REVISED CBCS

SYLLABUS FOR

THREE YEARS UNDER-GRADUATE COURSE

IN

Zoology (HONOURS)

(*w.e.f. 2018-19)*

BANKURA UNIVERSITY

BANKURA

WEST BENGAL

PIN 722155

MODEL STRUCTURE IN Zoology (HONOURS)

SEMESTER –I

Course Code	Course Title	Credit	Marks			No. of Hours		
			I.A.	ESE	Total	Lec.	Tu.	Pr.
UG/ZOOH / 101/C-1	CT-1: Non-chordates I CP-1: Non-chordates I Lab	4 2	10	25 15	50			
UG/ZOOH / 102/C-2	CT-2: Perspectives In Ecology CP-2: Perspectives In Ecology Lab	4 2	10	25 15	50			
UG/ZOO/ 103/GE-1	GE T : Animal Diversity GE P: Animal Diversity Lab	4 2	10	25 15	50			
UG/104/ AECC-1	Environmental Studies	4	10	40	50			
Total in Semester - I		**22**	**40**	**160**	**200**			

SEMESTER –II

Course Code	Course Title	Credit	Marks			No. of Hours		
			I.A.	ESE	Total	Lec.	Tu.	Pr.
UG/ZOO H/ 201/C-3	CT-3: Non-chordates II CP-3: Non-chordates II Lab	4 2	10	25 15	50			
UG/ZOO H 202/C-4	CT-4: Cell-Biology CP-4: Cell-Biology Lab	4 2	10	25 15	50			
UG/ZOO 203/GE-2	GET : Aquatic Biology GEP: Aquatic Biology Lab	4 2	10	25 15	50			
UG/204/ AECC-2	English/Hind/MIL	2	10	40	50			
Total in Semester - II		**20**	**40**	**160**	**200**			

SEMESTER –III

Course Code	Course Title	Credit	Marks			No. of Hours		
			I.A.	ESE	Total	Lec.	Tu.	Pr.
UG/ZOO H 301/C-5	CT-5: Diversity of Chordata CP-5: Diversity of Chordata Lab	4 2	10	25 15	50			
UG/ZOO H/ 302/ C-6	CT-6: Animal Physiology: Controlling and Co-ordinating systems CP-6: Animal Physiology: Controlling and Co-ordinating systems Lab	4 2	10	25 15	50			
UG/ZOO H/303/C-7	CT-7: Fundamental of Biochemistry CP-7: Fundamental of Biochemistry Lab	4 2	10	25 15	50			
UG/ZOO/ 304/GE-3	GET : Environment and Public Health GEP : Environment and Public Health Lab	4 2	10	25 15	50			
UG/ZOOH/ 305/SEC-1	SECT: Apiculture	2	10	40	50			
Total in Semester - III		**26**	**50**	**200**	**250**			

SEMESTER –IV

Course Code	Course Title	Credit	Marks			No. of Hours		
			I.A.	ESE	Total	Lec.	Tu.	Pr.
UG/ZOOH /401/C-8	CT-8: Comparative Anatomy of Vertebrates CP-8: Comparative Anatomy of Vertebrates Lab	4 2	10	25 15	50			
UG/ZOOH /402/C-9	CT-9: Animal Physiology: Life Sustaining System CP-9: Animal Physiology: Life Sustaining System Lab	4 2	10	25 15	50			
UG/ZOOH /403/C-10	CT-10: Immunology CP-10: Immunology Lab	4 2	10	25 15	50			
UG/ZOO/ 404/GE-4	GET : Insect Vectors and Diseases GEP : Insect Vectors and Diseases Lab	4 2	10	25 15	50			
UG/ZOOH/ 405/SEC-2	SECT: Sericulture Or Aquarium Fish keeping	2	10	40	50			
Total in Semester – IV		**26**	**50**	**200**	**250**			

