vegetable mite. (d) <i>Epilachna</i> – The Hadda beetle Life cycle and control of <i>Aulacophora faveicollis</i> Stored grains: (Their systematic position, habits and nature of damage caused. (a) Pulse beetle (<i>Callosobruchus maculatus</i>) (b) Rice weevil (<i>Sitophilus oryzae</i>) (c) Wheat weevil (<i>Trogoderma granarium</i>) (d) Rust Red Flour beetles (<i>Tribolium castaneum</i>) (e) Lesser grain borer (<i>Rhizopertha dominica</i>) (f) Grain & Flour moth (<i>Sitotroga cerealella</i>) Life cycle and control of <i>Trogoderma granarium</i>)								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, Sugarcane whitefly, Sugarcane 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: <i>Aulocophora faveicollis</i>, <i>Dacus cucurbitas</i>, <i>Tetranychus tecarious</i>, <i>Epilachna</i> (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		
Internal Assessment: ➤ 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. 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	24L5.0-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 (if any): 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: <i>in-situ</i> and <i>ex-situ</i> 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									
Internal Assessment: ➤ 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	24L5.0-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 (if any):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 <i>C. elegans</i> , <i>Drosophila</i> 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. <i>In –vitro</i> 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 – catcry 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 cytometry, 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	
Internal Assessment: ➤ 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. Saunders CollegePublishing, Harcourt 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	

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, B,C & D	MDC-1 3 credit	24L4.5-MDC-ZOO101	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 (if any): NA									
Course Learning Outcomes (CLO) 1. Student will be able to learn about Kingdom Animalia 2. Student will be able to learn about 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									
Internal Assessment: ➤ 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,B,C & D	MDC-2 3 credit	24L4.5-MDC-ZOO201	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 (if any): NA									
Course Learning Outcomes (CLO) 1. Student will learn the role of different groups of chordates in maintaining 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									
Internal Assessment: ➤ 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, Edinburgh. 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& D	MDC-3 3 credit	24L5.0-MDC-ZOO301	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 (if any): 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

Internal Assessment: ➤ 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
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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

VAC-VALUE ADDED COURSE								
Course Type	Course Code	Name of the Course	Credit	Contact Hours/ Week	Internal Assessment marks	End Term Marks	Max. Marks	Exam Duration
VAC-3	24L5.0-VAC-ZOO-301	Indian Biodiversity	2	2	15	35	50	3 hrs.
Level of the course: NA								
Pre-requisite for the course (if any): NA								
Course Learning Outcomes (CLO): 1. Know about an overview of Indian Biodiversity 2. Understand various strategies of biodiversity conservation 3. Improve their knowledge about Important Protected areas 4. To identify the local biodiversity								
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	An overview of Indian Biodiversity; Faunal and Floral Indian biodiversity, Definition and concept of Biodiversity; Important Biodiversity area of India, Biodiversity: levels, values and threats and conservation						8	
II	Popular Biosphere Reserves and their biodiversity, Popular Tourist spots of Rich Biodiversity, In-situ and Ex-situ conservation of biodiversity						8	
III	Protected Areas and their roles in biodiversity conservation, Important National Park and Wildlife sanctuaries, IUCN categories, Threatened categories						7	
IV	Terrestrial Biodiversity, Aquatic and Coastal biodiversity, Biodiversity hotspots, their characteristic flora and fauna, Biodiversity resources of north-east India						7	
Suggested Evaluation Methods								
Internal Assessment: ➤ Theory •Class Participation: 4 •Seminar/presentation/assignment/quiz/class test etc.: 4 •Mid-Term Exam: 7					End Term Examination: ➤ Theory •Written Examination: 35			
Learning Resources								
1. Thammineni Pullaiah and Sandhya Rani (2016) “ Biodiversity in India” Volume: Regency Publications 2. Shukla Mahanty and Anjali Srivastava (2016). “Biodiversity And It's Conservation” Disha International Publishing House 3. Ramakrishanan, N “Biodiversity in Indian Scenarios” Daya Publishing House, New Delhi 4. Erach Bharucha (2002) “The Biodiversity of India” Mapin Pub. 5. Asad R. Rahmani and Dhritiman Mukherjee (2016) “Magical Biodiversity Of India” Oxford University Press								

VAC-VALUE ADDED COURSE								
Course Type	Course Code	Name of the Course	Credit	Contact Hours/ Week	Internal Assessment marks	End Term Marks	Max. Marks	Exam Duration
VAC-4	24L5.0-VAC-ZOO-401	Ecology and Environment	2	2	15	35	50	3 hrs.
Level of the course: NA								
Pre-requisite for the course (if any): NA								
Course Learning Outcomes (CLO): 1. Know about basics of ecological science 2. Understand various strategies for research and development on ecological succession and dynamics 3. Improve their knowledge about conservation science 4. Describe about various conservation projects								
Instructions for Paper-Setter 1. Nine questions will be set in all. All questions will carry equal marks. 2. Question No. 1, which will be short answer type covering the entire syllabus, will be compulsory. The remaining eight questions will be set unit wise selecting two questions from each Unit I to IV. The candidate will be required to attempt question No. 1 and four more questions selecting one question from each unit.								
UNIT	TOPICS						CONTACT HOURS	
I	Environmental components: biotic and abiotic components and their interactions. Concept of habitat and niche; Major terrestrial biomes; Biogeographical zones of India.						8	
II	Population and Community ecology: Characteristics of a population; life history strategies (r and K selection); concept of metapopulation – demes and dispersal, Species Interactions: Types of interactions, interspecific competition, Community Ecology: Nature of communities; community structure and attributes; levels of species diversity and its measurement; edges and ecotones.						8	
III	Ecosystem and Ecological Succession: Ecosystem: structure and function; energy flow and mineral cycling (C,N,P); primary production and decomposition; structure and function of some Indian ecosystems: terrestrial and aquatic. Ecological Successions: Types; mechanisms; changes involved in succession; concept of climax.						7	
IV	Applied Ecology and Conservation Biology: Environmental pollution; biodiversity: status, monitoring and documentation; biodiversity management approaches; Principles of conservation and it's management; Project Tiger, Biosphere reserves.						7	
Suggested Evaluation Methods								
Internal Assessment: ➤ Theory • Class Participation: 4 • Seminar/presentation/assignment/quiz/class test etc.: 4 • Mid-Term Exam: 7					End Term Examination: ➤ Theory • Written Examination: 35			
Learning Resources								
1. Odum, E. P. & Barrett, G. W. <i>Fundamentals of Ecology</i> 2. Begon, M., Townsend, C. R. & Harper, J. L. <i>Ecology: From Individuals to Ecosystems</i> 3. Smith, R. L. & Smith, T. M. <i>Elements of Ecology</i>								

SEC-SKILL ENHANCEMENT COURSE								
Course Type	Course Code	Name of the Course	Credit	Contact Hours/ Week	Internal Assessment Marks	End Term Marks	Max. Marks	Exam Duration
SEC-2	24L4.5-SEC-ZOO-201	Taxidermy	2	2	15	35	50	3 hrs.
		Practical	1	2	5	20	25	4 hrs.
Level of the course: NA								
Pre-requisite for the course (if any): NA								
Course Learning Outcomes (CLO): 1. Students will be able to learn about the materiality of the taxidermy animal within the museum context 2. Learners will be able to develop a knowledge and understanding of how to sustain a line of enquiry in a series of related art works 3. This Practice will be effective in the uses of a range drawing and in development studies which consider a creative response to the taxidermy animal. 4. Learners will be able for editing of visual ideas derived from research and study of the taxidermy animal. 5. Students will get practical exposure of Taxidermy procedure								
Instructions for Paper-Setter 1. Nine questions will be set in all. All questions will carry equal marks. 2. Question No. 1, which will be short answer type covering the entire syllabus, will be compulsory. The remaining eight questions will be set unit wise selecting two questions from each Unit I to IV. The candidate will be required to attempt question No. 1 and four more questions selecting one question from each unit.								
UNIT	TOPICS						CONTACT HOURS	
I	General introduction to Taxidermy; Past and present scenario of Taxidermy; Types of Taxidermy for different animals; Applications of taxidermy						8	
II	Layout of Taxidermy- Techniques and Materials used for Skinning, Cleaning and Preservation of dead animals; Keeping the record of dead animal- age, sex, infestation of pests						8	
III	Methods of Taxidermy in Fishes, Snakes and Birds; Instruments used in Taxidermy; Maceration; Chemical treatments and procedure of Tanning						7	
IV	Economic importance of Taxidermy; Role of Taxidermy in conservation and education; Factors affecting Taxidermy; Ethical issues; Pros and cons of Taxidermy						7	
V Practical	1. Visit to the museum; 2. Identification of animals in Museum; 3. Prepare small models of animals; 4. To study the best and easiest method of Taxidermy of Birds; 5. Procedure of Taxidermy in mammals; Enlist the different types of chemicals used for Taxidermy; 6. Enlist the different types of instruments used for taxidermy						30	
Suggested Evaluation Methods								
Internal Assessment: ➤ Theory • Class Participation: 4					End Term Examination: ➤ Theory • Written Examination: 35			

• 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	➤ Practicum ➤ Practical Examination: 20
Learning Resources	
1. Taxidermy by Alexis Turner. Rizzoli. 2. Taxidermy by Leon Pray. 3. Barber's Manual : A text book on taxidermy by T.J. McConnaughay 4. Home Book of taxidermy and tanning by Gerold . J Grantz. Stackpole Books, 1985.	

SEC-SKILL ENHANCEMENT COURSE								
Course Type	Course Code	Name of the Course	Credit	Contact Hours/ Week	Internal Assessment marks	End Term Marks	Max. Marks	Exam Duration
SEC-2	24L4.5-SEC-ZOO-202	Techniques in Bird Watching	2	2	15	35	50	3 hrs.
		Practical	1	2	5	20	25	4 hrs.
Level of the course: NA								
Pre-requisite for the course (if any): NA								
Course Learning Outcomes (CLO): 1. Students will be able to learn about the theory of camera trap 2. Learners will be able to learn about installation of camera trap 3. This Practice will be effective for students for collection of data with camera trap 4. Learners will be able theory of camera trap field operations 5. Students will get practical exposure of camera trap								
Instructions for Paper-Setter 1. Nine questions will be set in all. All questions will carry equal marks. 2. Question No. 1, which will be short answer type covering the entire syllabus, will be compulsory. The remaining eight questions will be set unit wise selecting two questions from each Unit I to IV. The candidate will be required to attempt question No. 1 and four more questions selecting one question from each unit.								
UNIT	TOPICS						CONTACT HOURS	
I	Introduction to Bird watching						8	
	Characteristics of Birds with flight adaptations							
	Important field signs of bird watching							
II	Zoological Names of Important birds						8	
	Field characters of important birds							
	Sexual dimorphism in birds							
III	Important Indian Bird areas						7	
	Important Bird areas of Haryana							
	Resident & Migratory Birds							
IV	Birds as bio-indicators						7	
	Birds in food chain and Agriculture							
	Bird Migration							
V Practical	1. Instruments in Bird watching						30	
	2. Identification of Birds							
	3. Sexual Dimorphism studies in Birds							
	4. Field visits to local Bird areas							
Suggested Evaluation Methods								
Internal Assessment: ➤ Theory • Class Participation: 4 • Seminar/presentation/assignment/quiz/class test etc.: 4 • Mid-Term Exam: 7 ➤ Practicum					End Term Examination: ➤ Theory • Written Examination: 35 ➤ Practicum ➤ Practical Examination: 20			

• Class Participation: NA • Seminar/Demonstration/Viva-voce/Lab records etc.: 5 • Mid-Term Exam: NA	
Learning Resources	
1. Birds of Indian subcontinent by Richard Grimmett, Inskipp. 2. Birds of Haryana. A field guide by Kalsi and Coworkers 3. Birds of Basai Wetlands Haryana by Deepak Rai and Coworkers. 4. Birding basics: Tips, tools and techniques for great bird watching by Noah Stryckar.	

SEC-SKILL ENHANCEMENT COURSE								
Course Type	Course Code	Name of the Course	Credit	Contact Hours/ Week	Internal Assessment Marks	End Term Marks	Max. Marks	Exam Duration
SEC-2	24L4.5-SEC-ZOO-203	Camera Trapping in Wildlife Studies	2	2	15	35	50	3 hrs.
		Practical	1	2	5	20	25	4 hrs.
Level of the course: NA								
Pre-requisite for the course (if any): NA								
Course Learning Outcomes (CLO): - Students will be able to learn about the theory of camera trap - Learners will be able to learn about installation of camera trap - This Practice will be effective for students for collection of data with camera trap - Learners will be able theory of camera trap field operations - Students will get practical exposure of camera trap								
Instructions for Paper-Setter - Nine questions will be set in all. All questions will carry equal marks. - 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	Camera trap, Theory and practice Various modes and settings of Camera trap.						8	
II	Installation of Camera Trap. How to operate it in field						8	
III	Collection of data through camera trap. What the collected data can tells us., Information retrieval						7	
IV	Use of Camera Trap in wildlife studies. Field studies for hands on experience on camera trap						7	
V Practical	Practical Knowledge of camera trap Practical working of camera trap Extraction of field data from camera trap						30	
Suggested Evaluation Methods								
Internal Assessment: ➤ 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								
- Camera trapping for wildlife research by Frensko Rovero and Fridolin Zimmerman - Camera traps in animal ecology. Methods and Analyses by Allan F.O. Channel, James D. Nichols - Camera trapping Guide. Tracks, signand behaviour of eastern wild life by Janet Pesaturo.								

SEC-SKILL ENHANCEMENT COURSE								
Course Type	Course Code	Name of the Course	Credit	Contact Hours/ Week	Internal Assessment marks	End Term Marks	Max. Marks	Exam Duration
SEC-3	24L5.0-SEC-ZOO-301	Microtomy	2	2	15	35	50	3 hrs.
		Practical	1	2	5	20	25	4 hrs.
Level of the course: NA								
Pre-requisite for the course (if any): NA								
Course Learning Outcomes (CLO): 1. Students will have thorough understanding of modern development in microtomy. 2. Learners will be able to process animal samples for permanent slide preparation. 3. Gain knowledge regarding various biological stains. 4. Localize histochemical of proteins, lipids and nucleic acids. 5. Students will get practical exposure of Microtomy								
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	Microtomy:- Introduction, definition, History and Applications in Biological sciences; Types of microtomes- Rotary microtome, Sledge Microtome and Cryomicrotome						8	
II	Collection and transportation of sample/specimens for histological examination; Basic concepts of fixation- Various types of fixatives used in microtomy; Process of fixation; Embedding-Block formation						8	
III	Section Cutting: Paraffin section cutting ; Streching- Spreading the sections and attachment to the glass slides; Staining – Principle and procedure; Preparation of Stains and solvents						7	
IV	General Staining Procedures for Paraffin Embedded tissue; Nuclear Stains and Cytoplasmic stains- Haematoxylin and Eosin staining, Mercury Bromophenol Blue staining; Toulidine Blue; Commonly used mountants in microtomy.						7	
V Practical	1. Collection and labeling of histological samples/specimens 2. To demonstrate various part and types of microtome 3. Preparation of various fixatives- Bouin’s fluid, Corney’s fluid; 10% Neutral formalin,Normal saline 4. Processing of tissue by manual method 5. To perform embedding and casting of block, section cutting, stretching 6. To perform & practice the Haematoxylin and Eosin staining, Mercury Bromophenol Blue staining; Toulidine Blue Staining 7. Study the permanent slides of different tissues						30	

Suggested Evaluation Methods	
Internal Assessment: ➤ 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. Principles and interpretation of laboratory practices in surgical pathology by S. S. and Kaler Amrit Kaur 2. Practical approach to histopathology staining and microtomy by Prof. Punit Puri 3. Histopathology Techniques and its management by Ramdas Nayak. 4. Troubleshooting histopathology stains by Richard.W. Horobin and John D. Baneroff.	

