Scheme and Syllabus B.Sc Zoology

Chaudhary Bansi Lal University, Bhiwani

PROPOSED

Structure and syllabus

Of

Zoology

For

B.Sc. Undergraduate Programme

Based on:

U.G.C. Choice Based Credit System (CBCS)

Model Curriculum

SCHEME AND SYALLBUS UNDER CHOICE BASED CREDIT SYSTEM B. Sc. (ZOOLOGY, BOTANY, CHEMISTRY) **Total Credits- 130**

SEMESTER	**CORE COURSE (CC) (Credits- 72)**	**Credit**	**Ability Enhancement Compulsory Course (AECC) (Credits-6)**	**Credit**	**Skill Enhancement Course (SEC) (Credits-12)**	**Credit**	**Discipline Specific Elective (DSE) (Credits-36)**	**Credit**	**Generic Elective Courses (Credits 4)**	**Credit**
I	CC- Botany I CC- Zoology I CC- Chemistry I	6 6 6	English/ Environmental Science	2	SEC-I (Compulsory Course) Basics of Computer	3			Hobby Courses (NCCCESE)	1
II	CC- Botany II CC- Zoology II CC- Chemistry II	6 6 6	Environmental Science/ English	2					Hobby Courses (NCCCESE)	1
III	CC- Botany III CC- Zoology III CC- Chemistry III	6 6 6	Hindi/Sanskrit	2						
IV	CC- Botany IV CC- Zoology IV CC- Chemistry IV	6 6 6			SEC-II */MOOCs** /OEC@	3			Personality Development (NCCSE)	2
V					SEC-III*	3	DSE- Botany I DSE - Zoology I DSE - Chemistry I	6 6 6		
VI					SEC-IV*	3	DSE- Botany II DSE - Zoology II DSE - Chemistry II	6 6 6		

*In SEC, One to be chosen from Zoology/Botany/ Chemistry @ OEC: Open Elective Course to be chosen from the pool of courses offered by University
(excluding the courses offered by the departments of their own subjects, if not stated otherwise.)
**Students may choose MOOC course with same number of credits(or more) subject to the approval of the Principal of the concerned college on the recommendation of the Committee in the beginning of the Semester as per UGC (Credit Framework for online learning courses through SWAYAM) Regulation 2016.

General instructions:

1. One credit equivalent to 1 hour of teaching/2 hours of Practical work/ 2 hour of field work per week
2. The duration of classes may be decided according by respective principals of collages.
3. The DSE courses will be taught by faculties of the same department.
4. The Principals of colleges may take decision for offering more than one DSE paper to be opted by the students in each semester and may plan the number of seats (minimum 20) for DSE/Skill enhancement paper as per the facilities.
5. Colleges/university should may follow the policy about Hobby Courses and Personality Development provided by university. It may be displayed on DMC as letter grade (A/B/C).
6. NCCCESE- NON CGPA Credit Courses Compulsory Specified course
7. NCCESE- NON CGPA Credit Courses Compulsory Elective course/ Activity

Credit Distribution Course Wise

Sr. No	Course		Credits
I.	Core Course		Paper+ Practical
4 paper CC I		12x4=48	
4 paper CC II			
4 paper CC III			
Core course Practical/ Tutorial		12x2=24	
			72
II	Elective Course		
2 paper DSEC I		6x4=24	
2 paper DSEC II			
Elective course Practical / Tutorial		6x2=12	
			36
III	Ability Enhancement Course		
Ability Enhancement Compulsory		AECC I,II,III= 6	
Skill Enhancement Compulsory			
1 paper SEC I			
SEC Choice Based			
SEC II,III & IV		3X4=12	
			18
IV	Non CGPA (NCCC)		
2 paper NCCESE			1+1=2
2 paper NCCCSE			2
			4
Grand Total=		130	

Distribution of Periods Subject Wise & Credit Wise per Week

Semester	Paper	Total Credit	Credit Paper+ Practical	Hours per Week
Semester- 1st	CC I A Botany	6	4+2	4+ 4
	CC II A Zoology	6	4+2	4+ 4
	CC III A Chemistry	6	4+2	4+ 4
	AECC I English	2	2	2
	SEC I	3	3(2+1)	2+2
	NCCCESE	1	1	1
	Total	**24**	**24**	**31**
Semester-2nd	CC I B Botany	6	4+2	4+ 4
	CC II B Zoology	6	4+2	4+ 4
	CC III B Chemistry	6	4+2	4+ 4
	AECC II EVS	2	2	2
	NCCCESE	1	1	1
	Total	**21**	**21**	**27**
Semester- 3rd	CC I C Botany	6	4+2	4+ 4
	CC II C Zoology	6	4+2	4+ 4
	CC III Chemistry	6	4+2	4+ 4
	AECC III Hindi/Sanskrit	2	2	2
	Total	**20**	**20**	**26**
Semester- 4th	CC I D Botany	6	4+2	4+ 4
	CC II D Zoology	6	4+2	4+ 4
	CC III D Chemistry	6	4+2	4+ 4
	SEC II	3	3	3
	NCCESE	2	2	2

Total		**23**	**23**	**29**
Semester-5th	DSE I Botany	6	4+2	4+4
	DSC I Zoology	6	4+2	4+4
	DSC I Chemistry	6	4+2	4+4
	SEC III	2	2	2
Total		**21**	**21**	**27**
Semester-6th	DSE II Botany	6	4+2	4+4
	DSC II Zoology	6	4+2	4+4
	DSC II Chemistry	6	4+2	4+4
	SEC IV	2	2	2
Total		21	21	27
Grand Total		**130**	**130**	**167**

Details of Courses for B.Sc. Undergraduate Programme

Course	Credits (Theory + Practical)
I. Core Course (6 Credits) 12 Papers 04 Courses from each of the 03 disciplines of choice	12X4= 48
Core Course Practical **(12 Practical)** 04 Courses from each of the 03 Disciplines of choice	12X2=24
II. Elective Course (6 Credits) **(6 Papers)** Two papers from each discipline of choice including paper of interdisciplinary nature.	6x4=24
Elective Course Practical **(6 Practical)** Two Papers from each discipline of choice including paper of interdisciplinary nature	6 X 2=12
III. Ability Enhancement Courses **1. Ability Enhancement Compulsory Courses (AECC)** **(3 Papers of 2 credits each)** **Environmental Science** **English/Hindi/MIL Communication**	3 X 2=6
2. Skill Enhancement Course **(Skill Based)** **(4 Papers of 3 credits each)**	4 X 3=12
Generic Elective Courses (4 Credits) Hobby Courses (2 papers of 1 credit each) Personality Development (1 paper of 2 credits)	
	Total credit= 130

Proposed Scheme for Choice Based Credit System (CBCS) in B.Sc. Life Sciences (Zoology, Botany and Chemistry)

Semester	Discipline Core course	Credits (24)	Ability Enhancement Compulsory Course(AECC)	Credits (8)	Skill Enhancement Course (SEC)	Credits (12)	Discipline Specific Elective (DSE)	Credits (12)	Generic Elective Courses Credits (4)	
I.	**Animal Diversity Non chordates I** 20UZOO101 (T) **Animal Diversity Non Chordates II** 20UZOO102(T) **Animal Diversity Non chordates** 20UZOO103 (PR)	TH 4 PR 2	**English**	TH 2	-		-		Hobby Course	1
II.	**Animal Diversity Chordates I** 20UZOO201 (T) **Animal Diversity Chordates II** 20UZOO202 (T) **Animal Diversity Chordates** 20UZOO203 (PR)	TH 4 PR 2	**English Communication** **Environmental Science**	TH 2 TH2	-		-		Hobby Course	1

III.	**Animal Physiology** 20UZOO301 (T) **Animal Biochemistry** 20UZOO302 (T) **Animal Physiology and Biochemistry** 20UZOO303 (PR)	TH 4 PR 2	**Hindi/Sanskrit**	TH 2	**Basics of Computer (Compulsory)**	3	-			
IV	**Cell Biology and Genetics** 20UZOO401 (T) **Developmental Biology** 20UZOO402 (T) **Cell Biology, Genetics and Developmental Biology** 20UZOO403 (PR)	TH 4 PR 2	-		**Medical Diagnostics** 20USECZ404 (T)	3	-		Personality Development Course	2
V	-		-		**Public Health and Hygiene** 20USECZ507 (T)	3	Immunology 20UZOO501(T), **Animal Biotechnology** 20UZOO502 (T),	TH 4 PR 2		

							Immunology and Animal Biotechnology 20UZOO503 (PR) / **Aquaculture** 20UZOO504 (T), **Economic Zoology** 20UZOO505 (T), **Aquaculture and Economic Zoology** 20UZOO506 (PR)			
VI	-		-		**Apiculture & Poultry forming** 20USECZ607 (T)	3	**Applied Zoology** 20UZOO601 (T), **Insect, Vector and Diseases** 20UZOO602 (T), **Applied Zoology and Insect, Vector and Diseases** 20UZOO603 (PR) / **Ecology** 20UZOO604 (T), **Evolution and Wild life conservation** 20UZOO605	TH 4 PR 2		