SEMESTER – V

Course Code	Course Title	Credit	Marks			No. of Hours		
			I.A.	ESE	Total			
UG/ZOOH / 501/C-11	CT-11: Molecular Biology CP-11: Molecular Biology Lab	4 2	10	25 15	50			
UG/ZOOH / 502/C-12	CT-12: Principles of Genetics CP-12: Principles of Genetics Lab	4 2	10	25 15	50			
UG/ZOOH / 503/DSE-1	DSET: Animal Behavior & Chronobiology DSEP: Animal Behavior & Chronobiology Lab	4 2	10	25 15	50			
UG/ZOOH / 504/DSE-2	DSET: Biology of Insecta DSEP: Biology of Insecta Lab	4 2	10	25 15	50			
Total in Semester – V		**24**	**40**	**160**	**200**			

SEMESTER – VI

Course Code	Course Title	Credit	Marks			No. of Hours		
			I.A.	ESE	Total	Lec.	Tu.	Pr.
UG/ZOOH/ 601/C-13	CT-13: Developmental Biology CP-13: Developmental Biology Lab	4 2	10	25 15	50			
UG/SC/ 602/C-14	CT-14: Evolutionary Biology CP-14: Evolutionary Biology Lab	4 2	10	25 15	50			
UG/ZOOH/ 603/DSE-3	DSET: Fish & Fisheries DSEP: Fish & Fisheries Lab Or DSET: Parasitology DSEP: Parasitology Lab	4 2	10	25 15	50			
UG/ZOOH/ 604/DSE-4	DSET: Endocrinology DSEP: Endocrinology Lab	4 2	10	25 15	50			
Total in Semester – VI		**24**	**40**	**160**	**200**			

SC = Subject Code, C= Core Course, AECC= Ability Enhancement Compulsory Course, SEC= Skill Enhancement Course, GE= Generic Elective, DSE= Discipline Specific Elective IA= Internal Assessment, ESE= End-Semester Examination, Lec.=Lecture, Tu.= Tutorial, and Prc.=Practical

Syllabus Zoology (Hons)

1. Introduction

The syllabus for Zoology at undergraduate level using the Choice Based Credit system has been framed in compliance with model syllabus given by UGC. While framing the syllabus as per the UGC guideline, the topics have been kept as generic as possible in order to provide enough freedom to the individual Universities to detail out their own syllabus as per their own infrastructure, expertise and strength.

The main objective of framing this new syllabus is to give the students a holistic understanding of the subject giving substantial weightage to both the core content and techniques used in Zoology.

Keeping in mind and in tune with the changing nature of the subject, adequate emphasis has been given on new techniques and understanding of the subject.

The syllabus has also been framed in such a way that the basic skills of subject are taught to the students, and everyone might not need to go for higher studies and the scope of securing a job after graduation will increase.

There is wide deviation in the infrastructure, be it physical or in human resource, in the form of teachers' expertise and ability and aspiration of the students. Hence, University is free to choose the Electives as per their infrastructural strengths and offer at least 6 to 7 electives

While the syllabus is in compliance with UGC model curriculum, it is necessary that Zoology students should learn "Immunology" as one of the core courses rather than as elective while. Also, an important elective on "Microbiology" has been added.

Project Work may be introduced instead of the 4th Elective with a credit of 6 split into 2+4, where 2 credits will be for continuous evaluation and 4 credits reserved for the merit of the dissertation.

2. Scheme for CBCS Curriculum

2.1 Credit Distribution across Courses

		Credits	
Course Type	**Total Papers**	**Theory + Practical**	**Theory***
Core Courses	14	14*4=56 14*2 =28	14*5 =70 14*1=14
Discipline Specific	4	4*4=16	4*5=20
Electives		4*2=8	4*1=4
Generic Electives	4	4*4=16 4*2=8	4*5=20 4*1=4
Ability Enhancement Language Courses	2	2*2=4	2*2=4
Skill Enhancement Courses	2	2*2=4	2*2=4
Total	26	140	140