VOC-VOCATIONAL COURSE

Course Type	Course Code	Name of the Course	Credit	Contact Hours/ Week	Internal Assessment marks	End Term Marks	Max. Marks	Exam Duration
VOC-1 Scheme B only	24L5.0-VOC-ZOO-301	Apiculture	2	2	15	35	50	3 hrs.
VOC-2 Scheme A/C/D	24L5.5-VOC-ZOO-501	Practical	2	4	15	35	50	4 hrs.
Level of the course: NA								
Pre-requisite for the course (if any): NA								
Course Learning Outcomes (CLO): - Students will be able to understand the significance of honey bees and Apiculture - Students will acquire knowledge about different species and castes of the honey bees - Students will learn to manage beehives for honey production and pollination, and Learn various product of honey bees and value addition in these products, - Students will be aware about economic importance of honey bees, and use of Apiculture for employment, self employment and conservation of nature - Students will gain practical knowledge about various methods of bee keeping and extraction of honey thus create scope for entrepreneurship.								
Instructions for Paper-Setter - Nine questions will be set in all. All questions will carry equal marks. - 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 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						8	
II	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.						8	
III	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						7	
IV	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						7	
V Practical	Practical Exercises on - Identification of different bee species - Training of Bee keeping in Artificial boxes - Demonstration of Modern Bee Keeping Equipment and Methods. - Training of methods of Extraction of Honey (Indigenous and Modern) - Field visit to Honey Bee farm/Unit - Report of field visit						60	

Suggested Evaluation Methods	
Internal Assessment: ➤ Theory • Class Participation: 4 Seminar/presentation/assignment/quiz/class test etc.: 4 • Mid-Term Exam: 7	End Term Examination: ➤ Theory • Written Examination: 35
➤ Practicum • Class Participation: 5 • Seminar/Demonstration/Viva-voce/Lab records etc.: 10 Mid-Term Exam: NA	➤ Practicum - Practical Examination: 35
Learning Resources	
• Prost, P. J. (1962). Apiculture. Oxford and IBH, New Delhi. • Bisht, D.S. (2004). Agricultural Development in India, Anmol Pub. Pvt. Ltd. • Singh S. (1964). Beekeeping in India, Indian council of Agricultural Research, New Delhi • Mehrotra, K.N. Bisht, D.S. (1981). Twenty-five years of apiculture research at IARI. I. Apiculture in relation to agriculture. • The Social Behaviour of the Bees, 1974 : By Missioner C.D • The Social Behaviour of the Bees, A Comparative Study 1974, C.D.Mathener, Harvard University Press, Cambridge, England. Bees and Mankind 1982, J.B.Free, George Allen & Unwin (Pub.), Limited London, UK. 25. Biogeography and Taxonomy of Honeybees 1985, F.Ruttnar, Springer-Verlag, Berlin, Jermamy.	

VOC-VOCATIONAL COURSE								
Course Type	Course Code	Name of the Course	Credit	Contact Hours/ Week	Internal Assessment marks	End Term Marks	Max. Marks	Exam Duration
VOC-2	24L5.0-VOC-ZOO-401	Vermicomposting	2	2	15	35	50	3 hrs.
		Practical	2	4	15	35	50	4 hrs.
Level of the course: NA								
Pre-requisite for the course (if any): NA								
Course Learning Outcomes (CLO): 1. Student will get the knowledge of composting 2. The student will get the knowledge of biodiversity of local earthworms 3. The student can generate income by supplying worms, vermiwash and vermicompost. 4. It leads towards organic farming and healthy food. 5. Student will be trained to identify Earthworms and their use in small vermicompost bin for converting the home waste.								
Instructions for Paper-Setter 1. Nine questions will be set in all. All questions will carry equal marks. 2. Question No. 1, which will be short answer type covering the entire syllabus, will be compulsory. The remaining eight questions will be set unit wise selecting two questions from each Unit I to IV. The candidate will be required to attempt question No. 1 and four more questions selecting one question from each unit.								
UNIT	TOPICS						CONTACT HOURS	
I	Vermiculture: Introduction, definition, history, general characters of Annelida, systematic position of earthworm, habits and habitat of earthworm, diversity of earthworms, collection of earthworms, preservation of earthworms.						8	
II	Vermitechnology: Role of earthworm in maintenance of soil structure and their role as recycling, reduce, reuse, restore (4r's), choosing right species of earthworm.						8	
III	Earthworm biology and rearing: Key to identify the species of earthworm, life cycle of <i>Eisenia fetida</i> , <i>Lampito mauritii</i> and their role on ecology, an eco-friendly approach to sustainable agriculture						7	
IV	Vermicomposting (methods and products): Preparation of vermibed, small scale earthworm farming for home garden, large scale commercial composting, properties of vermicompost and vermiwash, application on crop plants economic development and self-employment.						7	
V Practical	Practical 1. Key to identify different types of earthworms. 2. Collection of some native earthworms and identification. 3. Study of systematic position, habits, habitat and external feature of earthworm 4. Study of life stages of <i>Elisenia fetida</i>, <i>Eudrilus eugeniae</i>, <i>Lampito mauritii</i> 5. Preparation of vermibeds, maintenance of vermicompost and climatic conditions. 6. Field visit of Vermicomposting unit. 7. Report of field visit.						60	
Suggested Evaluation Methods								

Internal Assessment: ➤ Theory • Class Participation: 4 • Seminar/presentation/assignment/quiz/class test etc.: 4 • Mid-Term Exam: 7 ➤ Practicum • Class Participation: 5 • Seminar/Demonstration/Viva-voce/Lab records etc.: 10 • Mid-Term Exam: NA	End Term Examination: ➤ Theory • Written Examination: 35 ➤ Practicum ➤ Practical Examination: 35
Learning Resources	
1. Dash, M. C. (2012). Charles Darwin's Plough Tool for Vermitechnology. I.K. International Publishing House Pvt Ltd. New Delhi, India. 2. Tripathi, G (2003). Vermiresources Technology Discovery Publishing House, New Delhi. 3. Rajnesh Kumar Sharma and Poonam Bhardwaj (2018). Green Farming- Earthworms and Vermitechnology. RAR Publication, New Delhi.	

VOC-VOCATIONAL COURSE								
Course Type	Course Code	Name of the Course	Credit	Contact Hours/ Week	Internal Assessment marks	End Term Marks	Max. Marks	Exam Duration
VOC-3	24L5.5-VOC-ZOO-601	Poultry Farming	2	2	15	35	50	3 hrs.
		Practical	2	4	15	35	50	4 hrs.
Level of the course: NA								
Pre-requisite for the course (if any): NA								
Course Learning Outcomes (CLO): 1. Understand the field level structure and functioning of Poultry Farming 2. This course will enlighten the students about the operation of livestock and poultry farming. 3. It will develop the knowledge of poultry in an operational farm for more profit management, feed requirements etc. 4. Learning of poultry farming will generate a source of employment opportunities in rural areas and employment to the farmers. 5. Will gain all round knowledge of Poultry Farming as a business enterprise rather than as a community profession								
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 introduction to poultry farming -Definition of Poultry Past and present scenario of poultry industry in India. Breeds, Varieties and Strains, Life cycle of poultry birds						8	
II	Poultry feed management – Principles of feeding Nutrient requirements for different stages of layers and broilers. Feed formulation Methods of feeding.						8	
III	Layer Industry in India Systems of layer farming – Location & Lay out of the farm Systems of housing –Types of roof, materials, pillars, trusses for poultry house Management of layers in different systems of rearing.						7	
IV	Poultry diseases – viral, bacterial, fungal and parasitic (two each); symptoms, control and management. Vaccination programme Cleaning, Disinfection and Fumigation of Poultry Houses						7	

V Practical	Following Practical Exercises shall be taught 1. Identification of External Body Parts of a Bird 2. Identification of Chicken Breeds 3. General View of Poultry Farm 4. Rearing, Feeding and Watering of Chicks, Growers and Layers 5. Debeaking, Delicing, Deworming and Spraying 6. Candling and Grading of Eggs 7. Field visit of Poultry farm 8. Report of field visit	60
Suggested Evaluation Methods		
Internal Assessment: ➤ Theory • Class Participation: 4 • Seminar/presentation/assignment/quiz/class test etc.: 4 • Mid-Term Exam: 7 ➤ Practicum • Class Participation: 5 • Seminar/Demonstration/Viva-voce/Lab records etc.: 10 • Mid-Term Exam: NA		End Term Examination: ➤ Theory • Written Examination: 35 ➤ Practicum ➤ Practical Examination: 35
Learning Resources		
1. Das D, Das B C, Nayak N, Jena B, Sahu A R 2021, "TextBook on Poultry Management" Narendra Publishing House 2. Ghosh N 2015, "Poultry Science And Practice: A Textbook" CBS Publishers & Distributors 3. Prasad Rajeshwar (2010): Poultry Management Alfa Publications. 4. Singh R A 2009, "Poultry Production" Kalyani Publishers 5. Shukla, G. S. and Upadhyay, V. B. (2011): Economic Zoology. Rastogi Publications.		

VOC-VOCATIONAL COURSE

Course Type	Course Code	Name of the Course	Credit	Contact Hours/ Week	Internal Assessment marks	End Term Marks	Max. Marks	Exam Duration
VOC-3	24L5.5-VOC-ZOO-602	Fish Farming	2	2	15	35	50	3 hrs.
		Practical	2	4	15	35	50	4 hrs.

Level of the course: NA

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

Course Learning Outcomes (CLO):

1. Create awareness about food security, significance of protein in diet and will learn the skills to develop business enterprise
2. Students will learn about various methods and significance of fish farming
3. Student/s will learn identification of fish species using classical morphological methods
4. Students will get acquainted about by products of fish farming industry and fish health
5. Students will develop capability of identifying different species of fishes and will be trained for analysis of water quality and fish culture in ponds

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 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	8
II	Culture fisheries and its types Criteria for the selection of fish species for farming Important culturable Fishes in India and Identification of commercially important fish species Basics of induced breeding in fishes	8
III	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	7
IV	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	7
V Practical	Practical Exercises on	60

	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	
Suggested Evaluation Methods		
Internal Assessment: ➤ Theory - Class Participation: 4 - Seminar/presentation/assignment/quiz/class test etc.: 4 - Mid-Term Exam: 7 ➤ Practicum - Class Participation: 5 - Seminar/Demonstration/Viva-voce/Lab records etc.: 10 - Mid-Term Exam: NA		End Term Examination: ➤ Theory - Written Examination: 35 ➤ Practicum ➤ Practical Examination: 35
Learning Resources		
1. APHA (1995) Standard Methods of Examination of Water and Wastewater. American Public Health Association, AWWA, WCPF, Washington DC. 2. Bardach, JE, Ryther & 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, VG (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 edn (PB) Narendra Publishing House, India		

INDIRA GANDHI UNIVERSITY
MEERPUR, REWARI



Syllabus of V, VI, VII & VIII
Semester for
Under-Graduate Programme
(Subject: Zoology)
w.e.f. session 2024-25

**Under Multiple Entry-Exit, Internship and
CBCS-LOCF in accordance to NEP-2020**

ZOOLOGY: SEMESTER-V									
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	24L5.5-ZOO-501	Ecology and Environment	3	3	20	50	70	3 hrs.
			Practical	1	2	10	20	30	4 hrs.
Level of the course: 300-399									
Pre-requisite for the course (if any): Biology as a Subject at 4.0 Level (Class XII)									
Course Learning Outcomes (CLO) 1. Students will be able to describe interactions and relation between abiotic and biotic factors. 2. Students will able to describe about ecosystem and Biogeochemical cycles. 3. Students will be able to describe about population characteristics & biodiversity. 4. Students will be able to understand the causes of different types of pollution. 5. Students will be able to practical approaches of natural resources and their conservation.									
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	Basic concepts of ecology: Definition, significance. Concepts of habitat and ecological Niche. Ecosystem: Concept, components, properties and functions; Ecological energetics and energy flow models, food chain, food web, trophic structure; ecological pyramids, concept of productivity.							12	
II	Factors affecting environment: Abiotic factors (light-intensity, quality and duration), temperature, humidity, wind, Rainfall, topography; edaphic factors; Biotic factors. Introduction to major ecosystems of the world. Biogeochemical cycles: Concept, reservoir pool, gaseous cycles and sedimentary cycles. Community Ecology: Characteristics, Composition, structure, origin and development of a community Ecological Succession.							11	
III	Population: Growth and regulation. Population interactions: Competition, predation, parasitism, commensalisms and mutualism. Concept of biodiversity and conservation of natural resources.							11	
IV	Climate change: Global warming, Greenhouse Effect, Ozone Depletion, Sustainable Development. Natural Recourses: Types, Uses and conservation. Environmental Pollution: Air, water, soil and management strategies. Environmental Impact Assessment.							11	
V Practical	1. Chemical analysis of pond water (pH, Salinity, free CO ₂ , alkanity, hardness) 2. Chemical analysis of soil for pH, moisture, nitrates, and phosphates. 3. Estimation of DO, BOD for given Sample of water. 4. A study of pond ecosystem. 5. Basic Zooplankton & Phytoplankton study of any water body.							30	

Suggested Evaluation Methods	
Internal Assessment: ➤ 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. Colinviaux, P. A. (1993). Ecology. II Edition. Wiley, John and Sons, Inc. 2. Krebs, C. J. (2001). Ecology. VI Edition. Benjamin Cummings. 3. Odum, E.P., (2008). Fundamentals of Ecology. Indian Edition. Brooks/Cole 4. Robert Leo Smith Ecology and field biology Harper and Row publisher 5. Ricklefs, R.E., (2000). Ecology. V Edition. Chiron Press 6. Rockwood Larry L. (2015) Introduction to Population Ecology,)2nd Edition Wiley-Blackwell	

ZOOLOGY: SEMESTER-V									
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-10 4 credit	24L5.5-ZOO-502	Animal Taxonomy	3	3	20	50	70	3 hrs.
			Practical	1	2	10	20	30	4 hrs.
Level of the course: 300-399									
Pre-requisite for the course (if any): Biology as a Subject at 4.0 Level (Class XII)									
Course Learning Outcomes (CLO) 1. Students will be able to attain knowledge of taxonomy which helps in classifying and identifying biodiversity 2. Students will understand animal relationships by making phylogenetic trees. 3. It will enhance the knowledge of students to understand the overall biodiversity of the world and their application. 4. Students will be able to acquire, analyse and understand the significance of Biosystematics 5. Students will able to learn the practical knowledge of general organisation, affinities and systematic position of animals.									
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	Fundamental concept of taxonomy Introduction to taxonomy: Stages of Taxonomy, objectives of biological classification, Importance and application of biosystematics in zoology, principles and rules of taxonomy, ICZN regulation.							12	
II	Historical perspectives of biosystematics: Taxonomic stages: alpha, beta and Gamma taxonomy, Taxonomic Hierarchy, Taxonomic characters, Neo taxonomy and difference with classical taxonomy.							11	
III	Taxonomic procedure Study methods: Collection, preservation and identification, evaluation of taxonomic characters, morphological, embryological, cytogenetical, biochemical, numeral components of classification. Importance of studying taxonomic with demerits							11	
IV	Concept of speciation Varieties, subspecies, siblings, species and races. Concept of taxon, holotype, paratype, topotype. Molecular basis of taxonomy Phylogenetic: principle. Concept and applications.							11	
V Practical	1. Demonstration for the preparation and use of different types of taxonomic keys. 2. Construction of cladogram, dendrograms and phylograms. 3. Construction of dichotomous key 4. Classify different animal kingdom upto order 5. Study of museum specimens and slides with emphasis on evolutionary and adaptive significance. 6. Software used to study animal taxonomy.							30	

Suggested Evaluation Methods	
Internal Assessment:	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. G.G. Simpson, Principle of animal taxonomy, Oxford ISH Publishing Company. 2. E. Mayer, Elements of Taxonomy. 3. M. Kato. The Biology of Biodiversity, Springer. 4. E.O. Wilson, Biodiversity, Academic Press, Washington.	