							(T), **Ecology, Evolution and Wild Life Conservation** 20UZOO606 (PR)			

- One Course to be chosen from DSE out of two in semester V and VI
- The decision of offering DSE course is the sole choice of Colleges/ University

First Semester

Sr. No.	Papers Name	Paper Code	Type of Courses	Credits	Contact Hours	External Marks	Internal Marks	Total Marks
1.	ANIMAL DIVERSITY NON CHORDATES I	20UZOO101	Theory (CC)	2	2	40	10	50
2.	ANIMAL DIVERSITY NON CHORDATES II	20UZOO102	Theory(CC)	2	2	40	10	50
3.	ANIMAL DIVERSITY NON CHORDATES	20UZOO103	Practical(CC)	2	4	50	-	50

Second Semester

Sr. No.	Papers Name	Paper Code	Type of Courses	Credits	Contact Hours	External Marks	Internal Marks	Total Marks
1.	ANIMAL DIVERSITY CHORDATES I	20UZOO201	Theory(CC)	2	2	40	10	50
2.	ANIMAL DIVERSITY CHORDATES II	20UZOO202	Theory(CC)	2	2	40	10	50
3.	ANIMAL DIVERSITY CHORDATES	20UZOO203	Practical(CC)	2	4	50	-	50

Third Semester

Sr. No.	Papers Name	Paper Code	Type of Courses	Credits	Contact Hours	External Marks	Internal Marks	Total Marks
1.	ANIMAL PHYSIOLOGY	20UZOO301	Theory (CC)	2	2	40	10	50
2.	ANIMAL BIOCHEMISTRY	20UZOO302	Theory(CC)	2	2	40	10	50
3.	ANIMAL PHYSIOLOGY AND BIOCHEMISTRY	20UZOO303	Practical(CC)	2	4	50	-	50

Fourth Semester

Sr. No.	Papers Name	Paper Code	Type of Courses	Credits	Contact Hours	External Marks	Internal Marks	Marks
1.	CELL BIOLOGY AND GENETICS	20UZOO401	Theory (CC)	2	2	40	10	50
2.	DEVELOPMENTAL BIOLOGY	20UZOO402	Theory(CC)	2	2	40	10	50
3.	CELL BIOLOGY, GENETICS AND DEVELOPMENTAL BIOLOGY	20UZOO403	Practical(CC)	2	4	50	-	50

Fifth Semester

Sr. No.	Papers Name	Paper Code	Type of Courses	Credits	Contact Hours	External Marks	Internal Marks	Total Marks
1.	IMMUNOLOGY	20UZOO501	Theory (DSE IA)	2	2	40	10	50
2.	ANIMAL BIOTECHNOLOGY	20UZOO502	Theory (DSE IA)	2	2	40	10	50
3.	IMMUNOLOGY AND ANIMAL	20UZOO503	Practical*(DSE IA)	2	4	50	-	50

	BIOTECHNOLOGY							
4.	AQUACULTURE	20UZOO504	Theory(DSE IB)	2	2	40	10	50
5.	ECONOMIC ZOOLOGY	20UZOO505	Theory(DSE IB)	2	2	40	10	50
6.	AQUACULTURE AND ECONOMIC ZOOLOGY	20UZOO506	Practical*(DSE IB)	2	4	50	-	50

Sixth Semester

Sr. No.	Papers Name	Paper Code	Type of Courses	Credits	Contact Hours	External Marks	Internal Marks	Total Marks
1	APPLIED ZOOLOGY	20UZOO601	Theory(DSE IIA)	2	2	40	10	50
2	INSECT, VECTORS AND DISEASES	20UZOO602	Theory(DSE IIA)	2	2	40	10	50

3	APPLIED ZOOLOGY, INSECT, VECTORS AND DISEASES	20UZOO603	Practical*(DSE IIA)	2	4	50	-	50
4	ECOLOGY AND EVOLUTION	20UZOO604	Theory(DSE IIB)	2	2	40	10	50
5	WILD LIFE CONSERVATION	20UZOO605	Theory(DSE IIB)	2	2	40	10	50
6	ECOLOGYAND EVOLUTION , WILD LIFE CONSERVATION	20UZOO606	Practical*(DSE IIB)	2	4	50	-	50

CC- Core Course

DSE- Discipline Specific Electives

***Practical will be conducted according to Theory Paper**

**** One DSE course to be selected by students from DSE IA and DSE IB; DSE IIA and DSE IIB courses in fifth and sixth semesters, respectively**

SEC- Skill Enhancement Course Offered by the Department of Zoology

Fourth Semester

Sr. No.	Papers Name	Paper Code	Type of Courses	Credits	Contact Hours	External Marks	Internal Marks	Total Marks
1.	MEDICAL DIAGNOSTICS	20USECZ404	Theory(SEC)	3	3	80	20	100

Fifth Semester

Sr. No.	Papers Name	Paper Code	Type of Courses	Credits	Contact Hours	External Marks	Internal Marks	Total Marks
1.	PUBLIC HEALTH AND HYGIENE	20USECZ507	Theory(SEC)	3	3	80	20	100

Sixth Semester

Sr. No.	Papers Name	Paper Code	Type of Courses	Credits	Contact Hours	External Marks	Internal Marks	Total Marks
1.	APICULTURE & POULTRY FARMING	20USECZ607	Theory (SEC)	3	3	80	20	100

SEC- Skill Enhancement Course

CORE COURSE I (Semester I)
ANIMAL DIVERSITY NON CHORDATES I (20UZOO101)
THEORY (Credits 2)

Max. Marks: 40+10 (Internal assessment) **Time allotted: 3 Hours**

Note: Nine questions are to be set in all and the candidates are required to attempt five questions including compulsory question.

1. Question number I is compulsory consisting of 8 parts (1.0 mark each) covering the entire syllabus. Answer to each part should not exceed 20 words.
2. Out of remaining eight questions, two questions are to be set from each unit (I to IV), possibly splitting them in parts. Candidate is required to attempt four questions, selecting one question from each unit.

UNIT-I

Phylum- Protozoa

i) General characters and classification up to order level
ii) Biodiversity and economic importance
iii) Type study of *Plasmodium;*
iv) Parasitic protozoans: Life history, mode of infection and pathogenicity of *Entamoeba, Trypanosoma, Leishmania* and *Giardia.*

UNIT-II

Phylum- Porifera:

i) General characters and classification up to order level
ii) Biodiversity and economic importance
iii) Type study - *Sycon.*
iv) Canal system in sponges
v) Spicules in sponges

UNIT-III

Phylum - Coelentrata:

i) General characters and classification up to order level
ii) Biodiversity, economic importance
iii) Type Study - *Obelia*
iv) Corals and coral reefs
v) Polymorphism in Siphonophores

UNIT-IV

Phylum - Helminths:

i) General characters and classification up to order level
ii) Biodiversity, economic importance
iii) Type study - *Fasciola hepatica*
iv) Helminths parasites: Brief account of life history, mode of infection and pathogenesity of Schistosoma, *Ancylostoma, Trichinella, Wuchereria* and *Oxyuris.*

(2)

CORE COURSE I (Semester I)
ANIMAL DIVERSITY NON CHORDATES II (20UZOO102)
THEORY (Credits 2)

Max Marks: 40+10 (Internal assessment) **Time allotted: 3 Hours**

Note: Nine questions are to be set in all and the candidates are required to attempt five questions including compulsory question.

1. Question number I is compulsory consisting of 8 parts (1.0 mark each) covering the entire syllabus. Answer to each part should not exceed 20 words.
2 Out of remaining eight questions, two questions are to be set from each unit (I to IV), possibly splitting them in parts. Candidate is required to attempt four questions, selecting one question from each unit.

UNIT-I

Phylum - Annelida:
i) General characters and classification up to order level
ii) Type study - *Pheretima* (Earthworm)
iii) Metamerism in Annelida
v) Trochophore larva:. Affinities, evolutionary significance

UNIT-II

Phylum - Arthropoda:
i) General characters and classification up to order level
ii) Type study – *Periplaneta*

UNIT-III

Phylum - Mollusca:
i) General characters and classification up to order level
ii) Type study - *Pila*
iii) Torsion and detorsion in gastropoda

UNIT-IV

Phylum - Echinodermata:
i) General characters and classification up to order level
ii) Type Study -*Asteries* (Sea Star)
iii) Echinoderm larvae

Phylum – Hemichordata:
Type study: *Balanoglossus*

SUGGESTED READINGS

Ruppert and Barnes, R.D. (2006). Invertebrate Zoology, VIII Edition. Holt Saunders International Edition.
Barnes, R.S.K., Calow, P., Olive, P.J.W., Golding, D.W. and Spicer, J.I. (2002). The Invertebrates: A New Synthesis, III Edition, Blackwell Science.
Hickman, C.P. 1961. Principles of Zoology. Mosby, St. Louis.