"Tutorials of 1 Credit will be conducted in case there is no practical component

Scheme for CBCS Curriculum

Semester	Course Name	Course Details	Credits
I	**Ability Enhancement Compulsory Course - I**	English communication / Environmental Science	2
	Core course -1	Non-chordates I: Protista to Pseudocoelomates	4
	Core course -1 Practical	Non-chordates I: Protista to Pseudocoelomates Lab	2
	Core course – II	Perspectives in Ecology	4
	Core course - II Practical	Perspectives in Ecology Lab	2
	Generic Elective – 1	TBD	4
	Generic Elective - 1 Practical	TBD	2
II	**Ability Enhancement Compulsory Course - II**	English communication / Environmental Science	2
	Core course – III	Non-chordates II: Coelomates	4
	Core course - III Practical	Non-chordates II: Coelomates Lab	2
	Core course - IV	Cell Biology	4
	Core course - IV Practical	Cell Biology Lab	2
	Generic Elective - 2	TBD	4
	Generic Elective - 2 Practical	TBD	2
III	Core course – V	Diversity of Chordates	6
	Core course - V Practical	Diversity of Chordates Lab	-
	Core course – VI	Animal Physiology: Controlling and Coordinating Systems	6
	Core course - VI Practical	Animal Physiology: Controlling and Coordinating Systems Lab	-
	Core course - VII	Fundamentals of Biochemistry	4
	Core course - VII Practical	Fundamentals of Biochemistry Lab	2
	Skill Enhancement Course – 1	TBD	2
	Generic Elective - 3	TBD	4
	Generic Elective - 3 Practical	TBD	2

IV	Core course – VII	Comparative Anatomy of Vertebrates	4
	Core course - VII Practical	Comparative Anatomy of Vertebrates Lab	2
	Core Course IX	Animal Physiology : Life Sustaining Systems	4
	Core Course IX Practical	Animal Physiology : Life Sustaining Systems Lab	4
	Core Course X	Immunology	4
	Core Course X Practical	Immunology Lab	2
	Skill Enhancement Course – 2	TBD	2
	Generic Elective - 3	TBD	4
	Generic Elective - 3 Practical	TBD	2
V	Core Course-XI	Molecular Biology	4
	Core Course-XI Practical	Molecular Biology	4
	Core Course-XII	Principles of Genetics	4
	Core Course-XII Practical	Principles of Genetics Lab	4
	Discipline Specific Elective - 1	TBD	4
	Discipline Specific Elective - 1 Practical	TBD	2
	Discipline Specific Elective - 2	TBD	4
	Discipline Specific Elective - 2 Practical	TBD	2
VI	Core Course-XIII	Developmental Biology	4
	Core Course-XIII Practical	Developmental Biology lab	4
	Core Course-XIV	Evolutionary Biology	4
	Core Course-XIV Practical	Evolutionary Biology Lab	4
	Discipline Specific Elective - 1	TBD	4
	Discipline Specific Elective - 1 Practical	TBD	2
	Discipline Specific Elective - 3	TBD	4
	Discipline Specific Elective - 3 Practical	TBD	2

Discipline Specific Elective - 4	TBD	4
Discipline Specific Elective - 4 Practical	TBD	2

2.3 Choices for Discipline Specific Electives

Discipline Specific Elective - 1 to 4			
Animal Behavior & Chronobiology	Animal Biotechnology	Biology of Insecta	Endocrinology
Fish and Fisheries	Microbiology	Parasitology	Wild Life Conservation & Management
Reproductive Biology			

2.4 Choices for Skill Enhancement Courses

Skill Enhancement Course-1 & Skill Enhancement Course-2			
Apiculture	Aquarium Fish Keeping	Medical Diagnostics Techniques	Sericulture