ZOOLOGY: SEMESTER-V									
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-2 4 credit Select one Option	24L5.5-ZOO-503	Animal Behaviour and Chronobiology	3	3	20	50	70	3 hrs.
			Practical	1	2	10	20	30	4 hrs.
Level of the course: 300-399									
Pre-requisite for the course (if any): Biology as a Subject at 4.0 Level (Class XII)									
Course Learning Outcomes (CLO) 1. Students will be able to describe origin of animal behavior and its perception with environment. 2. Students will be able to describe biological clock and concepts of learning. 3. Students will be able to describe different types of social behavior in animals 4. Students will be able to describe effects of various stimuli on animal behavior. 5. Students will be able to describe to understand how animal behavior plays a key role to in interaction the biotic and abiotic world.									
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	<u>Concept of Animal Behaviour;</u> Mile-Stones in the history of animal behaviour and scope. Stereotyped and acquired behavior patterns : Tropisms, Taxes, Reflexes, Instincts, learning & reasoning; Perception of the environment : Mechanical, Electrical, chemical, olfactory, auditory, visual							12	
II	Social behaviour: Aggregations and society; Advantages of group living; Types of social organization in animals, Group selection, kin selection, altruism, reciprocal altruism, Territoriality. Social behaviour of termites, ants and primates. Concept of learning: law of learning, types of learning – Habituation, trial & error learning, latent learning, Insight, Imprinting, Classical conditioning & Instrumental learning. Concept of Migratory behavior							11	
III	Behaviour Ecology: Habitat selection. Various means of communication in animals: Chemical, Visual, auditory, touch etc. Hormones and animal Behaviour: Hormones important to behavioural regulation; Genetic basis of behavior Aggressive behaviour; sexual attraction and sexual behaviour. Pheromones and animal behaviour: types of pheromones, role of pheromones in animal behaviour; pheromones of social insects. Ecological adaptation;							11	
IV	Chronobiology : Introduction to chronobiology; Various terminology used in chronobiology; Biological Rythms and Biological clocks; Types of biological rhythms: Lunar rhythms, circadian rhythms; Circannual rhythms; Epicycles, Tidal rhythms, Sleep Disorders, Insomnia, chronotherapy.							11	
V Practical	1. To study nests and nesting habits of the birds and social insects. 2. To study the behavioural responses of wood lice to dry and humid conditions.							30	

	3. To study geotaxis behaviour in earthworm. 4. To study the phototaxis behaviour in insect larvae. 5. Visit to Forest/Wild life Sanctuary/Biodiversity Park/Zoological Park to study behavioural activities of animals and prepare a short report. 6. Study of behaviour repertoire sheets. 7. Study of circadian functions in humans (daily eating, sleep and temperature patterns).	
Suggested Evaluation Methods		
Internal Assessment: ➤ 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. Alcock J. 2013. Animal Behaviour, Sinauer Associate Inc., USA. 2. Chaki K C; Kundu G & Sarkar S. - Introduction to General Zoology ;Vol. 2, NCBA, Kolkata 3. Chattopadhyay S. 2012. Life: Evolution, Adaptation, Ethology. 3rd Edn. Books and Allied, Kolkata. 4. Drickamer LC , Vessey SH . 2001. Animal Behaviour. McGraw-Hill 5. Dujatkin LA. 2014. Principles of Animal Behaviour. 3rd Edn. W.W.Norton and Co. 6. Dunlap JC, Loros JJ, DeCoursey PJ. 2004. Chronobiology Biological Timekeeping. Sinauer Assoc. 7. Kumar V. 2002. Biological Rhythms. Narosa Publishing House, New Delhi.		

ZOOLOGY: SEMESTER-V									
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-2 4 credit Select one Option	24L5.5-ZOO-504	Comparative Anatomy of Vertebrates	3	3	20	50	70	3 hrs.
			Practical	1	2	10	20	30	4 hrs.
Level of the course: 300-399									
Pre-requisite for the course (if any): Biology as a Subject at 4.0 Level (Class XII)									
Course Learning Outcomes (CLO) 1. The student will be able to identify and understand comparative anatomical structure of vertebrate organ systems 2. The learner will be able to understand the evolution of various organs and systems in the vertebrate body according to its environment 3. The student will be able to understand the plasticity of organ systems to adapt to the environment and acquire different novel forms 4. The student will be able to enhance the Ability to understand the anatomical organization of organs and systems in representative species 5. Students will be able to describe to understand practical approaches of anatomical systems in vertebrates.									
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	Integumentary and Skeletal System Structure, functions and various derivatives (hard and soft) of integuments of vertebrates Overview of axial and appendicular skeleton, Jaw suspensorium, Visceral arches							12	
II	Digestive and Urino-genital System Alimentary canal and associated glands, dentition Succession of kidney, Evolution of urino-genital ducts, Types of mammalian uteri							11	
III	Respiratory and Circulatory System External and internal respiration, respiratory organ (Skin, gills, lungs and air sacs); respiratory pigments Blood components, General plan of circulation, evolution of heart and aortic arches							11	
IV	Nervous System and Sense Organs Comparative account of brain, Autonomic nervous system, Spinal cord, Cranial nerves in mammals Classification of receptors, olfactory receptors, Brief account of visual and auditory receptors in Man							11	
V Practical	1. Study of placoid, cycloid and ctenoid scales through permanent slides/photographs 2. Comparative study on skeleton of Frog, Varanus, Fowl, Rabbit 3. Study on Different types of Feathers, Scales and Hair. 4. Mammalian skulls: One herbivorous and one carnivorous animal 5. Study of rat arterial and urinogenital system (demonstration/online videos) 6. Study of structure of any two organs (heart, lung, kidney, eye and ear) from online video/manuals.							30	

Suggested Evaluation Methods	
Internal Assessment: ➤ 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. Kardong, K.V. (2005) Vertebrates' Comparative Anatomy, Function and Evolution. IV Edition. McGraw-Hill Higher Education 2. Milton Hilderbrand. Analysis of vertebrate structure. IV. Ed. John Wiley and Sons Inc., New York. 3. Kent, G.C. and Carr R.K. (2000). Comparative Anatomy of the Vertebrates. IX Edition. The McGraw-Hill Companies 4. Weichert C.K and William Presch (1970). Elements of Chordate Anatomy, Tata McGraw Hills 5. Hilderbrand, M and Gaslow G.E. Analysis of Vertebrate Structure, John Wiley and Sons 6. Walter, H.E. and Sayles, L.P; Biology of Vertebrates, Khosla Publishing House 7. Torrey, T.W. Morphogenesis of vertebrates. John Wiley and Sons Inc., New York and London.	

ZOOLOGY: SEMESTER-V									
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-3 4 credit Select one Option	24L5.5-ZOO-505	Biology of Insects	3	3	20	50	70	3 hrs.
			Practical	1	2	10	20	30	4 hrs.
Level of the course: 300-399									
Pre-requisite for the course (if any): Biology as a Subject at 4.0 Level (Class XII)									
Course Learning Outcomes (CLO): Students will be able to: 1. Attain a solid foundation in insect biology, including general entomology, basic systematic, morphology, physiology, and biodiversity. 2. Understand evolution and biodiversity generation through macro- and micro-evolutionary processes, including how these processes have formed and diversified insects. 3. Develop an understanding of the distributions and abundances of organisms including insects, and their interactions with each other and the environment. 4. Gain appreciation of insects in society and human affairs, and as model systems in insect biology. 5. Develop the ability to design and perform a scientific study on insects, and to analyze results.									
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 Diversity and General Features of Insects Distribution, origin and Success of Insects on the Earth Economic importance of Insects							12	
II	Insect Taxonomy Basis of insect classification; Classification of insects up to orders Insects as plant pests, with special reference to Wheat and Paddy Insects as mechanical and Biological vectors, Brief discussion on houseflies and mosquitoes as important insect vectors							11	
III	General Morphology of Insects External Features; Head – Eyes, Types of antennae, Mouth parts with respect to feeding habits, Thorax: Wings and wing articulation, Types of Legs adapted to diverse habitat Abdominal appendages and genitalia							11	
IV	Physiology of Insects Structure and physiology of Insect body systems - Integumentary, digestive, excretory, circulatory, respiratory, endocrine, reproductive, and nervous system; Sensory receptors; Growth and metamorphosis, Insect Societies, Group of social insects and their social life, Social organization and social behaviour (Termites)							11	
V Practical	1. Study of one specimen from each insect order 2. Study of different kinds of antennae, legs and mouth parts of insects 3. Study of head and sclerites of any one insect 4. Study of insect wings and their venation.							30	

	5. Study of insect spiracles 6. Methodology of collection, preservation and identification of insects. 7. Morphological studies of various castes of <i>Apis</i> 8. Study of any three insect pests and their damages. 9. Study of any three beneficial insects and their products. 10. Field study of insects and submission of a project report on the insect diversity	
Suggested Evaluation Methods		
Internal Assessment: ➤ 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. A general text book of entomology, Imms , A. D., Chapman & Hall, UK 2. The Insects: Structure and function, Chapman, R. F., Cambridge University Press, UK 3. Principles of Insect Morphology, Snodgrass, R. E., Cornell Univ. Press, USA 4. Introduction to the study of insects, Borror, D. J., Triplehorn, C. A., and Johnson, N. F., M Saunders College Publication, USA 5. The Insect Societies, Wilson, E. O., Harward Univ. Press, UK 6. Physiological system in Insects, Klowden, M. J., Academic Press, USA 7. The Insects, An outline of Entomology, Gullan, P. J. , and Cranston, P. S., Wiley Blackwell, UK 8. Insect Physiology and Biochemistry, Nation, J. L., CRC Press, USA		

ZOOLOGY: SEMESTER-V									
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-3 4 credit Select one Option	24L5.5-ZOO-506	Parasitology	3	3	20	50	70	3 hrs.
			Practical	1	2	10	20	30	4 hrs.
Level of the course: 300-399									
Pre-requisite for the course (if any): Biology as a Subject at 4.0 Level (Class XII)									
Course Learning Outcomes (CLO): Students will be able to: 1. Demonstrate detailed knowledge and understanding of the biology, life cycles, pathogenesis, diagnosis of parasitic infections in humans and their relevance for human health and strategies for control. 2. Demonstrate detailed knowledge and understanding of the biology and strategies for control of the vectors and intermediate hosts of human parasites. 3. Carry out practical laboratory identification of the various parasite stages both free and in tissues and diagnose infections. 4. Demonstrate specialised skills acquired through taking modules on: advanced diagnostic, molecular, immunological, genetic, chemotherapeutic, and ecological and/or control aspects of the subject. 5. Demonstrate the ability to design a laboratory or field based research project, apply relevant research skills, critically analyse and interpret data, and work with minimal supervision.									
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							12	
	Introduction to Parasitology; Brief introduction of Parasitism, Parasite, Parasitoid and Vectors (mechanical and biological vector) Host parasite relationship								
II	Parasitic Protists: Study of Morphology, Life Cycle, Prevalence, Epidemiology, Pathogenicity, Diagnosis, Prophylaxis and Treatment of <i>Entamoeba histolytica</i> , <i>Giardia intestinalis</i>							11	
III	Parasitic Platyhelminthes: Study of Morphology, Life Cycle, Prevalence, Epidemiology, Pathogenicity, Diagnosis, Prophylaxis and Treatment of <i>Fasciolopsis buski</i> , <i>Schistosoma haematobium</i> , Parasitic Nematodes: Study of Morphology, Life Cycle, Prevalence, Epidemiology, Pathogenicity, Diagnosis, Prophylaxis and Treatment of <i>Ancylostoma duodenale</i> , Study of structure, life cycle and importance of <i>Meloidogyne</i> (root knot nematode)							11	
IV	Parasitic Arthropoda: Biology, importance and control of ticks, mites, <i>Pediculus humanus</i> (head and body louse), Parasitic Vertebrates; A brief account of parasitic vertebrates; <i>Cookicutter shark</i> , Hood Mockingbird and Vampire bat							11	
V Practical	1. Study of life stages of <i>Entamoeba histolytica</i> , <i>Giardia intestinalis</i> through permanent slides/micro photographs. 2. Study of adult and life stages of <i>Fasciolopsis buski</i> and <i>Schistosoma haematobium</i> through permanent slides/micro photographs. 3. Study of adult and life stages of <i>Ancylostoma duodenale</i> through permanent slides/micro photographs.							30	

	4. Study of plant parasitic root knot nematode, <i>Meloidogyne</i> from the soil sample. 5. Study of <i>Pediculus humanus</i> (Head louse and body louse) through permanent slides/photographs. 6. Submission of a brief report on parasitic vertebrates.	
Suggested Evaluation Methods		
Internal Assessment: ➤ 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. Arora, D. R and Arora, B. (2001) Medical Parasitology. II Edition. CBS Publications and Distributors 2. E.R. Noble and G.A. Noble (1982) Parasitology: The biology of animal parasites. V Edition,Lea & Febiger 3. Ahmed, N., Dawson, M., Smith, C. and Wood, Ed. (2007) Biology of Disease. Taylor and Francis Group 4. Parija, S. C. Textbook of medical parasitology, protozoology & helminthology (Text and colour Atlas), II Edition, All India Publishers & Distributers, Medical Books Publishers, Chennai, Delhi 5. Rattan Lal Ichhpujani and Rajesh Bhatia. Medical Parasitology, III Edition, Jaypee Brothers Medical Publishers (P) Ltd., New Delhi 6. Meyer, Olsen & Schmidt's Essentials of Parasitology, Murray, D. Dailey, W.C. Brown Publishers 7. Thomas C. Cheng (1986). General Parasitology, II Edition, Academic Press Inc 8. K. D. Chatterjee (2009). Parasitology: Protozoology and Helminthology. XIII Edition, CBS Publishers & Distributors (P) Ltd.		