CORE COURSE I (Semester I)
ANIMAL DIVERSITY NON CHORDATES (20UZOO103)

PRACTICAL (Credits 2)

Max. Marks:50 **Time allowed: 3Hrs**

(A) Classification up to orders with ecological note and economic importance of the following animal:

I. Protozoa: Permanent prepared slides: *Euglena, Trypanosoma, Noctiluca, Paramecium* (binary fission and conjugation), *Opalina, Verticella, Balantidium, Nyctotherus*

2. Parazoa (Porifera)Specimens: Sycon. *Grantia, Euplectella, Hyalonema, Spongilla, Euspongia*

3. Coelenterata.Specimens: *Porpita, Valella, Physalia, Aurelia, Metridium, Millipora, Alcyonium, Tubipora, Madrepora, Fungia,* and *Astrea,*

4. Platyhelminthes Specimens: *Dugesia, Fasciola, Taenia, Echinococus,*

5. Aschelminthes *Ascaris* (male & female), *Trichinella, Ancylostoma, Meloidogyne.*

6. Annelida Specimens: Pheretima, Heteronereis, Polynoe, Aphrodite, Chaetopterus, Arenicola, Tubifex and Pontobdella.

7. Arthropoda Specimens: Peripatus, Palaemon (Prawn), Lobster, Cancer, Sacculina, Eupagurus, Lepas, Balanus, Cyclops, Daphnia, Lepisma, Periplaneta, Schistocerca, Poecilocerus, Mantis, Cicada, termite queen, Apis, Bombyx, Millipedes, Centipedes, Scorpion, Aranea, Limulus.

3. Mollusca Specimens: Mytilus, Cardium, Solen, Pecten, Holiotis, Patella, Aplysia, Doris, Limax, Loligo, Sepia, Octopus, Chiton and Dentalium.

4. Echinodermata Specimens: Asterias, Echinus, Cucumara, Ophiothrix, Antedon and Asterophyton.

5. Hemichordata Specimen: Balanoglossus

(B) Study of the following permanent stained preparations:

1. L.S. and TS. *Sycon;* gemmules, spicules and sponging fibres of *Sycon,* canal system of sponges.
2. TS. *Hydra* (testis and ovary region), W.M. of Sertularia, Tubularia and Obelia.
3. T.S. *Fasciola.*
4. T.S. *Ascaris* (male and female).
5. T.S. Pheretima (pharyngeal and typhlosolar regions)
6. Mouth parts of cockroach
7. Glochidium larva of Anodonta; radula of Pila

(C) **Preparation of the following slides:**

1. Temporary preparation of *Volvox, Paramecium,* Gemmules and spicules of *Sycon*
2. Preparation of permanent stained whole mounts of *Hydra, Obelia, Sertularia, Plumularia* and *Bougainvillea.*

(D) Study of the different systems of the following animals by charts/models:

1. Earthworm: Digestive, reproductive and nervous systems.
2. Grasshopper/ cockroach: Digestive, reproductive and nervous systems.

(E) **Project:**

1. Parasitic adaptations (Protozoa to helminthes)
2. Survey- Diversity of particular family/taxa in your surrounding area

SUGGESTED READINGS

Ruppert and Barnes, R.D. (2006). Invertebrate Zoology, VIII Edition. Holt Saunders International Edition.

Barnes, R.S.K., Calow, P., Olive, P.J.W., Golding, D.W. and Spicer, J.I. (2002). The Invertebrates: A New Synthesis, III Edition, Blackwell Science.

Hickman, C.P. 1961. Principles of Zoology. Mosby, St. Louis.

B.Sc. PART- I (Zoology Practical) (Semester I)

Guidelines/Instructions for Practical Examination

PRACTICAL -20UZOO103

Max Marks: 50 **Time allowed: 3 Hrs**

Note: Following exercises will be set in the examination as per marks assigned

S. No.	Exercise	Marks
		P-103
1.	Labelled diagram of different systems	3
2.	Temporary mounting –one	4
	(Staining, identification, sketch)	
3.	Museum specimens - five	10
	(identification and classification)	
4.	Ecological note –one specimen	4
5.	Permanent slides - two	4
	(Identification with reasons)	
6.	Invertebrate/ collection and report	4 (2+2)
7.	Practical record and slides	8 (6+2)
8.	Viva	6
9	Project report	7

CORE COURSE II (SEMESTER II)
ANIMAL DIVERSITY CHORDATES I (20UZOO201)
THEORY (CREDITS 2)

Max Marks: 40+10 (Internal assessment) **Time allotted: 3 Hours**

Note: Nine questions are to be set in all and the candidates are required to attempt five questions including compulsory question.

1. Question number I is compulsory consisting of 10 parts (1.0 mark each) covering the entire syllabus. Answer to each part should not exceed 20 words.
2. Out of remaining eight questions, two questions are to be set from each unit (I to IV), possibly splitting them in parts. Candidate is required to attempt four questions, selecting one question from each unit.

UNIT-I

Chordates:

Principles of classification; Origin and Evolutionary tree;Salient features of chordates;
Functional morphology of the types with examples emphasizing their biodiversity, economic importance.

UNIT-II

General characters and classification of phyla Protochordata upto orders with examples emphasizing their biodiversity, economic importance.

Protochordates: Systematic position, distribution, ecology, morphology and affinities
Urochordata: *Herdmania* – type study
Cephalochordata; *Amphioxus* – type study

UNIT-III

General characters and classification of phyla cyclostomata upto orders with examples emphasizing their biodiversity, economic importance.

Cyclostomes: Classification and ecological significance. Type study of *Petromyzon.*

UNIT-IV

General characters and classification of pisces upto orders with examples emphasizing their biodiversity, economic importance. **Pisces:** Scales, Parental care in fishes, fish migration. Types study of Labeo

Note: **Type study includes detailed study of various systems of the animal.**

SUGGESTED READINGS

Young, J. Z. (2004). The Life of Vertebrates. III Edition. Oxford university press.

Pough H. Vertebrate life, VIII Edition, Pearson International.

Kotpal, R.L. Modern text book of Zoology Vertebrates. Rastogi Publications. Meerut.

Hickman, C.P. 1961. Principles of Zoology. Mosby, St. Louis.

CORE COURSE II (Semester II)
ANIMAL DIVERSITY CHORDATES II (20UZOO202)
THEORY (Credits 2)

Max Marks: 40+10 (Internal assessment) **Time allotted: 3 Hours**

Note: Nine questions are to be set in all and the candidates are required to attempt five questions including compulsory question.

1. Question number I is compulsory consisting of 10 parts (1.0 mark each) covering the entire syllabus. Answer to each part should not exceed 20 words.
2. Out of remaining eight questions, two questions are to be set from each unit (I to IV), possibly splitting them in parts. Candidate is required to attempt four questions, selecting one question from each unit.

UNIT-I

Amphibia: Type study of frog (*Rana tigrina*), Parental Care in Amphibia

UNIT-II

Reptilia: Type study of Lizard (Hemidactylus), Extinct reptiles; Poisonous and non-poisonous snakes.

UNIT-III

Aves: Type study of Pigeon (*Columba livia*); Flight adaptation, Principles of aerodynamics in Bird flight, migration in birds.

UNIT-IV

Mammals: Type study of Rat; Dentition.

Note: Type study includes detailed study of various systems of the animal.

SUGGESTED READINGS

Young, J. Z. (2004). The Life of Vertebrates. III Edition. Oxford university press.

Pough H. Vertebrate life, VIII Edition, Pearson International.

Kotpal, R.L. Modern text book of Zoology Vertebrates. Rastogi Publications. Meerut.

Hickman, C.P. 1961. Principles of Zoology. Mosby, St. Louis.