ZOOLOGY: SEMESTER-VI									
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	24L5.5-ZOO-601	Developmental Biology and Evolution	3	3	20	50	70	3 hrs.
			Practical	1	2	10	20	30	4 hrs.
Level of the course: 300-399									
Pre-requisite for the course (if any): Biology as a Subject at 4.0 Level (Class XII)									
Course Learning Outcomes (CLO) 1. Students will be able to describe origin of life and theories of evolution. 2. Students will able to describe concept of speciation and evolution of horse and man. 3. Students will be able to describe different stages during fertilization. 4. Students will be able to describe the different stages in the development of chick and frog. 5. Students will be able to describe to understand how evolution and development leads to a sustainable life in 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	Historical perspectives, aims and scope of developmental biology. <u>Human fertilization</u> -Generalized structure of mammalian ovum & sperm, spermatogenesis and Oogenesis, fertilization, parthenogenesis, different types of eggs and patterns of cleavage. <u>Blastulation of Frog and Chick-</u> Process of blastulation and fate-map construction in frog and chick.							12	
II	<u>Gastrulation in Frog and Chick-</u> Gastrulation in frog and chick upto the formation of three germinal layers. Elementary knowledge of primary organizers and extra embryonic membranes. Placenta: types; structure and function of placenta in humans. Concepts of competence, determination and differentiation. Concept of regeneration.							11	
III	<u>Origin of life.</u> Concept and evidences of organic evolution. Theories of organic evolution. Concept of micro, macro-and mega-evolution. Evidences of Evolution: Fossil record- types of fossils, geological time scale, Natural selection. Isolating mechanisms, modes of speciation—allopatric, sympatric, Adaptive radiation							11	
IV	Population genetics: Hardy-Weinberg Law Concept of species: Different species concept and speciation. Genetic Drift (mechanism, founder’s effect, bottleneck phenomenon; Role of Migration and Mutation in changing allele frequencies Phylogeny of horse, Evolution of man.							11	
V Practical	1. Preparation of permanent/temporary slides of developmental stages of frog/mosquito. 2. Study of Life History of Frog. 3. Study of permanent slides of WM of chick embryo (13-18h, 24-36h, 36-48h, 48-72h). 4. Window preparation and identification of stages of development in chick egg. 5. Histology: Preparation and study of permanent histological slides of testis, ovary, kidney, intestine, liver of rat (H & E staining).							30	

Suggested Evaluation Methods	
Internal Assessment: ➤ 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. Gilbert, S. F. (2010). Developmental Biology, IX Edition, Sinauer Associates, Inc., Publishers, Sunderland, Massachusetts, USA 2. Balinsky B. I. and Fabian B. C. (1981). An Introduction to Embryology, V Edition, International Thompson Computer Press 3. Carlson, R. F. Patten's Foundations of Embryology 4. Kalthoff (2008). Analysis of Biological Development, II Edition, McGraw-Hill Publishers 5. Lewis Wolpert (2002). Principles of Development. II Edition, Oxford University Press 6. Dobzhansky, Th. Genetics and Origin of Species. Columbia University Press. Dobzhansky, Th., F.J. Ayala, G.L. Stebbins and J.M. Valentine. Evolution. Surjeet Publication, Delhi. 7. Futuyama, D.J. Evolutinary Biology, Suinuaer Associates, INC Publishers, Dunderland. 8. Hartl, D.L. A Primer of Population Genetics. Sinauer Associates, Inc, Massachusetts.	

ZOOLOGY: SEMESTER-VI									
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-12 4 credit	24L5.5-ZOO-602	Basics of Endocrinology and Immunology	3	3	20	50	70	3 hrs.
			Practical	1	2	10	20	30	4 hrs.
Level of the course: 300-399									
Pre-requisite for the course (if any): Biology as a Subject at 4.0 Level (Class XII)									
Course Learning Outcomes (CLO): Students will be able to 1. Develop an in-depth comprehensive knowledge of endocrinology from a physiological cellular and molecular perspective. 2. This course will make students understand the basic structure and chemical organization of hormones and various signaling molecules. 3. The students will know how the immune system can fight infection and other diseases 4. Students will be able to understand the concept of vaccines and its cons and pros. 5. The student will get practical knowledge of basic structure and function of hormones and Immune system.									
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 hormone History of endocrinology, Classification and Characteristic, pituitary gland and its general physiological action: Adenohypophysis hormone (somatotropin and prolactin), Glycoprotein hormones (FSH, LH and TSH), Neurohypophysis hormone (oxytocin and vasopressin, urotensin), physiological role of adrenal hormone, Thyroid hormone action in poikilotherms and homeotherms.							12	
II	Hormone Action and applications Membrane and nuclear receptor hormones (regulation and signal transduction) Permissive actions of hormones and termination of hormone action. Endocrine feedback to stimuli. Hormone and human health: Production of hormones as pharmaceuticals, Genetic analysis of Hormonal disorders. Hormones on IVF, Pregnancy testing and Amniocentesis.							11	
III	Overview of Immune System Introduction to basic concepts in immunology, Components of immune system of Innate and Adaptive Immunity, Cells and organs of immune system (primary and secondary organs), Basic properties of antigen B and T cell epitopes, Adjuvants and haptens, structure ,classes and functions of antibodies and interaction as tools for research and diagnosis.							11	
IV	Working of immune system Structure and functions of MHC molecules. Basic properties and functions of cytokines, Complement system (component and pathways), Introduction to concept of autoimmunity (Rheumatoid Arthritis and tolerance, AIDS). General introduction to Vaccines with its function in biological sciences.							11	
V Practical	1. Study of the permanent slides of all the endocrine glands. 2.Histological study of lymphoid organs spleen, thymus and lymph nodes through slides/ photographs							30	

	3. Preparation of stained blood film to study various types of blood cells. 4. ABO blood group determination. 5. Demonstration of a. ELISA b. Immunoelectrophoresis 6. Immunological diagnosis of pregnancy. 7. Qualitative test for the presence of sugar in urine.	
Suggested Evaluation Methods		
Internal Assessment: ➤ 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. General Endocrinology C. Donnell Turner Pub- SaundersToppan Endocrinology: An Integrated Approach; Stephen Nussey and Saffron Whitehead. Oxford: BIOS Scientific Publishers; 2001. 2. Hadley, M.E. and Levine J.E. 2007. Endocrinology, 6th Edition. Pearson Prentice- Hall, Pearson Education Inc., New Jersey. 3. Kindt, T. J., Goldsby, R.A., Osborne, B. A. and Kuby, J (2006). Immunology, VI Edition. W.H. Freeman and Company. 4. David, M., Jonathan, B., David, R. B. and Ivan R. (2006). Immunology, VII Edition, Mosby, Elsevier Publication. 5. Abbas, K. Abul and Lechtman H. Andrew (2003.) Cellular and Molecular Immunology. V Edition. Saunders Publication		

ZOOLOGY: SEMESTER-VI									
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-4 4 credit Select one Option	24L5.5-ZOO-603	Reproductive Physiology	3	3	20	50	70	3 hrs.
			Practical	1	2	10	20	30	4 hrs.
Level of the course: 300-399									
Pre-requisite for the course (if any): Biology as a Subject at 4.0 Level (Class XII)									
Course Learning Outcomes (CLO): A students is able to learn about 1. The cellular, molecular and biochemical changes in reproductive physiology 2. The basic and molecular concepts of spermatogenesis folliculogenesis, ovulation, follicular atresia and germ line-soma interaction. 3. The importance of diet, exercise, stress and yoga during ageing 4. Various problems of male sterility and female infertility. 5. To give knowledge of animals reproduction to deal with reproduction and fertility problems in animals and 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	Reproductive Endocrinology Introduction to gonadal hormones and mechanism of hormone action, basic mechanism of mode of action of steroid hormones, glycoprotein hormones, and prostaglandins, hypothalamo-hypophyseal – gonadal axis, regulation of gonadotrophin secretion in male and female. Mechanism of sex differentiation.							12	
II	Functional anatomy of male reproduction Outline and architecture of male reproductive system in mammals, spermatogonia, biology of spermatozoa, seminiferous epithelial cycle, spermatogenesis, hormonal control of spermatogenesis, Biochemistry of semen, semen analysis and its utility in medico legal cases.							11	
III	Functional anatomy of female reproduction Outline and histological of female reproductive system in mammals, Reproductive cycles in mammals and their regulation: ovulation, implantation (its type, squencial events during implantation, delayed implantation), Pregnancy: corpus luteum, hormonal control of pregnancy, Parturition: activation and stimulation of uterus, Hormonal meditation; Lactation, morphological and functional development of mammary glands, maintenance of lactation, milk secretion, Menopause.							11	
IV	Reproductive Health Infertility in male and female: causes, diagnosis and management; Assisted Reproductive Technology: sex selection, sperm banks, frozen embryos, in vitro fertilization, ET, EFT, IUT, ZIFT, GIFT, ICSI, PROST; Modern contraceptive technologies; Demographic terminology used in family planning.							11	
V	1. Demonstration of Surgical techniques: principles of surgery in endocrinology.							30	

Practical	Ovarectomy, hysterectomy, castration and vasectomy in rats. 2. Examination of histological sections from photomicrographs/ permanent slides of rat/human: testis, epididymis and accessory glands of male reproductive systems; Sections of ovary, fallopian tube, uterus (proliferative and secretory stages), cervix and vagina 3. Study of modern contraceptive devices 4. Demonstration of male and female reproductive systems of mammals by photograph/online videos. 5. Demonstration of Sperm motility.	
Suggested Evaluation Methods		
Internal Assessment: ➤ 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. Austin, C.R. and Short, R.V. reproduction in Mammals. Cambridge University Press. 2. Degroot, L.J. and Jameson, J.L. (eds). Endocrinology. W.B. Saunders and Company. 3. Knobil, E. et al. (eds). The Physiology of Reproduction. Raven Press Ltd.		

ZOOLOGY: SEMESTER-VI									
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-4 4 credit Select one Option	24L5.5-ZOO-604	Neurophysiology	3	3	20	50	70	3 hrs.
			Practical	1	2	10	20	30	4 hrs.
Level of the course: 300-399									
Pre-requisite for the course (if any): Biology as a Subject at 4.0 Level (Class XII)									
Course Learning Outcomes (CLO) 1. Student will able to understand the structure and function of nervous system at various levels of organization 2. This paper will help students to diagnose and monitor the progress of nervous disorders 3. It will help the students to develop knowledge in cellular and molecular or behavioral perspectives 4. Students will able to understand the neural basis of behaviour and sensory physiology in animals. 5. Students develop critical thinking skills to formulate scientific questions									
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 Neuroscience Introduction to origins of Neuroscience; Neuroanatomy, Neurophysiology, Neurobiology and Neuropharmacology of Behaviour. Introduction to the structure and function of the nervous system: Neurons; Neuroglia; Neuron doctrine; The prototypical neuron.							12	
II	Nerve physiology Basis and significance of membrane potential, equilibrium potential and changes during stimulation action potential generation and its propagation, Na ⁺ K ⁺ current in action potential, Principles of synaptic integration, types of synapsis and synaptic transmission (electric and chemical), synaptic inhibition. EPSP and IPSP Transmission.							11	
III	Neurotransmitters Different types of neurotransmitters– catecholamines, amino acidergic and peptidergic neurotransmitters; Transmitter gated channels; neurotransmitter receptors; Ionotropic and metabotropic receptors.							11	
IV	Sensory physiology Mechanism involved in perception of mechano, photoreception, lateral and compound vertebrate eyes, Neural basis of behaviour, behaviour concepts and measurements. Neurobiology: Neural disorders: Parkinson's, Alzheimer's, Epilepsy, Schizophrenia							11	
V Practical	1. Study of different types of nerve cells with their functions. 2. To demonstrate working of brain with video or photographs. 3. Demonstration the effect of complex trauma on brain function and its recovery 4. Methods used to study neurobiology: CT, MRI, EEG, MEG, PET, FMRI & Visit to lab. 5. Olfaction studies in different groups of vertebrates. 6. Study of novelty, anxiety and spatial learning in mice.							30	

Suggested Evaluation Methods	
Internal Assessment: ➤ 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. Neuroscience: Exploring the brain by Mark F. Baer; Barry W. Connors. 2015 2. From Molecules to Networks: An Introduction to Cellular and Molecular Neuroscience by John H. Byrne, Ruth Heidelberg and M. Neal Waxham 3. Neuroscience-Eds. Dale Purves et. al. (3rd Edn)-Sinauer Associates, Inc.-2004 4. Principles of Neural Science-4th Edn-Eds. Kandel, Schwartz and Jessell- McGraw- Hill Companies-2000 5. Nerve Cells and Animal Behaviour-2nd Edn-Peter J Simmons and David Young- CUP-2003 6. EssentialPsychopharmacology-Neuroscientific Basis and Practical Applications- 2nd Edn.-Stephan M. Stahl-CUP-2000 7. Phantoms in the Brain - Vilayanur S. Ramachandran and Sandra Blakeslee-1998 8. The Human Brain Book - Rita Carter-2009	

ZOOLOGY: SEMESTER-VI									
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-5 4 credit Select one Option	24L5.5-ZOO-605	Molecular Biology	3	3	20	50	70	3 hrs.
			Practical	1	2	10	20	30	4 hrs.
Level of the course: 300-399									
Pre-requisite for the course (if any): Biology as a Subject at 4.0 Level (Class XII)									
Course Learning Outcomes (CLO): Students will be able to understand									
1. Molecular Biology which chiefly deals with interactions among various systems of the cell, including those between DNA and RNA and learning how these are regulated									
2. The Concept of gene, gene cistron relationship in prokaryotes and eukaryotes									
3. DNA regulation and replication; Types of DNA damage, DNA repair pathways Transcription in prokaryotes									
4. The process of Reverse transcription; Repeated sequences; Transposons types and transposition mechanism									
5. The concept of qualitative and quantitative estimation of nucleic acid by designing and implementing experimental procedures using relevant techniques									
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	Nucleic Acids: Salient features of DNA and RNA, Watson and Crick model of DNA DNA Replication: DNA Replication in prokaryotes and eukaryotes, mechanism of DNA replication, Semi-conservative, bidirectional and semi-discontinuous replication							12	
II	Transcription: RNA polymerase and transcription Unit, mechanism of transcription in prokaryotes and eukaryotes, transcription factors Translation: Genetic code, Degeneracy of the genetic code and Wobble Hypothesis; Process of protein synthesis in prokaryotes: Ribosome structure and assembly in prokaryotes, fidelity of protein synthesis, Difference between prokaryotic and eukaryotic translation							11	
III	Post Transcriptional Modifications and Processing of Eukaryotic RNA: Concept of introns and exons, splicing mechanism, alternative splicing, exon shuffling, and RNA editing, Processing of t-RNA Gene Regulation: Transcription regulation in prokaryotes: Principles of transcriptional regulation with examples from lac operon and trp operon; Transcription regulation in eukaryotes: Activators, repressors, enhancers, silencer elements; Gene silencing, Genetic imprinting							11	
IV	DNA Repair Mechanisms: Pyrimidine dimerization and mismatch repair Regulatory RNAs: RNA interference, miRNA, siRNA							11	
V Practical	1. Study of Polytene chromosomes from Chironomous /Drosophila larvae 2. Estimation of the growth kinetics of E. coli by turbidity method 3. Preparation of solid culture medium (LB) and growth of E. coli by spreading and streaking 4. Demonstration of antibiotic sensitivity/resistance of E. coli to antibiotic pressure and interpretation of results 5. Quantitative estimation of RNA using Orcinol reaction							30	

	6. Study and interpretation of electron micrographs/photograph showing (a) DNA replication (b) Transcription (c) Translation	
Suggested Evaluation Methods		
Internal Assessment: ➤ 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. Becker, W.M., Kleinsmith, L.J., Hardin. J. and Bertoni, G. P. (2009). The World of the Cell. VII Edition. Pearson Benjamin Cummings Publishing, San Francisco. 2. Bruce Alberts, Alexander Johnson, Julian Lewis, Martin Raff, Keith Roberts, Peter Walter: Molecular Biology of the Cell, IV Edition. 3. Cooper G. M. and Robert E. Hausman R. E. The Cell: A Molecular Approach, V Edition, ASM Press and Sinauer Associates. 4. De Robertis, E.D.P. and De Robertis, E.M.F. (2006). Cell and Molecular Biology. VIII Edition. Lippincott Williams and Wilkins, Philadelphia. 5. Karp, G. (2010) Cell and Molecular Biology: Concepts and Experiments. VI Edition. John Wiley and Sons. Inc. 6. Lewin B. (2008). Gene XI, Jones and Bartlett 7. McLennan A., Bates A., Turner, P. and White M. (2015). Molecular Biology IV Edition. GS, Taylor and Francis Group, New York and London.		