CORE COURSE II (SEMESTER II)
ANIMAL DIVERSITY CHORDATES (20UZOO203)
PRACTICAL (CREDITS 2)

Max. Marks:50 **Time allowed: 3Hrs**

Max. Marks:50 **Time allowed: 3Hrs**

1. **Classification upto orders, habit, habitats, external characters and economic importance (if any) of the following animals:-**

Protochordata	:	*Molgula, Botryllus, Pyrosoma, Doliolum, Oikopleura,* and *Amphioxus.*
Cyclostomata	:	*Myxine, Petromyzon* and *Ammocoetus larva.*
Chondrichthyes:		*Zygaena, Pristis, Narcine* (electric ray), *Trygon, Rhinobatus, Raja* and
Osteichthyes	:	*Chimaera.*
		Acipenser, Lepidosteus, Mystus, Catla, Hippocampus,
		Syngnathus, Exocoetus, Anabas, Diodon, Tetradon, Echinus,
		Solea. Any of the Lung Fishes.
Amphibia	:	: *Necturus, Proteus, Amphiuma, Salamandra, Amblystoma, Axolotl larva*
		Alytes, Bufo, Rana.
Reptilia	:	*Hemidactylus, Calotes, Draco, Varanus, Phrynosoma, Chamaeleon, Typhops, Python, Eryx, Ptyas, Bungarus, Naja, Hydrus, Viper, Crocodilus, Gaviali, Chelone* (Turtle) and *Testudo* (Tortoise).
Aves		*Casuarius, Anas, Pavo, Eudynamis, Tyto, Halcyon*
Mammalia		*Ornithorphynchus, Echidna, Macropus, Macaque, Hystrix, Funambulus,*

2. **Study of models of the different systems of the following animals with the help of Charts/models:**

   Herdmania: General anatomy

   Labeo: Digestive, reproductive systems and cranial nerves

   Hemidactylus

   Rat

3. **Study of the skeleton of *Scoliodon, Labeo,* Frog, Gallus and Rat**
4. **Study of the following prepared slides:** Tornaria larva, T.S. *Amphioxus* (through different regionds). Oikopleura, different types of scales and histology of rat.
5. **Make permanent stained preparations of the following**: *Salpa,* Spicules, and Cycloid scales
6. **Zoological excursion and its report**
7. **Project Report on any one**
   Parental care
   Dentition in mammals
   Migration in Birds

B.Sc. PART- I (Zoology Practical) (Semester II)

Guidelines/Instructions for Practical Examination

PRACTICAL - 20UZOO203

Max Marks: 50

Time allowed: 3 Hrs

Note: Following exercises will be set in the examination as per marks assigned

S. No.	Exercise	Marks
		P-203
1.	Labeled diagram of different systems	3
2.	Temporary mounting –one	4
	(Staining, identification, sketch)	
3.	Museum specimens – four	8
	(identification and classification)	
4.	Ecological note –one specimen	4
5.	Permanent slides – two	4
	(Identification with reasons)	
6.	Bone identification and Sketch	4
7.	Invertebrate/ collection and report	4 (2+2)
8.	Practical record and slides	7 (5+2)
9.	Viva	6
10	Project report	6

CORE COURSE III (Semester III)
ANIMAL PHYSIOLOGY (20UZOO301)
THEORY (Credits 2)

Max Marks: 50 [40 (Theory) +10 (Internal Assessment)] Time Allotted: 3 hours

Note: Nine questions to be set in all and all the candidates are required to attempt five questions including compulsory question.

1. Question number 1 is compulsory constituting of 8 parts (1 Mark each) covering the entire syllabus.
2. Out of the remaining eight questions (8 marks each), two questions are to be set from each Unit (I to IV), possibly splitting them in parts. Candidate is required to attempt four questions, selecting one question from each unit.

Unit I

Digestion and Respiration

Physiology of digestion in the alimentary canal; Absorption of carbohydrates, proteins, lipids, Pulmonary ventilation, Respiratory volumes and capacities, Transport of Oxygen and carbon dioxide in blood

Unit II

Cardiovascular system and Excretion

Composition of blood, Homeostasis, Structure of Heart, Origin and conduction of the cardiac impulse, Cardiac cycle, Structure of nephron, Physiology of excretion

Unit III

Nervous system and muscular system

Structure of a neuron, Resting membrane potential, Graded potential, Origin of Action potential and its propagation in myelinated and non-myelinated nerve fibres, Ultra-structure of skeletal muscle, Molecular and chemical basis of muscle contraction

Unit IV

Reproduction and Endocrine Glands

Physiology of male reproduction: hormonal control of spermatogenesis; Physiology of female reproduction: hormonal control of menstrual cycle in human, Structure and function of pituitary, thyroid, Parathyroid, pancreas and adrenal

SUGGESTED READINGS

Tortora, G.J. and Derrickson, B.H. (2009). *Principles of Anatomy and Physiology*, XII Edition, John Wiley & Sons, Inc.

Widmaier, E.P., Raff, H. and Strang, K.T. (2008) *Vander's Human Physiology*, XI Edition., McGraw Hill

Guyton, A.C. and Hall, J.E. (2011): T*extbook of Medical Physiology*, XII Edition, Harcourt Asia Pvt. Ltd/ W.B. Saunders Company

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CORE COURSE III (Semester III)
ANIMAL BIOCHEMISTRY (20UZOO302)
THEORY (Credits 2)

Max Marks: 50 [40 (Theory) +10 (Internal Assessment)] Time Allotted: 3 hours

Note: Nine questions to be set in all and all the candidates are required to attempt five questions including compulsory question.

1. Question number 1 is compulsory constituting of 8 parts (1 Mark each) covering the entire syllabus.
2. Out of the remaining eight questions (8 marks each), two questions are to be set from each Unit (I to IV), possibly splitting them in parts. Candidate is required to attempt four questions, selecting one question from each unit.

Unit I

Carbohydrates and their Metabolism
Structure and Biological Importance, Monsaccharides, Disaccharides, Oligosaccharide, Polysaccharides, Glycolysis, Krebs Cycle, Electron transport chain

Unit II

Lipids and their Metabolism
Structure and their biological importance of fatty acids, triacylglycerols, phospholipids, glycolipids, Biosynthesis and β oxidation of palmitic acid

Unit III

Introduction, Classification, Structure, function and general properties of proteins; Nomenclature, Classification and mechanisms of enzyme, Transport through biomembranes (Active and Passive), Buffers

Unit IV

Nucleic Acids
Structure, functions and types of DNA, RNA and their components, Central dogma

SUGGESTED READINGS

Berg, J. M., Tymoczko, J. L. and Stryer, L. (2006). *Biochemistry*. VI Edition. W.H. Freeman and Co.

Nelson, D. L., Cox, M. M. and Lehninger, A.L. (2009). *Principles of Biochemistry*. IV Edition. W.H. Freeman and Co.

Murray, R.K., Granner, D.K., Mayes, P.A. and Rodwell, V.W. (2009). *Harper's Illustrated Biochemistry*. XXVIII Edition. Lange Medical Books/Mc Graw3Hill.

CORE COURSE III (Semester III)
ANIMAL PHYSIOLOGY AND BIOCHEMISTRY (20UZOO303)
PRACTICAL (Credits 2)

Maximum Marks- 50

Time allowed- 3 hours

1. Preparation of heme and hemochromogen crystals
2. Study of permanent histological sections of mammalian pituitary, thyroid, pancreas, adrenal gland
3. Study of permanent slides of spinal cord, duodenum, liver, lung, kidney, bone, cartilage
4. Qualitative tests to identify functional groups of carbohydrates in given solutions (Glucose, Fructose, Sucrose, Lactose)
5. Estimation of total protein in given solutions by Lowry's method.
6. Study of activity of salivary amylase under optimum conditions.
7. Paper chromatography of amino acids

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B.Sc. PART- II (Zoology Practical) (Semester III)

Guidelines/Instructions for Practical Examination

PRACTICAL -20UZOO303

Max Marks: 50 **Time allowed: 3 Hrs**

Note: Following exercises will be set in the examination as per marks assigned

S. No.	Exercise	Marks
		P-303
1.	Preparation of Crystals	5
2.	Permanent slides of endocrine glands	6
	(identification, sketch)	
3.	Permanent slide of tissues	6
	(identification, reason)	
4.	Qualitative tests of carbohydrate	6
5.	Experiment of Physiology	8
6.	Chromatography	6
7.	Practical record	7
8.	Viva	6

CORE COURSE IV (Semester IV)
CELL BIOLOGY AND GENETICS (20UZOO401)
THEORY (Credits 2)

Max Marks: 50 [40 (Theory) +10 (Internal Assessment)] Time Allotted: 3 hours

Note: Nine questions to be set in all and all the candidates are required to attempt five questions including compulsory question.

1. Question number 1 is compulsory constituting of 8 parts (1 Mark each) covering the entire syllabus.
2. Out of the remaining eight questions (8 marks each), two questions are to be set from each Unit (I to IV), possibly splitting them in parts. Candidate is required to attempt four questions, selecting one question from each unit.

UNIT-I

1. Plasma Membrane: Fluid mosaic model, various modes of transport across the membrane, mechanism of active and passive transport, endocytosis and exocytosis,
2. Endoplasmic reticulum (ER): types, role of ER in protein synthesis and transportation in animal cell.
3. Goigi complex: Structure, role of golgi-complex in animal cell.
4. Ribosomes: Types, biogenesis and role in protein synthesis.