ZOOLOGY: SEMESTER-VI									
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-5 4 credit Select one Option	24L5.5-ZOO-606	Forensic Biology	3	3	20	50	70	3 hrs.
			Practical	1	2	10	20	30	4 hrs.
Level of the course: 300-399									
Pre-requisite for the course (if any): Biology as a Subject at 4.0 Level (Class XII)									
Course Learning Outcomes (CLO): The students will be able to know 1. The significance of biological and serological evidence 2. The importance of biological fluids – blood, urine, semen, saliva, sweat and milk – in crime investigations 3. The Enhance the knowledge about wildlife forensics aid in conserving natural resources 4. The Enhance the knowledge of forensic entomology assists in death investigations 5. About practical applications of forensic 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	Biological Evidence Nature and importance of biological evidence. Composition and Functions of Blood and Semen. Significance of hair evidence. Transfer, persistence and recovery of hair evidence. Structure of human hair. Types and identification of microbial organisms of forensic significance, Identification of Blood, Semen, Saliva and Urine through preliminary and confirmatory crystal examinations.							12	
II	Forensic Botany Identification of wood, leaves, pollens and juices as botanical evidence. Diatoms and their forensic significance.							11	
III	Wildlife Forensics Fundamentals of wildlife forensic. Significance of wildlife forensic. Protected and endangered species of animals and plants. Illegal trading in wildlife items, such as skin, fur, bone, horn, teeth, flowers and plants. Identification of physical evidence pertaining to wildlife forensics. Identification of pug marks of various animals.							11	
IV	Forensic Entomology Basics of forensic entomology. Insects of forensic importance. Collection of entomological evidence during death investigations.							11	
V Practical	1. To examine hair morphology and its Comparison with animal hair. 2. To prepare slides of scale pattern of human hair. 3. To examine human hair for cortex and medulla. 4. To carry out microscopic examination of pollen grains. 5. To carry out microscopic examination of diatoms.							30	

	6. To cite a crime case in which diatoms have served as forensic evidence. 7. To prepare a case report on forensic entomology. 8. To prepare a case report on problems of wildlife forensics.	
Suggested Evaluation Methods		
Internal Assessment: ➤ 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. L. Stryer, Biochemistry, 3rd Edition, W.H. Freeman and Company, New York (1988). 2. R.K. Murray, D.K. Granner, P.A. Mayes and V.W. Rodwell, Harper's Biochemistry, APPLETON & Lange, Norwalk (1993). 3. S. Chowdhuri, Forensic Biology, BPRD, New Delhi (1971). 4. R. Saferstein, Forensic Science Handbook, Vol. III, Prentice Hall, New Jersey (1993). 5. G.T. Duncan and M.I. Tracey, Serology and DNA typing in, Introduction to Forensic Sciences, 2nd Edition, W.G. Eckert (Ed.), CRC Press, Boca Raton (1997).		

ZOOLOGY: SEMESTER-VII

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-H14 Credit	24L6.0-ZOO-701	Advances of Cell Biology	4	4	30	70	100	3hrs.

Level of the course:	400-499
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Pre-requisite for the course(if any): Zoology as single major in 3 years UG
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Course Learning Outcomes(CLO)

1. This core course will make students able to understand how the cell functions as a unit of life.
2. Through this course, students will be able to appreciate the importance of various cell function and structures in the evolution of multi cellular organisms.
3. The studies will make the students reveal elegance, dynamics and economy in the living cell and a gratifying unity in the principles by which a cell functions.
4. The students will know about the basic cellular and molecular approaches for cancer development and treatment.

Instructions for Paper-Setter

- 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	1. Bio membranes 1.1 Molecular composition and arrangement, functional consequences 1.2 Cellular Transport – Recapitulation of the plasma membrane; diffusion, active transport and pumps, uniports, symports and antiports. 1.3 Donnan equilibrium; ion movements and cell function: acidification of cell organelles 1.4 Maintenance of cellular pH; cell excitation; bulk transport; Receptor mediated endocytosis 1.5 Trans epithelial transport 2. Cytoskeleton and cell movement 2.1 Introduction to the Cytoskeleton and its role 2.2 Molecular structure of Actin, myosin and their organisation 2.3 Structure and dynamic organizations of microtubules and microfilaments 2.4 Microtubule motors and movement 2.5 Intermediate filaments 2.6 Role of Centrioles and Basal Bodies 2.7 Structure and functions of Cilia and flagella	15
II	3 The Extra Cellular Matrix and Cell interactions 3.1 Cell walls 3.2 The E C M and cell-matrix interactions 3.3 Cell-cell interactions: adhesion junctions, tight junctions, gap junctions, plasmodesmata 3.4 Ca⁺⁺dependent and Ca⁺⁺independent Homophilic cell-cell adhesion	15

	4 Cell matrix adhesion 4.1 Integrins 4.2 Collagen 4.3 Non-collagen components 4.4 Auxin and cell expansion 4.5 Cellulose fibril synthesis and orientation 5 Protein sorting and transport 5.1 Protein uptake into the ER 5.2 Membrane proteins and Golgi sorting 5.3 Mechanism of vesicular transport 5.4 Lysosomes 5.5 Molecular mechanism of secretory pathway	
III	6 Cell cycle 6.1 Eukaryotic cell cycle 6.2 Regulators of cell cycle progression 6.3 Role of Meiosis in Genetic Variation 7 Cell–Cell signaling 7.1 Signaling molecules and their receptors 7.2 Pathways of intracellular signal transduction 8 Biology of Cancer 8.1 The development and causes of cancer 8.2 Oncogenes 8.3 Tumor suppressor genes Molecular approaches to cancer treatment	15
IV	9 Genome organization 9.1 Chromosomal organization of genes 9.2 Transposons in prokaryotes and eukaryotes 9.3 Morphological and functional elements of eukaryotic chromosomes 10 Cell Death 10.1 Necrosis and Programmed cell death 10.2 Molecular Mechanism 10.3 Applications and Significance 11 Biology of Ageing 11.1 Morphological, Physiological and Functional changes during Ageing 11.2 Telomeres and Ageing 11.3 Theories of Ageing	15
Total Contact Hours		60
Suggested Evaluation Methods		
Internal Assessment: 30		End Term Examination: 70
Theory	30	Written Examination
Class Participation:	5	
Seminar/presentation/assignment/quiz/ class test etc.:	10	
Mid-Term Exam:	15	
Part C-Learning Resources		
Recommended Books/e-resources/LMS: 1. Molecular Cell Biology ,J. Darnell, H.Lodish and D.Baltimore ScientificAmerican Book,Inc., USA. 2. Molecular Biology of the Cell,B.Alberts,D.Bray,J.Lewis,M.Raff,K.RobertsandJ.D.Watson.Garland Publishing Inc., New York. 3. Cell and molecular biology Phillip Sheeler,Donald E.BianchiWiley,1987 4. Life: The Science of Biology by David Sadava 5. Cell and Molecular Biology by De Robertis 6. Cell Biology by A.K.Berry, EMKAY Publlications 7. Molecular Cell Biology, Lodish et al.,W.H. Freeman and Company (8thEd.2016) 8. Molecular Biology, Weaver R. F.,Mc Graw-Hill Education(5thEd. 2011)		

ZOOLOGY: SEMESTER-VII									
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-H2 4 Credit	24L6.0-ZOO-702	Biochemistry and Biotechniques	4	4	30	70	100	3hrs.
Level of the course: 400-499									
Pre-requisite for the course(if any): Zoology as single major in 3 years UG									
Course Learning Outcomes (CLO): - Students will be able to understand A basic knowledge of the underlying principles and practical strategy of the analytical and preparative techniques that are fundamental to study and understanding of life processes. - The general reactions of various metabolic pathways. - The principle, working, materials used and applications of various biological techniques that are used to study the basic biological processes. - The underlying description of the structure and classification of biomolecules.									
Instructions for Paper-Setter - Nine questions will be set in all. All questions will carry equal marks. - 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	1.0 General Principles of Biochemistry and chemical composition of life 1.1 General Introduction to Bio molecules 2.0 Protein Biology: 2.1 Primary, Secondary, tertiary and quaternary structure of proteins : i) Domain, ii) Ramachandran plot and its significance 3.0 Enzyme: 3.1 Classification and nomenclature, 3.2 Co-enzymes and Cofactors 3.3 Induced fit and Molecular Mechanism of Enzyme action, 3.4 Enzyme feedback mechanism, Isozymes. 4.0 Nucleic acids: Structure and Functions 4.1 DNA structure and functions 4.2 RNA structure and functions, 4.3 DNA choreography 4.4 Qualitative and quantitative estimation of DNA							15	
II	5.0 Metabolism: 5.1 Glycolysis, citric acid cycles its regulation and role as metabolic hub. 5.2 Hexose monophosphate pathway its regulation and significance. 5.3 Cholesterol biosynthesis, its metabolism and steroidogenesis. 5.4 Bile acids and their metabolism 5.5 Saturated and unsaturated fatty acid and their metabolism.							15	
III	6.0 Chemical and Biological assays(<i>in vitro</i> and <i>in vivo</i> assays). 7.0 Principles and uses of analytical instruments:								

	7.1 Microscopes and imaging 7.2 Spectrophotometers, 7.3 NMR spectrophotometer 8.0 Microbiological and cell culture Techniques 8.1 Setting of microbiological laboratory, 8.2 Sterilization and Media preparation techniques 8.3 Inoculation and growth monitoring (Standard plate count technique), 8.4 Isolation of a microbial colony and slant preparation. 8.5 Design and functioning of tissue culture laboratory, 8.6 Basics of cell/tissue culture, Culture media preparation, 8.7 Cell proliferation measurements 8.8 Cell viability testing and Cell harvesting methods. 8.9 Bio safety levels 9.0 Cryotechniques: 9.1 Cryopreservation for cells, tissue, organisms 9.2 Cryotechniques for microscopy.	15
IV	10.0 Separation techniques in biology. 10.1 Molecular separations by chromatography, electrophoresis, precipitation etc. 10.2 Organelle separation by centrifugation. Density gradient centrifugation, Ultra Centrifugation, unit gravity centrifugation, affinity adsorption, anchorage based techniques etc. 10.3 Cell separation by flowcytometry and FACS 11.0 Radioisotopes and mass isotope techniques in biology: 11.1 Carbon dating and radioactive counting 11.2 Autoradiography 11.3 Biosensors 12.0 DNA fingerprinting	15
Total Contact Hours		60
Suggested Evaluation Methods		
Internal Assessment: 30		End Term Examination: 70
Theory	30	Written Examination
Class Participation:	5	
Seminar/presentation/assignment/quiz/class test etc.:	10	
Mid-Term Exam:	15	
Part C-Learning Resources		
Recommended Books/e-resources/LMS: 1. Animal Cell Culture–A practical approach, Ed. John R.W. Masters, IRL Press. 2. Introduction to Instrumental analysis, Robert Braun, McGraw Hill International editions 3. A Biologists guide to Principles and Techniques of Practical Biochemistry, K.Wilsonand K.H. Goulding, ELBS Edn. 4. Lehninger AL, Nelson DL & Cox MM(1993)Principles of Biochemistry,2ndedn.NewYork:Worth. 5. StryerL (1995)Biochemistry, 4thedn.NewYork:WHFreeman. Voet D,Voet J G&PrattCW(1999)Fundamentals of Biochemistry.NewYork:Wiley.		

ZOOLOGY: SEMESTER-VII

ZOOLOGY: SEMESTER-VII									
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-H3 4 Credit	24L6.0-ZOO-703	Structure and Function of Invertebrates	4	4	30	70	100	3hrs.
Level of the course: 400-499									
Pre-requisite for the course(if any): Zoology as single major in 3 years UG									
Course Learning Outcomes (CLO) 1. The study of invertebrates reveals progressive evolutionary history and adaptations together which forms the basis of huge complex and diverse life forms. 2. Students will acquire a clear understanding about organization of minor phyla and their relationship with other animal phyla 3. Students will be able to know the structure and significance of various systems of Invertebrates 4. Will have detail understanding of adaptations and significance of Invertebrates									
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	1.0	Introduction to invertebrates with their general characters, Basic body plan, Concept of Invertebrate v/s Vertebrata and Non-Chordata v/s Chordata							15
	2.0	Organization of coelom							
		2.1 Concept and structure of Acoelomate, Pseudo coelomates and Coelomates.							
		2.2 Protostomia and Deuterostomia							
		2.3 Metamerism in Annelida, Pseudometamerism.							
	3.0	Minor Phyla:							
		3.1 Concept and significance							
		3.2 Organization and general characters of Acoelomate, Pseudo coelomates and Coelomates minorphyla (with special emphasis on Ctenophora, Rotifera, Endoprocta, Ectoprocta, Phoronida, Sipunculida and Echiuroidea).							
II	4.0	Locomotion							15
		4.1 Flagella and ciliary movement in Protozoa							
		4.2 Hydrostatic movement in Coelenterata, Annelida and Echinodermata							
	5.0	Nutrition and Digestion							
		5.1 Patterns of feeding and digestion in lower metazoa							
		5.2 Filter-feeding in Polychaeta, Mollusca and Echinodermata							
	6.0	Respiration							
		6.1 Organs of respiration: Gills, lungs, trachea, skin, Cloacal chamber, Bucco pharyngeal area etc.							
		6.2 Respiratory pigments							
		6.3 Mechanism of respiration							
III	7.0	Excretion							

	7.1	Organs of excretion: Coelom, coelomoducts, Nephridia and Malpighian tubules.	15
	7.2	Mechanism of excretion and osmoregulation	
8.0	Nervous system		
8.1	Primitive nervous system: Coelenterata and Echinodermata		
8.2	Advanced nervous system: Annelida, Arthropoda (Crustacea and Insecta) and Mollusca (Cephalopoda).		
	8.3	Trends in neural evolution.	
	9.0	Social life in insects, Social life in Isoptera and Hymenoptera	
IV	10.0	Invertebrate larvae	15
	10.1	Larval forms of free living invertebrates	
	10.2	Strategies and Evolutionary significance of larval forms	
	10.3	Conservation of invertebrates.	
	11.0	Introduction to insects	
	11.1	Mouthparts of Insects	
	11.2	Mechanism of insect flight and hovering	
	11.3	Metamorphosis in insects	
	11.4	Hormonal control of moulting.	
12.0	Economic importance of Invertebrates; Various Adaptations in Invertebrates		
Total Contact Hours			60
Suggested Evaluation Methods			
Internal Assessment: 30		End Term Examination: 70	
Theory	30	Written Examination	
Class Participation:	5		
Seminar/presentation/assignment/quiz/class test etc.:	10		
Mid-Term Exam:	15		
Part C-Learning Resources			
Recommended Books/e-resources/LMS:			
1. Hyman,L.H. The invertebrates, Vol.I. Protozoa through Ctenophora, Mc GrawHil lCo., NewYork.			
2. Barrington,E.J.W. Invertebrate structure and function. Thomas Nelson and Sons Ltr J.London.			
3. Jagerstein,G. Evolution of Metazoan life cycle, Academic Press, New York &London.			
4. Barnes,R.D. Invertebrate Zoology, 3 rd edition.W.B.SaundersCo.,Philadelphia.			
5. Russel-Hunter,W.D. A Biology of higher invertebrates, theMacmillinCo.Ltd.London.			
6. Hyman,L.H.the Invertebratessmaller coelomate groups,Vol. V. Mc GrawHillCo., NewYork			
7. Read, C.P. Animal Parasitism. PrenticeHallInc.,NewJersey.			
8. Sedgwick,A.A. Student text book of Zoology. Vol.I,II and III CentralBookDepot, Allahabad			
9. Parker,T.J.,Haswell,W.A. Textbook of Zoology, McMillanCo., London.			