UNIT-II

1 Lysosomes: Structure, enzyme and their role; polymorphism
2 Mitochondria: Mitochondrial DNA; as semiautonomous body, biogenesis, mitochondrial enzymes (only names), role of mitochondria.
3 Cytoskeleton: Microtubules, microfilaments, centriole and basal body.
Cilia and Flagella

4 Ultrastructure and functions of Nucleus: Nuclear· membrane, nuclear lamina, nucleolus, Polytene chromosome

Unit III

Mendel's work on transmission of traits, Genetic Variation, Principles of Inheritance, Incomplete dominance and codominance, Multiple alleles, Lethal alleles, Epistasis, Pleiotropy, sex linked inheritance, Sex Determination, Human karyotype, Chromosomal abnormalities involving autosomes and sex chrosomes, inborn errors of metabolism

Unit VI

Linkage and crossing over, Interference and coincidence, Chromosomal Mutations: Deletion, Duplication, Inversion, Translocation, Aneuploidy and Polyploidy; Gene mutations: Induced versus Spontaneous mutations, Extra-chromosomal Inheritance, Maternal effects, Polygenic inheritance with suitable examples; simple numericals based on it, Euthenics, Euphenics, aminocentesis

SUGGESTED READINGS

Gardner, E.J., Simmons, M.J., Snustad, D.P. (2008). *Principles of Genetics*. VIII Edition. Wiley India.
Snustad, D.P., Simmons, M.J. (2009). *Principles of Genetics*. V Edition. John Wiley and Sons Inc.
Klug, W.S., Cummings, M.R., Spencer, C.A. (2012). *Concepts of Genetics*. X Edition. Benjamin Cummings.
Molecular Cell Biology, J. Darnell, H. Lodish and D. Baltimore Scientific American Book, Inc., USA.
Cell Biology by C.B. Panwar, Himalaya Publication

CORE COURSE II (Semester IV)
DEVELOPMENTAL BIOLOGY (20UZOO402)
THEORY (Credits 2)

Max Marks: 40+10 (Internal Assessment) Time allotted: 3 Hours

Note : Nine questions are to be set in all and the candidates are required to attempt five questions including the compulsory question

1. Question 1 is compulsory consisting of 10 parts (1.0 marks each) covering the entire syllabus. Answer to each part should not exceed 20 words.
2. Out of remaining eight questions, two questions are to be set from each unit (I to IV), possibly splitting them in parts. Candidates are required to attempt four questions, selecting one from each unit.

Unit I

1. Historical perspectives, aims and scope of developmental biology.
2. Generalized structure of mammalian ovum & sperm. Spermatogenesis and Oogenesis.

Unit II

1. Fertilization, parthenogenesis, different types of eggs and patterns of cleavage in invertebrates and vertebrates.
2. Process of blastulation in invertebrates and vertebrates
3. Fate-map construction in frog and chick.

Unit III

1. Gastrulation in invertebrates and vertebrates
2. Gastrulation & formation of three germinal layers in frog and chick.
3. Elementary knowledge of primary organizers.

Unit IV

1. Extra embryonic membranes: structure & significance in birds and mammals.
2. Concepts of competence, determination and differentiation.
3. Concept of regeneration.

SUGGESTED READINGS

Kardong, K.V. (2005) Vertebrates' Comparative Anatomy, Function and Evolution. IV Edition. McGraw-Hill Higher Education

Kent, G.C. and Carr R.K. (2000). Comparative Anatomy of the Vertebrates. IX Edition. The McGraw-Hill Companies

Hilderbrand, M and Gaslow G.E. Analysis of Vertebrate Structure, John Wiley and Sons

Gilbert, S. F. (2010). Developmental Biology, IX Edition, Sinauer Associates, Inc., Publishers, Sunderland, Massachusetts, USA

Balinsky B. I. and Fabian B. C. (1981). An Introduction to Embryology, V Edition, International Thompson Computer Press

Carlson, R. F. Patten's Foundations of Embryology

Kalthoff (2008). Analysis of Biological Development, II Edition, McGraw-Hill Publishers

Lewis Wolpert (2002). Principles of Development. II Edition, Oxford University Press

CORE COURSE IV (Semester IV)
CELL BIOLOGY, GENETICS AND DEVELOPMENTAL BIOLOGY (20UZOO403)
PRACTICAL (Credits 2)

Maximum Marks- 50 Time allowed- 3 hours

. Study of Mendelian Inheritance and gene interactions (Non Mendelian Inheritance) using uitable examples. Verify the results using Chi-square test.
. Study of Linkage, recombination, gene mapping using the data.
. Study of Human Karyotypes (normal and abnormal).
. Study of whole mounts and sections of developmental stages of frog through permanent slides: Cleavage tages, blastula, gastrula, neurula, tail-bud stage, tadpole (external and internal gill stages)
. Study of whole mounts of developmental stages of chick through permanent slides: Primitive streak (13 nd 18 hours), 21, 24, 28, 33, 36, 48, 72, and 96 hours of incubation (Hamilton and Hamburger stages)
. Study of Mitosis using onion root tip and meiosis using permanent slides.
. Project Report Salivary gland and polytene chromosome/ Human Karyotype

B.Sc. PART- II (Zoology Practical) (Semester IV)

Guidelines/Instructions for Practical Examination

PRACTICAL - 20UZOO403

Max Marks: 50 **Time allowed: 3 Hrs**

Note: Following exercises will be set in the examination as per marks assigned

S. No.	Exercise	Marks
		P-403
1.	Preparation of Chromosome slide using Onion root tip	7
2.	Permanent Slides Frog and Chick (identification, reason)	10
3.	Permanent slide of Mitosis and meiosis (Identification and Reason)	6
4.	Numerical based on Chi square test	6
5.	Project Report	6
6.	Practical record	8
7.	Viva	7

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SEC II (Semester IV)
MEDICAL DIAGNOSTICS (20USECZ404)
(Credits 3)

Max Marks: 100 [80 (Theory) +10 (Internal Assessment) +10 (Field Report)]
Time Allotted: 3 hours
Note: Nine questions to be set in all and all the candidates are required to attempt five questions including compulsory question.
1. Question number 1 is compulsory constituting of 8 parts (2 Mark each) covering the entire syllabus.
2. Out of the remaining eight questions (16 marks each), two questions are to be set from each Unit, splitting them in parts. Candidate is required to attempt four questions, selecting one question from each unit.

Unit 1

Introduction to Medical Diagnostics and its Importance

Unit 2

Diagnostics Methods Used for Analysis of Blood

Blood composition, Preparation of blood smear and Differential Leucocyte Count (D.L.C) using Leishman's stain, Platelet count using haemocytometer, Erythrocyte Sedimentary Rate (E.S.R), Packed Cell Volume (P.C.V.)

Unit 3

Diagnostic Methods Used for Urine Analysis and Tumours

Urine Analysis: Physical characteristics; Abnormal constituents
Tumours: Types (Benign/Malignant), Detection and metastasis; Medical imaging: X-Ray of Bone fracture, PET, MRI and CT Scan (using photographs).

Unit 4

Infectious Diseases and Non-infectious Diseases

Infectious Diseases: Causes, types, symptoms, diagnosis and prevention of Tuberculosis and Hepatitis and COVID-19

Non-infectious Diseases: Causes, types, symptoms, complications, diagnosis and prevention of Diabetes (Type I and Type II), Hypertension (Primary and secondary), Testing of blood glucose using Glucometer/Kit

Training Programme:-Two weeks training programme of medical diagnostics in laboratories for at least one hour per day and submission of report.

SUGGESTED READINGS

Park, K. (2007), *Preventive and Social Medicine*, B.B. Publishers
Godkar P.B. and Godkar D.P. *Textbook of Medical Laboratory Technology*, II Edition, Bhalani Publishing House
Cheesbrough M., *A Laboratory Manual for Rural Tropical Hospitals, A Basis for Training Courses*
Guyton A.C. and Hall J.E. *Textbook of Medical Physiology*, Saunders
Robbins and Cortan, *Pathologic Basis of Disease*, VIII Edition, Saunders
Prakash, G. (2012), *Lab Manual on Blood Analysis and Medical Diagnostics*, S. Chand and Co. Ltd.

DSE IA (Semester V)
IMMUNOLOGY (20UZOO501)
THEORY (Credits 2)

Max Marks: 50 [40 (Theory) +10 (Internal Assessment)] Time Allotted: 3 hours
Note: Nine questions to be set in all and all the candidates are required to attempt five questions including compulsory question.
1. Question number 1 is compulsory constituting of 8 parts (1 Mark each) covering the entire syllabus.
2. Out of the remaining eight questions (8 marks each), two questions are to be set from each Unit (I to IV), possibly splitting them in parts. Candidate is required to attempt four questions, selecting one question from each unit.

Unit I

Historical perspective of Immunology, Anatomical barriers, Inflammation, Cell and molecules involved in innate immunity, Adaptive immunity (Cell mediated and humoral), Passive: Artificial and natural Immunity, Active: Artificial and natural Immunity, Types of Antobodies

Unit II

Antigenicity and immunogenicity, Immunogens, Adjuvants and haptens, Factors influencing immunogenicity, B and T-Cell epitopesns,

UNIT III

Structure and functions of different classes of immunoglobulins, Antigen antibody interactions, Primary and Secondary immune response

UNIT IV

Hypersensitivity and Vaccines
Gell and Coombs' classification and brief description of various types of hypersensitivities, Various types of vaccines.