ZOOLOGY: SEMESTER-VII

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	DSE-H1 4 Credit	24L6.0-ZOO-704	Biosystematics and Biostatistics	4	4	30	70	100	3hrs.
Level of the course: 400-499									
Pre-requisite for the course(if any): Zoology as single major in 3 years UG									
Course Learning Outcomes(CLO): Students will be able to understand: 1. Knowledge of Taxonomy helps in classifying and identifying biodiversity and biologist study the well understood relationships by making phylogenetic trees. 2. It will help to understand the overall biodiversity of the world and their application in all the fields of biological sciences. 3. Biostatistics helps to generate a hypothesis from a set of observation and then design experiment to test the hypothesis. 4. Able to acquire, analyze and understand the significance of data.									
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	1.0 Biosystematics and taxonomy: Definition and perspectives, 2.0 Historical resume, Importance and applications of systematics in biology. 2.1 Concepts of newer aspects of biosystematics: Chemotaxonomy, Cytotaxonomy, Molecular taxonomy. 3.0 Dimensions of speciation and taxonomic characters: 3.1 Different Species concepts – species category, 3.2 Sub-species and other intra-specific categories. 4.0 Theories of biological classification, hierarchy of categories. 5.0 Taxonomic characters – different kinds, weighing of characters							15	
II	6.0 Methodology: 6.1 Taxonomic collections, preservation, curation process and identification. 6.2 Taxonomic keys-different kinds of taxonomic keys, their merits and demerits. 7.0 Systematic publications: 7.1 Different kinds of publications. 7.2 International code of Zoological Nomenclature (ICZN): principles, objectives and rules: Stability, Priority, Concept of availability, formation of names, synonymy, homonymy, the type method, kinds of type specimen, type-designation. 8.0 Principles of Bioethics in Biodiversity							15	
III	.1 Arithmetic mean, mode and median, Definition, calculation and its properties. 10.0 Measures of Dispersion: 10.1 Range, Interquartile range, 10.2 Quartile deviation.								

	10.3 Mean deviation and standard deviation, 10.4 Standard error 11.0 Correlation: 11.1 Types and Methods studying correlation – Scatter diagram method, Graphic method, Karl Pearson coefficient of correlation, Rank correlation. 12.0 Regression analysis (Regression lines and regression equation) 13.0 Chi-square analysis	15
IV	14.0 Concept of sampling and sampling methods: 14.1 Definition and law of sampling, 14.2 Judgment sampling, Random sampling, stratified sampling, systematic sampling, multi-stages sampling and quota sampling. 15.0 Test of significance for large samples and small samples (student t-test, F- test; ANOVA). 16.0 Probability and law of probability, Theoretical probability distribution: Binomial distribution, Poison distribution, Normal distribution. 17.0 Components of computers, Basic functioning of computers, Use of Statistical Software in Biology	15
Total Contact Hours		60
Suggested Evaluation Methods		
Internal Assessment: 30		End Term Examination: 70
Theory	30	Written Examination
Class Participation:	5	
Seminar/presentation/assignment/quiz/class test etc.:	10	
Mid-Term Exam:	15	
Part C-Learning Resources		
Recommended Books/e-resources/LMS:		
1. M. Kato. The Biology of Biodiversity, Springer.		
2. E.O. Wilson, Biodiversity, Academic Press, Washington.		
3. G.G. Simpson, Principle of animal taxonomy, Oxford ISH Publishing Company.		
4. E. Mayer, Elements of Taxonomy.		
5. E.O. Wilson, The Diversity of Life (The College Edition), W.W. Northerm& Co.		
6. Fundamental of statistics by S.C. Gupta. Himalayan Publishing House		
Elements of Biostatistics. By Satguru Prasad. Rastogi Publication.		

ZOOLOGY: SEMESTER-VII

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	DSE-H1 4 Credit Select one option	24L6.0-ZOO-705	Computational Biology	4	4	30	70	100	3hrs.

Level of the course: **400-499**

Pre-requisite for the course(if any):**Zoology as single major in 3 years UG**

Course Learning Outcomes (CLO)	
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1. Students will be able to describe basic components of computer hardware and software
2. Students will be able to access Working with MS Excel, MS Word and MS power point.
3. Students will be able to describe about computational statistics.
4. Students will be able to understand the bioinformatics techniques of data handling and processing.

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	Basic components of Computer: Hardware, CPU, input devices, output devices). Computer Memory, concepts of computing. Software: Basics of Operating system and its utilities., Application Software, word Processing, introduction to MS excel, Use of worksheet to enter Data, edit data, copy data, move data. Graphical tools in excel for data presentation, Various Formula and functions.	15
II	MS-word processor-editing, copying, formatting, table insertion, flow charts. Working with MS Powerpoint, Data handling and image Processing. Internet, Search engines, Web browser. E-governance websites, Working with arc GIS, Working with Google Earth Pro, USGS.QGIS , GPS KIT. UTM converter. Working with software like DISTANCE, PREFER., RAVEN.	15
III	Use of in-built statistical functions for computation of mean, S.D, correlation and regression coefficient, correlation, regression coefficient, ANOVA, PCA, Confidence Interval, Chi square test, Z-test, T-test, F-Test.. Computational use of histogram, bar diagram, scatter plot. Statistical errors. Data handling, Image processing.	15
IV	Introduction to Bioinformatics, Introduction to computational genomics and proteomics. Basics of Microarray and Image analysis. Basics of Molecular Modelling. Biological Data base, Primary , Secondary and composite database, Protein and Nucleic Acid Data base.	15
Total Contact Hours		60
Suggested Evaluation Methods		
Internal Assessment: 30		End Term Examination: 70
Theory	30	Written Examination
Class Participation:	5	
Seminar/presentation/assignment/quiz/c	10	

lass test etc.:		
Mid-Term Exam:	15	
Part C-Learning Resources		
1. Kelley, S.T., & Didulo, D. (2018) Computational Biology: A Hyper text book (ASM Books). ASM press. 2. Low,L & Tammi, M (2017) Bioinformatics: A Practical hand book of next generation , sequencing and applications. World scientific publishing cooperation. 3. Ghosh, Z and Mallick, B 92008) Bioinformatics, principles and application. Oxford Universty Press.		

ZOOLOGY: SEMESTER-VII									
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	PC-H1 4 Credit	24L6.0-ZOO-706	Practical Based on B24-ZOO-701 TO 703 and any one out of on B24-ZOO 704 & 705	4	8	30	70	100	6 hrs.
Level of the course: 400-499									
Pre-requisite for the course (if any): Zoology as a Subject at B.Sc. Level									
Course Learning Outcomes (CLO) 1. Students will develop skills in basic laboratory techniques and understand the principles in Biology. 2. Students will be able to apply the scientific method to the process of experimentation. 3. This course will make students able to understand the regulation of chemical reactions in living cells. 4. Students will be able to understand the computational biology and techniques of data handling and processing.									
UNIT	TOPICS								CONTACT HOURS
I	1. Preparation of mitotic chromosomes from onion root tips. 2. Preparation of meiotic chromosomes from grasshopper testes. 3. Preparation of karyotypes from micrographs. 4. Calculation of morphometric data and preparations of idiogram. 5. Study of permanent slides of different stages of meiosis and mitosis. 6. Proteins: Quantitative estimation of proteins by Biuret method and Lowry's method. 7. Carbohydrates: quantitative estimation of total carbohydrates and glucose 8. Analysis of Fats/Oils: iodine number, saponification value, acid value quantitative estimation of total lipids. 9. Paper chromatography: amino acids and carbohydrates. 10. Tools: demonstration of parts and working of the following tools: PCR, GLC, Spectrophotometers, various kinds of microscopes, pH meter, Electrophoresis, Centrifuges, Tissue culture unit, Incubators 11. Slides and Museum specimens of phylum Protozoa to Hemichordata 12. Study of various types of Larvae of class Insecta. 13. Study of various types of larvae of class Crustacea. 14. Identification and study of various types of Mouth parts in class insecta.								120
II	DSE-H1 (option 1) 15. Preparation and use of different types of taxonomic keys. 16. Statistical analysis of data using manual and computer software methods			DSE-H1 (option 2) 17. Use of Search engines like scopus Science direct of collection of reference material. 18. Use of GIS software like ARCGIS, Google earth pro etc					
Suggested Evaluation Methods									
Internal Assessment: 30					End Term Examination: 70				

➤ Practicum • Class Participation: 5 • Seminar/presentation/assignment/quiz/class test etc.: 10 Mid-Term Exam: 15	➤ Practicum Lab record, Viva-Voce, Execution of the practical Write up
Part C-Learning Resources	
Recommended Books/e-resources/LMS: 1. Sharma R K, Sangha S P S (2009). Basic Techniques in Biochemistry and Molecular Biology, I.K. International Publishing House Pvt. Ltd. New Delhi 2. Podder T, Mukhopadhyay S, Das SK (2003). An Advanced Laboratory Manual Of Zoology Published by Rajiv Beri for Macmillan India Limited, Rajkamal Electric Press, Delhi 3. Sadasivam S, Manickam A (1997). Biochemical Methods, Ed. 2nd, New Age International Publishers, New Delhi 4. David T. Plummer (1987). An Introduction to Practical Biochemistry. Ed., 3rd, McGraw-Hill Publisher, Rajkamal Electric Press, Delhi	

ZOOLOGY: SEMESTER-VIII

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 Scheme B & C	CC-H4 4 Credit	24L6.0-ZOO-801	Structure and Function of Vertebrates	4	4	30	70	100	3hrs.

Level of the course:**400-499**

Pre-requisite for the course(if any):**Zoology as single major in 3 years UG**

Course Learning Outcomes (CLO)	
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1. Students will be able to understand various biological functions, the evolution of life from most primitive to most advanced form with respect to their habit and habitat.
2. Students will have acquaintance with the basic concepts, external morphology and sexual dimorphism in chordates and understand the various systems, adaptation and dentition in chordates.
3. Students will also Understand the Classification various classes of phylum Chordate i.e., Pisces, Reptiles, Aves and Mammals.
4. This course will make students familiarize with the vertebrate diversity around them

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	1.0 Introduction to Chordates with their general characters. 1.1 Origin of Chordates 1.2 Concept of Proto chordata or pre-vertebrates 1.3 Classification of Vertebrates up to orders 2.0 Integument and its derivatives 2.1 Development, general structure and functions of skin and its derivative 2.2 Glands, scales, horns, claws, nails, hoofs, feathers and hair	15
II	3.0 Skeletal system 3.1 Form, function, body size and skeletal elements of the body 3.2 Comparative account of jaw suspensorium, Vertebral column 3.3 Limbs and girdles 4.1 Digestive system 4.1 Dentition, Stomach, Digestive Glands 4.2 Anatomy of gut in relation of to feeding habits- herbivores, carnivores and omnivores. 5.0 Respiratory system 5.1 Characters of respiratory tissue, Internal and External Respiration 5.2 Comparative account of respiratory organs	15
III	6.0 General plan of circulation in various groups 6.1 Components of Blood 6.2 General plan of circulation in reptiles, birds and mammals 6.3 Evolution of heart, aortic arches and Portal systems 7.0 Evolution of Urino-genital system in vertebrate series 7.1 Structure and functions of different types of kidney 7.2 Urino-genital ducts 8.0 Flight adaptation in birds, Migration in fish and Birds	15
IV	8.0 Nervous system	

	8.1 Comparative anatomy of the brain in relation to its functions 8.2 Comparative anatomy of spinal cord 8.3 Nerves-Cranial, Peripheral and Autonomous nervous systems 9.0 Sense organs 9.1 Simple receptors 9.2 Organs of Olfaction and taste 9.3 Lateral line system 9.4 Electroreception	15
Total Contact Hours		60
Suggested Evaluation Methods		
Internal Assessment: 30		End Term Examination: 70
Theory	30	Written Examination
Class Participation:	5	
Seminar/presentation/assignment/quiz/class test etc.:	10	
Mid-Term Exam:	15	
Part C-Learning Resources		
Recommended Books/e-resources/LMS: 1. Barrington, E.J.W. The Biology of Hemichordata and Protochordata .Oliver and Boyd, Edinburgh. 2. Bourne,G.H.The structure and functions of nervous tissue. Academic Press, New York. 3. Carter,G.S. Structure and habit invertebrate evolution-Sedgwick and Jackson, London. 4. Kingsley,J.S. Outlines of Comparative Autonomy of Vertebrates. Central Book Depot, Allahabad. 5. Kent, C.G. Comparative anatomy of vertebrates. 6. Milton Hilderbrand. Analysis of vertebrate structure. IV. Ed. John Wiley and Sons Inc., NewYork. 7. Sedgwick,A. A Students Text Book of Zoology, Vol. II. 8. Torrey,T.W. Morphogenesis of vertebrates. John Wiley and Sons Inc., New York and London. Walters,H.E. and Sayles, L.D. Biology of vertebrates. MacMillan &Co. ,NewYork.		