SUGGESTED READINGS

Beauchamp, T.I. and Childress, J.F. (2008). *Principles of Biomedical Ethics.* VI Edition, Oxford University Press.
Kindt, T. J., Goldsby, R.A., Osborne, B. A. and Kuby, J (2006). *Immunology*, VI Edition. W.H. Freeman and Company.
David, M., Jonathan, B., David, R. B. and Ivan R. (2006). *Immunology,* VII Edition, Mosby, Elsevier Publication.
Abbas, K. Abul and Lechtman H. Andrew (2003.) *Cellular and Molecular Immunology.* V Edition. Saunders Publication.

DSE IA (Semester V)
ANIMAL BIOTECHNOLOGY (20UZOO502)
THEORY (Credits 2)

Max Marks: 50 [40 (Theory) +10 (Internal Assessment)] Time Allotted: 3 hours
Note: Nine questions to be set in all and all the candidates are required to attempt five questions including compulsory question.
1. Question number 1 is compulsory constituting of 8 parts (1 Mark each) covering the entire syllabus.
2. Out of the remaining eight questions (8 marks each), two questions are to be set from each Unit (I to IV), possibly splitting them in parts. Candidate is required to attempt two questions, selecting one question from each unit.

Unit I

Concept, scope and applications of biotechnology in agriculture, veterinary, human health, medicine and fisheries

Unit II

Cloning vectors: Plasmids, Cosmids, Phagemids, Lambda Bacteriophage, M13, BAC, YAC, and Expression vectors (characteristics).

Unit III

Restriction enzymes: Nomenclature, DNA sequencing: Sanger dideoxy method and Maxam-gilbert method, Southern, Northern and Western blotting, Polymerase Chain Reaction, DNA Finger Printing

Unit IV

Genetically Modified Organisms, Applications of transgenic animals, Culture Techniques and Applications, Animal cell culture, Expressing cloned genes in mammalian cells, Recombinant DNA Technology

SUGGESTED READINGS

Brown, T.A. (1998). *Molecular Biology Labfax II: Gene Cloning and DNA Analysis*. II Edition, Academic Press, California, USA.

Glick, B.R. and Pasternak, J.J. (2009). *Molecular Biotechnology - Principles and Applications of Recombinant DNA*. IV Edition, ASM press, Washington, USA.

Griffiths, A.J.F., J.H. Miller, Suzuki, D.T., Lewontin, R.C. and Gelbart, W.M. (2009).

An Introduction to Genetic Analysis. IX Edition. Freeman and Co., N.Y., USA.

Watson, J.D., Myers, R.M., Caudy, A. and Witkowski, J.K. (2007). *Recombinant DNAGenes and Genomes-Short Course*. III Edition, Freeman and Co., N.Y., USA.

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DSE IA (Semester V)
IMMUNOLOGY AND ANIMAL BIOTECHNOLOGY (20UZOO503)
PRACTICAL (Credits 2)

Maximum Marks- 50 Time allowed- 3 hours

1. Demonstration of lymphoid organs through charts/models/video
2. Histological study of spleen, thymus and lymph nodes through slides/ photographs.
3. Preparation of stained blood film to study various types of blood cells.
4. ABO blood group determination.
5. Preparation of different solutions required in plasmic/genomic DNA isolation
6. Construction of circular and linear restriction map from the data provided.
7. Calculation of transformation efficiency from the data provided.
8. Project Report on following techniques

a) Southern Blotting
b) DNA Sequencing (Sanger's Method)
c) PCR

B.Sc. PART- III (Zoology Practical) (Semester V)

Guidelines/Instructions for Practical Examination

PRACTICAL-20UZOO503

Max Marks: 50 **Time allowed: 3 Hrs**

Note: Following exercises will be set in the examination as per marks assigned

S. No.	Exercise	Marks
		P-503
1.	Preparation of Film of Blood Cells/ Blood Group Determination	7
2.	Permanent Slides/Photograph of Different Organs: Identification and Reason	6
3.	Preparation of Different Solutions for DNA isolation	6
4.	Numerical based on Transformation Efficiency	6
5.	Construction of Restriction Map From the data provided	4
6.	Project Report	6
7.	Practical record	8
8.	Viva	7

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DSE IB (Semester V)
AQUACULTURE (20UZOO504)
THEORY (Credits 2)

Max Marks: 50 [40 (Theory) +10 (Internal Assessment)] Time Allotted: 3 hours

Note: Nine questions to be set in all and all the candidates are required to attempt five questions including compulsory question.

1. Question number 1 is compulsory constituting of 8 parts (1 Mark each) covering the entire syllabus.
2. Out of the remaining eight questions (8 marks each), two questions are to be set from each Unit (I to IV), possibly splitting them in parts. Candidate is required to attempt four questions, selecting one question from each unit.

Unit I

General description of fish; Feeding habits, habitat and manner of reproduction in fish. Types of fins and their modifications; Types of Scales, Use of scales in classification and determination of age of fish.

Unit II

Gills and gas exchange; Swim Bladder: Types and role in Respiration, buoyancy, Reproduction in fish (special reference to Indian fishes), milt, spawn, fry, fingerlings, brood fishes; Electric organs; Bioluminiscience; Mechanoreceptors; Schooling; Parental care; Migration

Unit III

Inland Fisheries; Marine Fisheries; Fish Diseases-Bacterial and Parasitic, Fishing Crafts and Gears, Depletion of fisheries resources

Unit IV

Sustainable Aquaculture; Extensive, semi-intensive and intensive culture of fish, Prawn culture and Pearl culture; Pen and cage culture; Polyculture; Composite fish culture; Brood stock management; Induced breeding of fish

SUGGESTED READINGS

1. Fish and Fisheries of India by Jhingran, V.G., Hindustan Publishing Corporation, New Delhi; 1991.
2. A Text Book of Fisheries Science and Indian Fisheries, by CBL Srivastav (2006), Kitab Mahal.
3. Experimental ichthyology by Garg et al., 2008, CBS
4. Q Bone and R Moore, Biology of Fishes, Talyor and Francis Group, CRC Press, U.K.
5. D. H. Evans and J. D. Claiborne, The Physiology of Fishes, Taylor and Francis Group, CRC Press,
6. C.B.L. Srivastava, Fish Biology, Narendra Publishing House
7. J.R. Norman, A history of Fishes, Hill and Wang Publishers
8. S.S. Khanna and H.R. Singh, A text book of Fish Biology and Fisheries, Narendra Publishing House

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DSE IB (Semester V)
ECONOMIC ZOOLOGY (20UZOO505)
THEORY (Credit 2)

Max Marks: 50 [40 (Theory) +10 (Internal Assessment)] Time Allotted: 3 hours

Note: Nine questions to be set in all and all the candidates are required to attempt five questions including compulsory question.

1. Question number 1 is compulsory constituting of 8 parts (1 Mark each) covering the entire syllabus.
2. Out of the remaining eight questions (8 marks each), two questions are to be set from each Unit (I to IV), possibly splitting them in parts. Candidate is required to attempt four questions, selecting one question from each unit.

Unit I

Life history, Control and damage caused by *Helicoverpa armigera*, *Pyrilla perpusilla* and *Papilio demoleus, Callosobruchus chinensis, Sitophilus oryzae* and *Tribolium castaneum,* Lac Culture

Unit II

Life History, Medical importance and control of *Pediculus humanus corporis*, *Anopheles, Culex, Aedes, Xenopsylla cheopis,* Sericulture

Unit III

Preservation and artificial insemination in cattle; Induction of early puberty and synchronization of estrus in cattle, Piggery

Unit IV

Poultry Farming, Principles of poultry breeding, Management of breeding stock and broilers, Processing and preservation of eggs

SUGGESTED READINGS

Park, K. (2007). *Preventive and Social Medicine.* XVI Edition. B.B Publishers.

Arora, D. R and Arora, B. (2001). *Medical Parasitology.* II Edition. CBS Publications and Distributors.

Kumar and Corton. *Pathological Basis of Diseases.*

Hafez, E. S. E. (1962). *Reproduction in Farm Animals.* Lea & Fabiger Publisher

Dunham R.A. (2004). *Aquaculture and Fisheries Biotechnology Genetic Approaches.* CABI publications, U.K.

DSE IB (Semester V)
AQUACULTURE AND ECONOMIC ZOOLOGY (20UZOO506)
PRACTICAL (Credits 2)

Maximum Marks- 50 Time allowed- 3 hours

1. Study of *Petromyzon*, *Myxine*, *Pristis*, *Chimaera*, *Mrigal*, *Catla catla*, *Exocoetus*, *Hippocampus*, *Gambusia*, *Labeo*, *Heteropneustes*, *Anabas*
2. Study of different types of scales (through permanent slides/ photographs).
3. Study of crafts and gears used in Fisheries
4. Water quality criteria for Aquaculture: Assessment of pH, conductivity, Total solids, Total dissolved solids
5. Demonstration of induced breeding in Fishes (video).
6. Study of arthropod vectors associated with human diseases: *Pediculus*, *Culex*, *Anopheles*, *Aedes* and *Xenopsylla*.
7. Study of insect damage to different plant parts/stored grains through damaged products/photographs: Identifying feature and economic importance of *Helicoverpa* (*Heliothis*) *armigera*, *Papilio demoleus*, *Pyrilla perpusilla*, *Callosobruchus chinensis*, *Sitophilus oryzae* and *Tribolium castaneum*
8. Project Report on a visit to any fish farm/ pisciculture unit/ Piggery/ Poultry.

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B.Sc. PART- III (Zoology Practical) (Semester V)

Guidelines/Instructions for Practical Examination

PRACTICAL- 20UZOO506

Max Marks: 50 **Time allowed: 3 Hrs**

Note: Following exercises will be set in the examination as per marks assigned

S. No.	Exercise	Marks
		P-506
1.	Identification and Classification of specimens (Fishes and Pests)	12
2.	Ecological note on economically important specimen (Fishes and Pests)	6
3.	Permanent Slides of scales and Vectors	8
4.	Chemical analysis of water	5
5.	Crafts and gears	3
6.	Project Report	5
7.	Practical record	5
8.	Viva	6

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DSE IIA (Semester VI)
APPLIED ZOOLOGY (20UZOO601)
THEORY (Credits 2)

Max Marks: 50 [40 (Theory) +10 (Internal Assessment)] Time Allotted: 3 hours

Note: Nine questions to be set in all and all the candidates are required to attempt five questions including compulsory question.

1. Question number 1 is compulsory constituting of 8 parts (1 Mark each) covering the entire syllabus.
2. Out of the remaining eight questions (8 marks each), two questions are to be set from each Unit (I to IV), possibly splitting them in parts. Candidate is required to attempt four questions, selecting one question from each unit.

Unit I

Introduction to Host-parasite Relationship, Host, Definitive host, Intermediate host, Parasitism, Symbiosis, Commensalism, Reservoir, Zoonosis, Transmission, Epidemiology of Diseases, Prevention and control of diseases: Tuberculosis and typhoid

Unit II

Rickettsiae and Spirochaetes

Brief account of *Rickettsia prowazekii, Borrelia recurrentis, Treponema pallidum and* mycoplasma

Unit III

Parasitic Protozoa

Life history and pathogenicity of *Entamoeba histolytica, Plasmodium vivax, Trypanosoma brucei* and *Leishmania*

Unit IV

Parasitic Helminthes

Life history and pathogenicity of *Ancylostoma duodenale, Wuchereria bancrofti, Taenia solium* and *Ascarias*

SUGGESTED READINGS

Park, K. (2007). *Preventive and Social Medicine*. XVI Edition. B.B Publishers.

Arora, D. R and Arora, B. (2001). *Medical Parasitology*. II Edition. CBS Publications and Distributors.

Kumar and Corton. *Pathological Basis of Diseases*.

Hafez, E. S. E. (1962). *Reproduction in Farm Animals*. Lea & Fabiger Publisher

DSE IIA (Semester VI)

INSECT, VECTORS AND DISEASES (20UZOO602)

THEORY (Credits 2)

Max Marks: 50 [40 (Theory) + 10 (Internal Assessment)] Time Allotted: 3 hours

Note: Nine questions to be set in all and all the candidates are required to attempt five questions including compulsory question.

1. Question number 1 is compulsory constituting of 8 parts (1 Mark each) covering the entire syllabus.
2. Out of the remaining eight questions (8 marks each), two questions are to be set from each Unit (I to IV), possibly splitting them in parts. Candidate is required to attempt four questions, selecting one question from each unit.

Unit I

General Features of Insects. Brief introduction of Carrier and Vectors (mechanical and biological vector). Reservoirs. Host-vector relationship. Vectorial capacity. Adaptations as vectors. Host Specificity. Detailed features of orders with insects as vectors – Diptera, Siphonaptera, Siphunculata, Hemiptera

Unit II

Dipterans as important insect vectors – Study of Mosquitoes, Study of mosquito-borne diseases – Malaria, Dengue, Chikungunya, Viral encephalitis, Filariasis; Control of mosquitoes

Unit III

Study of sand fly, house fly. Study of sand fly-borne diseases – Visceral Leishmaniasis, Cutaneous Leishmaniasis, Phlebotomus fever; Control of Sand fly. Study of house fly as important mechanical vector. Myiasis. Control of house fly

Unit IV

Fleas as important insect vectors. Human louse (Head, Body and Pubic louse) as important insect vectors. Bugs as insect vectors

SUGGESTED READINGS

Pedigo, L.P. (2002). *Entomology and Pest Management*. Prentice Hall.

Imms, A.D. (1977). *A General Text Book of Entomology*. Chapman & Hall, UK

Chapman, R.F. (1998). *The Insects: Structure and Function*. IV Edition. Cambridge University Press, UK

Pedigo L.P. (2002). *Entomology and Pest Management*. Prentice Hall Publication

Mathews, G. (2011). *Integrated Vector Management: Controlling Vectors of Malaria and Other Insect Vector Borne Diseases*. Wiley-Blackwell

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DSE IIA (Semester VI)
INSECT, VECTORS AND DISEASES (20UZOO602)
THEORY (Credits 2)

Max Marks: 50 [40 (Theory) +10 (Internal Assessment)] Time Allotted: 3 hours

Note: Nine questions to be set in all and all the candidates are required to attempt five questions including compulsory question.

1. Question number 1 is compulsory constituting of 8 parts (1 Mark each) covering the entire syllabus.
2. Out of the remaining eight questions (8 marks each), two questions are to be set from each Unit (I to IV), possibly splitting them in parts. Candidate is required to attempt four questions, selecting one question from each unit:

Unit I

General Features of Insects, Brief introduction of Carrier and Vectors (mechanical and biological vector), Reservoirs, Host-vector relationship, Vectorial capacity, Adaptations as vectors, Host Specificity, Detailed features of orders with insects as vectors – Diptera, Siphonaptera, Siphunculata, Hemiptera

Unit II

Dipterans as important insect vectors – Study of Mosquitoes, Study of mosquito-borne diseases – Malaria, Dengue, Chikungunya, Viral encephalitis, Filariasis; Control of mosquitoes

Unit III

Study of sand fly, house fly. Study of sand fly-borne diseases – Visceral Leishmaniasis, Cutaneous Leishmaniasis, Phlebotomus fever; Control of Sand fly Study of house fly as important mechanical vector, Myiasis, Control of house fly

Unit IV

Fleas as important insect vectors, Human louse (Head, Body and Pubic louse) as important insect vectors; Bugs as insect vectors

SUGGESTED READINGS

Pedigo, L.P. (2002). *Entomology and Pest Management*, Prentice Hall.

Imms, A.D. (1977). *A General Text Book of Entomology*. Chapman & Hall, UK

Chapman, R.F. (1998). *The Insects: Structure and Function*. IV Edition, Cambridge University Press, UK

Pedigo L.P. (2002). *Entomology and Pest Management*. Prentice Hall Publication

Mathews, G. (2011). *Integrated Vector Management: Controlling Vectors of Malaria and Other Insect Vector Borne Diseases*. Wiley-Blackwell

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DSE IIA (Semester VI)
APPLIED ZOOLOGY, INSECT, VECTORS AND DISEASES(20UZOO603)
PRACTICAL (Credits 2)

Maximum Marks- 50 Time allowed- 3 hours

1. Study of *Plasmodium vivax*, *Entamoeba histolytica, Trypanosoma gambiense, Ancylostoma duodenale, Wuchereria bancrofti, Mycoplasma, Leishmanaia and* Ascarias and their life stages through permanent slides/photomicrographs or specimens.
2. Study of arthropod vectors associated with human diseases: *Pediculus, Culex, Anopheles, Aedes* and *Xenopsylla*.
3. Study of following insect vectors through permanent slides/ photographs: *Aedes, Culex, Anopheles, Pediculus humanus capitis, Pediculus humanus corporis, Phithirus pubis, Xenopsylla cheopis, Cimex lectularius, Phlebotomus argentipes, Musca domestica,* through permanent slides/ photographs
4. Study of different diseases transmitted by above insect vectors

*Submission of a project/assignment report on any one of the insect vectors and disease transmitted

B.Sc. PART- III (Zoology Practical) (Semester VI)

Guidelines/Instructions for Practical Examination

PRACTICAL- 20UZOO603

Max Marks: 50 **Time allowed: 3 Hrs**

Note: Following exercises will be set in the examination as per marks assigned

S. No.	Exercise	Marks
		P-603
1.	Identification and Classification of specimens	8
2.	Ecological note on economically important specimen	6
3.	Permanent Slides	10
4.	Identification of Diseases and their Vectors	6
5.	Project Report	6
6.	Practical record	6
7.	Viva	8

DSE IIB (Semester VI)
ECOLOGY AND EVOLUTION (20UZOO604)
THEORY (Credits 2)

Max Marks: 100 [80 (Theory) +10 (Internal Assessment) +10 (Field Report)]
Time Allotted: 3 hours
Note: Nine questions to be set in all and all the candidates are required to attempt five questions including compulsory question.
1. Question number 1 is compulsory constituting of 8 parts (2 Mark each) covering the entire syllabus.
2. Out of the remaining eight questions (16 marks each), two questions are to be set from each Unit, splitting them in parts. Candidate is required to attempt four questions, selecting one question from each unit.