ZOOLOGY: SEMESTER-VIII									
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 Scheme B & C	CC-H5 4 Credit	24L6.0-ZOO-802	Comparative Physiology	4	4	30	70	100	3hrs.
Level of the course: 400-499									
Pre-requisite for the course(if any): Zoology as single major in 3 years UG									
Course Learning Outcomes (CLO) 1. An appropriate understanding of functioning of each system of different groups of animals with their comparison will be acquainted. 2. The students will be able to explore all reasoning and queries that how animals work. 3. The students will be able to learn that how the physiology of different groups of organisms is influenced by the different environments of their niches 4. Since this course also have some important practical component where interesting exercises will be conducted to perform experiment and answer various queries of animal physiology.									
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	1.0 Digestion 1.1 Feeding mechanisms and regulation 1.2 Comparative physiology of digestion and absorption in different animal groups 2.0 Respiration 2.1 Respiratory organs, Types of respiration, mechanism of breathing 2.2 Transport of respiratory gases 2.3 Respiratory pigments through different phylogenetic groups. 2.4 Physiological response to oxygen deficient stress. 3.0 Excretion 3.1 Patterns of nitrogen excretion among different animal groups 3.2 Functional anatomy of renal unit; mechanisms of ultra filtration, Counter Current mechanism, Dialysis 4.0 Osmo regulation in different animal groups 4.1 Definition and basic classification of organisms on the basis of osmo regulation 4.2 Osmotic challenges of different environments 4.3 Mechanism of Osmoregulation in fresh water, Estuarine and Marine animals 4.4 Osmoregulation in migratory organisms, Control and regulation of osmoregulation							15	
II	5.0 Thermoregulation 5.1 Homeothermic animals, Poikilotherms, Hibernation and Aestivation, 5.2 Physical, chemical, neural regulation, Physiological adaptations acclimatization & acclimation in response to high, low ambient temperature								

	6.0 Circulation of body fluids and the irregularity among different animal groups 6.1 Systems of circulation, heart beat and blood pressure, 6.2 Cardiac cycle, Cardiac output and its regulation, 6.3 Lymphatic system 7.0 Receptor physiology—a comparative study of Mechanoreception, Photoreception, Chemoreception and Equilibrium reception 8.0 Muscle and Contractile physiology 8.1 Contractile elements, cells and tissues among different phylogenetic groups; Muscle structure and function-correlation; 8.2 Electric organs and tissues	15
III	9.0 Comparative testicular physiology in animals 9.1 Morphology, Differentiation, Function and its regulation 10.0 Comparative ovarian physiology and differentiation in vertebrates 10.1 Morphology, Endocrinology, Oogenesis, vitellogenesis 11.0 Neuronal physiology 11.1 Structure and classification of neurons and glial cells. 11.2 Synaptic action, dendritic properties and functional operation of spinal cord, Brain stem 11.3 Autonomic nervous system	15
IV	12.0 Principles of synaptic transmission 12.1. Ca^{2+} and neurotransmitter release; post synaptic transmission mechanism; 12.2. Diversity of neurotransmitters: acetylcholine, catecholamine, serotonin, GABA, glycine, histamine, peptides, NO, and opioids. 13.0 Physiological adaptations to different environments 13.1 Physiological adaptations acclimatization & acclimation in response to high, low ambient temperature, 13.2 Physiological adaptation at high altitude and in deep sea environment. 14.0 Stress Physiology: Concept of Stress and Strain, 14.1 Stress hormones and stress regulatory mechanisms.	15
Total Contact Hours		60
Suggested Evaluation Methods		
Internal Assessment: 30		End Term Examination: 70
Theory	30	Written Examination
Class Participation:	5	
Seminar/presentation/assignment/quiz/ class test etc.:	10	
Mid-Term Exam:	15	
Part C-Learning Resources		
Recommended Books/e-resources/LMS:		
1. C.L.Prosser. Comparative Animal Physiology. W.B.Saunders & Company. 2. R.Eckert. Animal Physiology: Mechanisms and Adaptation. W.H. Freeman & Company. 3. W.S. Hoar. General and Comparative Animal Physiology 4. Schiemdt-Nielsen. Animal Physiology: Adaptation and Environment. Cambridge. 5. C.L.Prosser. Environment and Metabolic Physiology. Wiley-Liss, New York. 6. David Randall, Warren Burggren, Kathleen French: Eckert Animal Physiology 7. Guyton, A.X., Text Book of Medical Physiology, 7 th edition, Saunders Company (1986).		

ZOOLOGY: SEMESTER-VIII									
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 Scheme B & C	CC-H6 4 Credit	24L6.0-ZOO-803	Population Genetics & Evolution	4	4	30	70	100	3hrs.
Level of the course: 400-499									
Pre-requisite for the course(if any): Zoology as single major in 3 years UG									
Course Learning Outcomes (CLO) - To provide students the basic insight about the mechanism of evolution and to make them able to relate different forms of life on our planet earth. It will also provide them in-depth knowledge about the changing frequency and distribution of alleles within the population. - Acquire a clear understanding about genetic equilibrium in natural populations - To know about genetics of quantitative traits in populations - Detail understanding of molecular phylogenetics and methods of construction of phylogenetic tree									
Instructions for Paper-Setter - Nine questions will be set in all. All questions will carry equal marks. - 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	1.0 Concepts of evolution and theories of organic evolution with an emphasis on Darwinism. 2.0 Emergence of Neo-Darwinism-Neutral Hypothesis 3.0 Neo Darwinism 3.1 Hardy-Weinberg law of genetic equilibrium 3.2 A detailed account of destabilizing forces: 3.2.1 Natural selection 3.2.2 Mutation 3.2.3 Genetic drift 3.2.4 Migration 3.3 Meiotic drive							15	
II	4.0 Quantifying genetic variability 4.1 Genetic structure of natural populations 4.2 Phenotypic variations 4.3 Models explaining changes in genetic structure of populations 4.4 Factors affecting human disease frequency 5.0 Molecular population genetics 5.1 Patterns of change in nucleotide and amino acid sequences 5.2 Ecological significance of molecular variations 6.0 Genetics of quantitative traits in populations 6.1 Analysis of quantitative traits 6.2 Estimation of heritability 6.3 Genotype-environment interactions 6.4 Inbreeding depression and heterosis 6.5 Molecular analysis of quantitative traits 6.6 Phenotypic plasticity							15	

III	7.0	Genetics of speciation	15	
	7.1	Concept of species		
	7.2	Patterns and mechanisms of reproductive isolation		
	7.3	Modes of speciation (Allopatric, Sympatric, Parapatric, Peripatric)		
	8.0	Molecular Evolution		
	8.1	Gene Evolution		
	8.2	Evolution of gene families, Molecular drive		
	8.3	Assessment of molecular variations		
	9.0	Origin of higher categories		
	9.1	Phylogenetic gradualism and punctuated equilibrium		
Major trends in the origin of higher categories Micro-and Macro-evolution				
IV	10.0	Molecular phylogenetics	15	
	10.1	Concept of phylogenetic trees.		
	10.2	Methods of construction of Phylogenetic trees.		
	11.0	Population genetics and ecology		
	11.1	Metapopulations		
	11.2	Monitoring Natural Populations		
	11.3	Populations size and extinction		
	11.4	Loss of genetic variations		
	11.5	Conservation of genetic resources in diverse taxa		
Total Contact Hours			60	
Suggested Evaluation Methods				
Internal Assessment: 30		End Term Examination: 70		
Theory		30		Written Examination
Class Participation:		5		
Seminar/presentation/assignment/quiz/ class test etc.:		10		
Mid-Term Exam:		15		
Part C-Learning Resources				
RecommendedBooks/e-resources/LMS:				
1. Dobzhansky, Th .Genetics and Origin of Species. Columbia University Press. Dobzhansky, Th.,F.J.Ayala,G.L. Stebbins and J.M. Valentine. Evolution. Surjeet Publication, Delhi.				
2. Futuyama,D.J. Evolutinary Biology, SuinuaerAssociates,INCPublishers,Dunderland.				
3. Hartl,D.L. APrimer of Population Genetics. Sinaue r Associates,Inc, Massachusetts.				
4. Jha,A.P. Genes and Evolution. JohnPublication,New Delhi.				
5. King,M. Species Evolution-The role of chromosomal change. The Cambridge University Press,Cambridge.				
6. Merrel,D.J .Evolution and Genetics. Holt, Rinehartand Winston,Inc.				
7. Smith,J.M. Evolutinary Gentics. Oxford University Press, New York.				
8. Strikberger,M.W. Evolution. Jones and Bartett Publishers, Boston London.				

ZOOLOGY: SEMESTER-VIII									
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 Scheme B & C	DSE-H2 4 Credit	24L6.0-ZOO-804	Population and Community Ecology	4	4	30	70	100	3hrs.
Level of the course: 400-499									
Pre-requisite for the course(if any): Zoology as single major in 3 years UG									
Course Learning Outcomes (CLO): Students will be able to understand 1. Explanations of the need for intra- and interdisciplinary cooperation in researching different ecosystems. 2. The all biotic and abiotic factors that are related to individual, population, community and ecosystem and defines the relationships between them. 3. Information about the benefits of ecosystem and can be used in the management of natural resources for sustainable development in ways that leave the environment healthy. 4. Scope of the specialization within ecology such as marine, vegetation and statistical ecology to better understand the environment around them.									
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	1.0 Basic Concepts: Definition, Scope and Significance of Ecology, Concept of biosphere, atmosphere, lithosphere and hydrosphere. 2.0 Organizational level of ecological systems, Ecological aspects of abiotic, biotic and edaphic factors, limiting factors 3.0 Ecosystem: Concept, Kinds and components 4.0 Ecological energetic and energy flow: Food chains, food webs, trophic structure; concept of productivity: primary, secondary, gross and net, Energy flow models.							15	
II	5.0 Restoration Ecology Ecology of Disturbed Ecosystems: disturbance and its impact on the structure and functioning of terrestrial and aquatic ecosystems. 6.0 Population Characteristics 6.1 Introduction and concepts of population ecology 6.2 Attributes of populations 6.3 Population density, methods of population density measurement 6.4 Growth rate and growth forms 6.5 Natality, mortality, survivorship curves and life tables 6.6 Biotic potential– Generation time, net reproductive rate reproductive values 6.7 Population and distribution. 6.8 Population dispersion							15	
III	7.0 Population regulation and Interactions 7.1 Extrinsic and intrinsic mechanisms 7.2 Concept of density dependent and density independent factors in population regulation. 7.3 Concept of intra specific and inter specific population interactions							15	

	7.4 Proto-cooperation, mutualism and commensalisms 7.5 Host-parasite interactions, Life history strategies–r and k selection. 8.0 Competition and niche theory 8.1 Intra specific and inter specific interactions 8.2 History of niche concepts 8.3 Gause’s theory of niche	
IV	9.0 Predation 9.1 Theory; predator-prey oscillations 9.2 Model of prey–predatory dynamics 9.3 Role of predation in nature 9.4 Parasitism 10.0 Community characteristics 10.1 Species diversity; Biodiversity indices: Diversity, dominance, Similarity& dissimilarity Index 10.2 Ecological Succession 10.3 Ecological dominance 10.4 Ecotones and Edge effect 11.0 Ecological Impact Assessment	15
Total Contact Hours		60
Suggested Evaluation Methods		
Internal Assessment: 30		End Term Examination: 70
Theory	30	Written Examination
Class Participation:	5	
Seminar/presentation/assignment/quiz/ class test etc.:	10	
Mid-Term Exam:	15	
Part C-Learning Resources		
1. Colinvaux,P.A.(1993). Ecology. II Edition. Wiley, John and Sons, Inc. 2. Krebs,C.J.(2001). Ecology. VI Edition. Benjamin Cummings. 3. Odum, E.P.,(2008). Fundamentals of Ecology. Indian Edition. Brooks/Cole 4. Robert Leo Smith Ecology and field biology Harper and Row publisher 5. Ricklefs, R.E.,(2000).Ecology. V Edition. ChironPress 6. Rockwood Larry L.(2015) Introduction to Population Ecology, 2 nd Edition Wiley-Blackwell		

ZOOLOGY: SEMESTER-VIII

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 Scheme B & C	DSE-H2 4 Credit	24L6.0-ZOO-805	Environment and Public Health	4	4	30	70	100	3hrs.

Level of the course: **400-499**

Pre-requisite for the course(if any): **Zoology as single major in 3 years UG**

Course Learning Outcomes (CLO)

- Students will be able to explain the linkages between environmental factors (air, water, soil) and public health, and analyze the influence of nutrition, socio-cultural, and developmental aspects on individual health.
- Students will be able to assess the impacts of climate change and modern agricultural and industrial practices on public health, with emphasis on pollution and disease outcomes.
- Students will be able to classify various types of diseases (deficiency, infectious, pollution-related, non-communicable) and evaluate the role of hygiene, nutrition, and sanitation in disease prevention.
- Students will be able to explain key concepts in epidemiology, disease surveillance, and public health interventions, including AYUSH systems, immunization programmes, and occupational health management.
- Students will be able to critically evaluate environmental management policies and practices in India, particularly in waste management, pollution control, and their role in promoting public health.

Instructions for Paper-Setter

- Nine questions will be set in all. All questions will carry equal marks.
- 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	1.0 Linkages between Environment and Health 1.1 Understanding linkages between Environment and Public Health: Effect of quality of air, water and soil on health. 1.2 Perspective on Individual health: Nutritional, socio-cultural and developmental aspects. 1.3 Dietary diversity for good health, Human developmental indices for public health.	14
II	2.0 Climate Change and Implications on Public Health 2.1 Global warming: Agricultural practices (chemical agriculture) and Industrial technologies (use of non-biodegradable materials like plastics, aerosols, refrigerants, pesticides). 2.2 Manifestations of climate change on Public Health 2.3 Burning of fossil fuels, automobile emissions and acid rain.	14
III	3.0 Diseases in Contemporary Society 3.1 Definition and need for good health- factors affecting health. 3.2 Types of diseases: Deficiency diseases, infectious diseases, pollution-related diseases, allergies, respiratory diseases, cardiovascular diseases, and cancer. 3.3 Personal hygiene and food: Balanced diet, food habits and cleanliness, food adulterants, avoiding smoking, drugs and alcohol. 3.4 Communicable diseases: Mode of transmission; epidemic and endemic diseases. 3.5 Management of hygiene in public places: Railway stations, bus stands and other public places. Infectious diseases: Role of sanitation and poverty; case studies on TB, diarrhea, malaria, viral diseases Non-communicable diseases: Role of lifestyle and built environment; diabetes	14

	and hypertension.	
IV	4.0 Perspectives and Interventions in Public Health 4.1 Epidemiological perspectives: Disease burden and surveillance. 4.2 Alternative systems of medicine: Ayurveda, Yoga, Unani, Siddha and Homeopathy (AYUSH); 4.3 Universal Immunization Programme (UIP). Reproductive health: Youth Unite for Victory on AIDS (YUVA) programme of Government of India. 4.4 Occupational health hazards: physical, chemical and biological. Occupational diseases: prevention and control. 5.0 Environmental Management Policies and Practices 5.1 Municipal solid waste management: Definition, sources, characterization, collection and transportation, and disposal methods. Solid waste management system in urban and rural areas. 5.2 Municipal Solid waste rules. 5.3 Policies and practices with respect to Environmental Protection Act, Forest Conservation Act, Wildlife Protection Act, Water and Air Act, Industrial, Biomedical and E- waste disposal rules.	18
Total Contact Hours		60
Suggested Evaluation Methods		
Internal Assessment: 30		End Term Examination: 70
Theory	30	Written Examination
Class Participation:	5	
Seminar/presentation/assignment/quiz/ class test etc.:	10	
Mid-Term Exam:	15	
Part C-Learning Resources		
1. Indian Academy of Paediatrics. (2011). Guidebook on Immunization. MFC Bulletin, 45-50. 2. Nandini, N., Sunitha, N. and Tandon, S. (2007). Environmental Studies. Sapna Book House, Bangalore. 3. Park, K. (2011). Preventive and Social Medicine. Benarsi Das Publications, (pp. 16- 19, 24-27). 4. Mckinney, M. L., Schoch, R. M. and Yonavjak, L. (2015). Environmental Science: systems and solutions. Jones & Barlett Publishers, Canada. 5. Vir, S.C. (2011) Public Health Nutrition in Developing Countries. (Part-2). Woodhead Publishing India 6. Gupta, AD., Sachin, Bhateja, S. and Rajshekhar (2022). Environment and Public Health. Academic Guru Publishing House, India. 7. Biswas, K. and Biswas, P. (2015). Environment and Public Health. Himalayan Publishing House Pvt. Ltd., India.		