Unit I

History of ecology, Autecology and synecology, Levels of organization, Laws of limiting factors, Study of biotic and abiotic factors, Unique and group attributes of population: Density, natality, mortality, fecundity, survivorship curves, age ratio, sex ratio, dispersal and dispersion

Unit II

Community characteristics: species richness, dominance, diversity, abundance, vertical stratification, Ecological Niche, Ecotone and edge effect; Ecological succession with one example. Types of ecosystems with one example in detail, Food chain: Detritus and grazing food chains, Food web, Energy flow through the ecosystem, Ecological pyramids

Unit III

Origin of species, Lamarckism, Darwinism, Neo-Darwinism, Evidences of Evolution: Geological time scale, Neutral theory of molecular evolution, Natural selection, Genetic Drift

Unit IV

Population genetics: Hardy-Weinberg Law, Founder's effect, Bottleneck phenomenon; Species concept, Isolating mechanisms, modes of speciation—allopatric, sympatric, Adaptive radiation / macroevolution, Origin and evolution of man and horse.

SUGGESTED READINGS

1. Fundamentals of Ecology (5th Edition) by W.B. Odum, E.P. Saunders, Toppan Co. Ltd., Tokyo, Japan. (1963 1st Edition).
2. Environmental biology and toxicology by P.D. Sharma (2014), Rastogi Publication.
3. Concepts of Ecology by Edward J. Kormondy (4th Edition) (2017); Prentice Hall of India (Pvt.) Ltd.
4. Ecology: from individuals to ecosystem (4th Edition) by Michael Begen, Colen R, Harper 2005.
5. *Organic Evolution* by Veer Bala Rastogi, Published by MEDTECH (2016).
6. *Principles of Systematic Zoology* by E. Mayr and P. D. Ashlock, Tata McGraw Hill Publishing Co. Ltd., New Delhi; 1991.

DSE IIB (Semester VI)
WILD LIFE CONSERVATION (20UZOO605)
THEORY (Credits 2)

Max Marks: 50 [40 (Theory) +10 (Internal Assessment)] Time Allotted: 3 hours

Note: Nine questions to be set in all and all the candidates are required to attempt five questions including compulsory question.

1. Question number 1 is compulsory constituting of 8 parts (1 Mark each) covering the entire syllabus.
2. Out of the remaining eight questions (8 marks each), two questions are to be set from each Unit (I to IV), possibly splitting them in parts. Candidate is required to attempt four questions, selecting one question from each unit.

Unit I

Introduction to Wild Life

Values of wild life - positive and negative; Conservation ethics; Importance of conservation; Causes of depletion; World conservation strategies.

Unit II

Management planning of wild life in protected areas

Estimation of carrying capacity; Eco tourism/wild life tourism in forests; Concept of climax persistence; Ecology of perturbence.

Unit III

Management of excess population

Population density, Natality, Birth rate, Mortality, fertility schedules and sex ratio computation; Care of injured and diseased animal; Quarantine; Common diseases of wild animal

Unit IV

Protected areas

Preservation of general genetic diversity; Restoration of degraded habitats National parks & sanctuaries, Community reserve; Important features of protected areas in India; Tiger conservation - Tiger reserves in India; Management challenges in Tiger reserve.

SUGGESTED READINGS

Caughley, G., and Sinclair, A.R.E. (1994). *Wildlife Ecology and Management*. Blackwell Science.

Woodroffe R., Thirgood, S. and Rabinowitz, A. (2005). *People and Wildlife, Conflict or Co-existence*? Cambridge University.

Bookhout, T.A. (1996). *Research and Management Techniques for Wildlife and Habitats*, 5 th edition. The Wildlife Society, Allen Press.

Sutherland, W.J. (2000). *The Conservation Handbook: Research, Management and Policy*. Blackwell Sciences

Hunter M.L., Gibbs, J.B. and Sterling, E.J. (2008). *Problem-Solving in Conservation Biology and Wildlife Management: Exercises for Class, Field, and Laboratory*. Blackwell Publishing.

DSE IIB (Semester VI)
ECOLOGY, EVOLUTION AND WILD LIFE CONSERVATION (20UZOO606)
PRACTICAL (Credits 2)

Maximum Marks- 50 Time allowed- 3 hours

1. Study of homology and analogy from suitable specimens/ pictures
2. Charts:
a) Evolution of man with photographs
b) Phylogeny of horse with diagrams/ cut outs of limbs and teeth of horse ancestors
c) Darwin's Finches with diagrams/ cut outs of beaks of different species
3. Study of plotting of survivorship curves of different types from the hypothetical/real data provided
4. Determination of population density in a natural/hypothetical community by quadrate method and calculation of Shannon-Weiner diversity index for the same community
5. Study of an aquatic ecosystem: Phytoplankton and zooplankton, Measurement of area, temperature, turbidity/penetration of light, determination of pH, and Dissolved Oxygen content (Winkler's method), Chemical Oxygen Demand and free CO_2 of water.
6. Report on a visit to National History Museum, National Park/Biodiversity Park/Wild life sanctuary/ Bird sanctuary

B.Sc. PART- III (Zoology Practical) (Semester VI)

Guidelines/Instructions for Practical Examination

PRACTICAL

20UZOO606

Max Marks: 50 **Time allowed: 3 Hrs**

Note: Following exercises will be set in the examination as per marks assigned

S. No.	Exercise	Marks
		P-606
1.	Water Analysis	5
2.	Study of Aquatic Ecosystem	4
3.	Evolution of Horse and Man	6
4.	Darwin Finches	2
5.	Determination of Population Density/ Plotting of Survivorship curves	6
6.	Specimen of Homology and Analogy	6
7.	Project Report/ Field Report	8
8.	Practical record	6
9.	Viva	7

SEC III (Semester VI)
APICULTURE & POULTRY FARMING (20USECZ607)
(Credits 3)

Max Marks: 100 [80 (Theory) +10 (Internal Assessment) +10 (Field Report)]
Time Allotted: 3 hours
Note: Nine questions to be set in all and all the candidates are required to attempt five questions including compulsory question.
1. Question number 1 is compulsory constituting of 8 parts (2 Mark each) covering the entire syllabus.
2. Out of the remaining eight questions (16 marks each), two questions are to be set from each Unit, splitting them in parts. Candidate is required to attempt four questions, selecting one question from each unit.

Unit I

Biology and Rearing of Bees
History, Classification and Biology of Honey Bees; Social Organization of Bee Colony; Artificial Bee rearing (Apiary), Beehives – Newton and Langstroth; Bee Pasturage; Selection of Bee species for Apiculture; Bee Keeping Equipment; Methods of Extraction of Honey (Indigenous and Modern)

Unit II

Diseases, Enemies in Apiculture
Bee Diseases and Enemies; Control and Preventive measures; Products of Apiculture Industry and its Uses (Honey, Bees Wax, Propolis), Pollen etc.

Unit III

Introduction to Poultry
Definition of poultry; Broiler, layer and breeder; Common terms related to poultry; Development of poultry industry in India; Domestication of poultry; Different Indian and exotic breeds of poultry

Unit IV

Structure and Processing of Poultry industry
Importance of broiler and layer production under Indian scenario; System of rearing, range, semi intensive, intensive rearing, advantages and disadvantages. Introduction to rearing of fowls and Geese for meat and egg production; Regional influences, Structure of poultry industry – breeder farm, hatcheries, commercial farms, feed mills and processing industry.

Training Programme: Two weeks training programme in field and submission of report.

SUGGESTED READINGS

Prost, P. J. (1962). *Apiculture*. Oxford and IBH, New Delhi.

Bisht D.S., *Apiculture*, ICAR Publication.

Singh S., *Beekeeping in India*, Indian council of Agricultural Research, New Delhi.

Poultry Production by R.A. Singh

Poultry Production and management by Jagdish Prasad

Handbook of Poultry Production and management second edition by Jadhav and Siddiqui