ZOOLOGY: SEMESTER-VIII

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	PC-H2 4 Credit	24L6.0-ZOO-806	Practical Based on B24-ZOO-801 to B24-ZOO-803 and any one out of B24-ZOO-804 & 805	4	8	30	70	100	6 hrs.

Level of the course: **400-499**

Pre-requisite for the course (if any): Zoology as a Subject at B.Sc. Level

Course Learning Outcomes (CLO)

- Students will be able to understand the processes involved in the recognition of key groups of vertebrates.
- Students will be able to identify and classify the available specimens of vertebrate classes.
- This course will make students able to understand the regulation of chemical reactions in living cells.
- Students will be able to understand the computational biology and techniques of data handling and processing.

UNIT	TOPICS	CONTACT HOURS
I	- Museum specimens and slides :from Protochordates to mammals - Demonstration of cranial nerves and aortic arches of Scoliodon, Digestive system, Nervous system, Arterial and venous system of frog, Lizard, Pigeon and rabbit. - Comparative Osteology of Axial and appendicular skeleton - Construction of Phylogenetic tree - Histochemistry: Methods of fixation of different tissues. - Histochemical test: - Haemotoxylin-eosin - Toluidine Blue - Sudan Block-B - Mercury bromophenol blue - Methyl green-pyronin-Y - Periodic acid Schiff's - Acid phosphatase - Alkaline phosphatase - Demonstration of live gametes and their staining procedure. - Determination of optimum pH, temperature and concentration for optimum activity of salivary amylase - To demonstrate that the optimum activity of trypsin enzyme is pH and temperature dependent. - Qualitative test of vitamins and Quantification of vitamin A and C. - Total RBC, WBC and Differential WBC count - Estimation of Blood plasma - Methods of population density measurements	120

II	DSE- H2 (option 1) 14. Study of various components of pond and grassland ecosystem. 15. Determination of Water quality characteristics viz: Dissolved oxygen, pH, free carbon dioxide, salinity, transparency, alkalinity, chloride and hardness.. 16. Estimation of biodiversity indices. 17. Field Visit to Aquatic, Forest and other ecosystems for identification of biota.	DSE- H2 (option 2) 14. Detection of Adulterants in Common Food Items 15. Survey and Analysis of Waste Management and Sanitation Practices in a Public Place 16. Awareness Survey on Lifestyle Diseases and Personal Habits 17. Observation and Report on Solid Waste Management System in a Locality 18. Case Study Analysis on Occupational Health Hazards	
	Suggested Evaluation Methods		
Internal Assessment: 30 ➤ Practicum • Class Participation: 5 • Seminar/presentation/assignment/quiz/class test etc.: 10 Mid-Term Exam: 15		End Term Examination: 70 ➤ Practicum Lab record, Viva-Voce, Execution of the practical Write up	
Part C-Learning Resources			
1. Sharma R K, Sangha S P S (2009). Basic Techniques in Biochemistry and Molecular Biology, I.K. International Publishing House Pvt. Ltd. New Delhi 2. Podder T, Mukhopadhyay S, Das SK (2003). An Advanced Laboratory Manual Of Zoology Published by Rajiv Beri for Macmillan India Limited, Rajkamal Electric Press, Delhi 3. Sadasivam S, Manickam A (1997). Biochemical Methods, Ed. 2nd, New Age International Publishers, New Delhi 4. David T. Plummer (1987). An Introduction to Practical Biochemistry. Ed., 3rd, McGraw-Hill Publisher, Rajkamal Electric Press, Delhi			

ZOOLOGY: Semester-VIII (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 in Zoology Scheme B & C	CC-H4 4 Credit	24L6.0-ZOO-801	Structure and Function of Vertebrates	4	4	30	70	100	3hrs.
Level of the course: 400-499									
Pre-requisite for the course(if any): Zoology as single major in 3 years UG									
Course Learning Outcomes (CLO) 1. Students will be able to understand various biological functions, the evolution of life from most primitive to most advanced form with respect to their habit and habitat. 2. Students will have acquaintance with the basic concepts, external morphology and sexual dimorphism in chordates and understand the various systems, adaptation and dentition in chordates. 3. Students will also Understand the Classification various classes of phylum Chordate i.e., Pisces, Reptiles, Aves and Mammals. 4. This core course will make students familiarize with the vertebrate diversity around them									
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	1.0 Introduction to Chordates with their general characters. 1.1 Origin of Chordates 1.2 Concept of Proto chordate or pre-vertebrates 1.3 Classification of Vertebrates up to orders 2.0 Integument and its derivatives 2.1 Development, general structure and functions of skin and its derivative 2.2 Glands, scales, horns, claws, nails, hoofs, feathers and hair							15	
II	3.0 Skeletal system 3.1 Form, function, body size and skeletal elements of the body 3.2 Comparative account of jaw suspensorium, Vertebral column 3.3 Limbs and girdles 4.0 Digestive system 4.1 Dentition, Stomach, Digestive Glands 4.2 Anatomy of gut in relation to feeding habits- herbivores, carnivores and omnivores. 5.0 Respiratory system 5.1 Characters of respiratory tissue, Internal and External Respiration 5.2 Comparative account of respiratory organs							15	
III	6.0 General plan of circulation in various groups 6.1 Components of Blood 6.2 General plan of circulation in reptiles, birds and mammals 6.3 Evolution of heart , aortic arches and Portal systems 7.0 Evolution of Urino-genital system in vertebrate series 7.1 Structure and functions of different types of kidney 7.2 Urino-genital ducts							15	

	7.3 Flight adaptation in birds, Migration in fish and Birds	
IV	8.0 Nervous system 8.1 Comparative anatomy of the brain in relation to its functions 8.2 Comparative anatomy of spinal cord 8.3 Nerves-Cranial, Peripheral and Autonomous nervous systems 9.0 Sense organs 9.1 Simple receptors 9.2 Organs of Olfaction and taste 9.3 Lateral line system 9.4 Electroreception	15
Total Contact Hours		60
Suggested Evaluation Methods		
Internal Assessment: 30		End Term Examination: 70
Theory	30	Written Examination
Class Participation:	5	
Seminar/presentation/assignment/quiz/class test etc.:	10	
Mid-Term Exam:	15	
Part C-Learning Resources		
Recommended Books/e-resources/LMS:		
1. Barrington,E.J.W.The Biology of Hemi-chordata and Protochordata. Oliver and Boyd, Edinburgh.		
2. Bourne,G.H.The structure and functions of nervous tissue. Academic Press, New York.		
3. Carter,G.S. Structure and habit in vertebrate evolution-Sedgwick and Jackson, London.		
4. Kingsley,J.S. Outlines of Comparative anatomy of Vertebrates. CentralBook Depot, Allahabad.		
5. Kent, C.G.Comparative anatomy of vertebrates.		
6. Milton Hilderbrand. Analysis of vertebrate structure. IV.Ed.JohnWiley and Sons Inc., New York.		
7. Sedgwick,A. A Students Text Book of Zoology, Vol. II.		
8. Torrey,T.W. Morphogenesis of vertebrates. John Wiley and Sons Inc., New York and London.		
9. Walters, H.E. and Sayles,L.D. Biology of vertebrates. MacMillan & Co., New York.		

ZOOLOGY: Semester-VIII (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 in Zoology Scheme B & C	CC-H5 4 Credit	24L6.0-ZOO-802	Comparative Physiology	4	4	30	70	100	3hrs.
Level of the course: 400-499									
Pre-requisite for the course (if any): Zoology as single major in 3 years UG									
Course Learning Outcomes (CLO) 1. An appropriate understanding of functioning of each system of different groups of animals with their comparison will be acquainted. 2. The students will be able to explore all reasoning and queries that how animals work. 3. The students will be able to learn that how the physiology of different groups of organisms is influenced by the different environments of their niches 4. Since this course also have some important practical component where interesting exercises will be conducted to perform experiment and answer various queries of animal physiology.									
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	1.0 Digestion 1.1 Feeding mechanisms and regulation, 1.2 Comparative physiology of digestion and absorption in different animal groups 3.0 Respiration 3.1 Respiratory organs, Types of respiration, mechanism of breathing 3.2 Transport of respiratory gases 3.3 Respiratory pigments through different phylogenetic groups. 3.4 Physiological response to oxygen deficient stress. 4.0 Excretion 4.1 Patterns of nitrogen excretion among different animal groups 4.2 Functional anatomy of renal unit; mechanisms of ultra filtration, Counter Current mechanism, Dialysis 4.3 Osmoregulation in different animal groups 4.4 Definition and basic classification of organisms on the basis of osmoregulation 4.5 Osmotic challenges of different environments 4.6 Mechanism of Osmoregulation in freshwater, Estuarine and Marine animals 4.7 Osmoregulation in migratory organisms, Control and regulation of osmoregulation							15	

II	5.0 Thermoregulation 5.1 Homeothermic animals, Poikilotherms, Hibernation and Aestivation, 5.2 Physical, chemical, neural regulation, 5.3 Physiological adaptations acclimatization & acclimation in response to high, low ambient temperature 6.0 Circulation of body fluids and their regulation among different animal groups 6.1 Systems of circulation, heart beat and blood pressure, 6.2 Cardiac cycle, Cardiac output and its regulation, 6.3 Lymphatic system 7.0 Receptor physiology—a comparative study of Mechano reception, Photoreception, Chemo reception and Equilibrium reception 8.0 Muscle and Contractile physiology 8.1 Contractile elements, cells and tissues among different phylogenetic groups; Muscle structure and function-correlation; Electric organs and tissues	15
III	0 Comparative testicular physiology in animals 9.1 Morphology, Differentiation, Function and its regulation 10.0 Comparative ovarian physiology and differentiation in vertebrates 10.1 Morphology, Endocrinology, Oogenesis, vitellogenesis 11.0 Neuronal physiology 11.1 Structure and classification of neurons and glial cells. 11.2 Synaptic action, dendritic properties and functional operation of spinal cord, Brain stem 11.3 Autonomic nervous system.	15
IV	12.0 Principles of synaptic transmission 12.1 Ca ²⁺ and neurotransmitter release; post synaptic transmission mechanism; 12.2 Diversity of neurotransmitters: acetylcholine, catechol amine, serotonin, GABA, glycine, histamine, peptides, NO, and opioids. 12.3 Physiological adaptations to different environments 12.4 Physiological adaptations acclimatization & acclimation in response to high, low ambient temperature, 12.5 Physiological adaptation at high altitude and in deep sea environment. 13.0 Stress Physiology: Concept of Stress and Strain, Stress hormones and stress regulatory mechanisms.	15
Total Contact Hours		60
Suggested Evaluation Methods		
Internal Assessment: 30		End Term Examination: 70
Theory	30	Written Examination
Class Participation:	5	
Seminar/presentation/assignment/quiz/class test etc.:	10	
Mid-Term Exam:	15	
Part C-Learning Resources		
Recommended Books/e-resources/LMS:		
1. C.L.Prosser. Comparative Animal Physiology. W.B. Saunders & Company.		
2. R.Eckert. Animal Physiology: Mechanisms and Adaptation. W.H .Freeman &Company.		
3. W.S. Hoar. General and Comparative Animal Physiology		
4. Schiemdt-Nielsen. Animal Physiology: Adaptation and Environment. Cambridge.		
5. C.L.Prosser. Environment and Metabolic Physiology. Wiley-Liss, NewYork.		
6. David Randall, Warren Burggren, Kathleen French: Eckert Animal Physiology		
7. Guyton, A.X., Text Book of Medical Physiology, 7 th edition, Saunders Company(1986).		

ZOOLOGY: Semester-VIII (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 Scheme B & C	Project/ Dissertation 12 credit	24L6.0-ZOO-807	Project/ Dissertation	8+4	-	200 (Report as Dissertation)	100 (Viva-Voce)	100	-
Level of the course: 400-499									
Pre-requisite for the course(if any): Zoology as single major in 3 years UG									
Course Learning Outcomes (CLO) :Students will be able to									
1. Formulate a focused research question and design a robust, methodologically sound investigation to address it. 2. Employ appropriate experimental, analytical, or field techniques to collect, analyze, and interpret botanical data effectively. 3. Critically evaluate research findings in light of existing theories, and communicate results clearly through well-structured scientific writing and presentations. 4. Exhibit independence, time management, and scientific integrity throughout the research process, while responding thoughtfully to feedback and defending									
Instructions for Paper-Setter									
3. Nine questions will be set in all. All questions will carry equal marks. 4. Question No.1, which will be short answer type covering the entire syllabus, will be compulsory. The remaining eight questions will be set unit wise selecting two questions from each Unit I to IV. The candidate will be required to attempt question No. 1 and four more questions selecting one question from each unit.									
Description								CONTACT HOURS	
I	Each student is required to undertake a research project in a relevant area of Zoology. The outcome of this research will be compiled into a dissertation and submitted for evaluation at the end of the semester. Students will also present their dissertation before an external examiner. Both internal and external assessments of the project and training will be conducted as per the prescribed evaluation criteria. Assessment Structure Internal Assessment: - Submission of Project Synopsis - One Mid-Semester Progress Report and/or Presentation External Assessment: - Final Project Report (Dissertation) - Viva-Voce Presentation before an External Examiner Dissertation Report Submission Guidelines 1. Structure of the Dissertation Report: The dissertation should include the following components in order: - Cover page - Certificate signed by the student and supervisor - Table of contents - Introduction - Objectives - Literature review							15	

	o	Methodology	
	o	Results and Discussion	
	o	Conclusion	
	o	References	
	2.	Formatting Requirements:	
	o	Paper size: A4	
	o	Font: Times New Roman, size 12	
	o	Line spacing: 1.5 (one and a half spacing)	
	o	Printing: Double-sided (print on both sides of the paper)	
	o	Length: The written portion should be between 40 to 60 pages	
	3.	Submission Requirements:	
	o	Students must submit three hard-bound copies of the dissertation along with a CD containing a soft copy, to the department by the specified deadline.	
	4.	Evaluation and Presentation:	
	o	The student will be required to defend the dissertation/project work through a formal presentation before an external examiner at the end of the semester.	
	o	Marks will be awarded based on both the written report and the oral presentation.	