3. Core Subjects Syllabus

3.1 Core T1 - Non-chordates I: Protista to Pseudocoelomates **4 Credits**

Non-Chordates I: Protists to Pseudocoelomates

Unit 1: **Basics of Animal Classification**

1. Definitions: Classification, Systematics and Taxonomy: Taxonomic Hierarchy, Taxonomic types
2. Codes of Zoological Nomenclature; Principle of priority; Synonymy and Homonymy; Six kingdom concept of classification (Carl Woese)
3. Diversity of non-chordate and its significance
4. Evolution of coelom

Unit 2: Protista

1. Protozoa:

a. General characteristics and classification up to phylum (according to Levine et. al., 1981) Locomotion in *Euglena, Paramoecium* and *Amoeba*; Conjugation in *Paramoecium.*

b. Life cycle and pathogenicity of *Plasmodium vivax* and *Entamoeba histolytica*

Unit 3: Metazoa

a. Evolution of symmetry and segmentation of Metazoa

Unit 4: Porifera

General characteristics and classification up to classes (Hyman)

Canal system and spicules in sponges

Unit 5: Cnidaria

1. General characteristics and classification up to classes
2. Metagenesis in *Obelia & Aurelia*
3. Polymorphism in Siphonophora
4. Corals and coral reef diversity, function & conservation

Unit 6: Ctenophora

General characteristics

Unit 7: Platyhelminthes

1. General characteristics and classification up to classes
2. Life cycle and pathogenicity and control measures of *Fasciola hepatica* and *Taenia solium*

Unit 8: Nematoda

1. General characteristics and classification up to classes
2. Life cycle, pathogenicity and control measures of *Ascaris lumbricoides* and *Wuchereria bancrofti*
3. Parasitic adaptations in helminthes

Note: Classification to be followed from Barnes and Ruppert 1994,6th Edition

Reference Books

Anderson, D. T. (Ed.) (2001). Invertebrate Zoology. 2nd Ed. Oxford University Press.
Barnes, R. D. & Ruppert, E. E., (1994). Invertebrate Zoology. 6thEd. Brooks Cole
Brusca, R. C. & Brusca, G. J. (2002). Invertebrates. 4th Ed. Sinauer Associates
Mandal FB (2015), Human Parasitology 2nd Edition, PHI Learning
Kapoor, V. C. (2008). Theory and practice of animal taxonomy. 6th Ed. Oxford & IBH Pub
Mayr, E. (1969). Principles of Systematic Zoology. Tata McGraw-Hill.
Mayr, E. & Ashlock, P. D. (1991). Principles of Systematic Zoology. 2nd Ed., McGraw-Hill.
Meglitsch, P. A. & Schram, F. R. (1991). Invertebrate Zoology. Oxford University Press
Pechenik, J. A. (1998). Biology of the Invertebrates, 4th Ed. McGraw Hill
Ruppert and Barnes, R.D. (2006). Invertebrate Zoology, VIII Edition. Holt Saunders International Edition.
Sinha, K. S., Adhikari, S., & Ganguly, B. B. Biology of Animals. Vol. I. New Central Book Agency. Kolkata

3.2 Core PI - Non-Chordates I Lab **2 credits**

Non-Chordates I: Protists to Pseudocoelomates

Practicals

1. Identification of following specimen

a. Amoeba, Euglena, Entamoeba, Opalina, Paramecium, Plasmodium,

b. *Sycon*, Neptune's Cup, *Fasciola, Taenia* and *Ascaris*

c. *Physalia, Millepora, Aurelia,Tubipora, Corallium, Alcyonium, Gorgonia, Metridium, Pennatula, Fungia, Madrepora.*

2. Whole mount preparation of *Euglena, Amoeba*, and *Paramoecium.*

3. Staining and mounting of any protozoa/helminth from gut of cockroach.

4. Submission of Laboratory Note Book

Distribution of Marks:

Full marks: 15

1. Identification with reasons (any three):	9 [3×3]
(From Item No. 1; maximum one from each group)	
2. Staining/Mounting (any one) (From Item no. 2 and 3):	4 [2+1+1]
3. Submission of Laboratory note book:	2

Note:

Q1. Sc. name :1 mark, Reasons: 2 marks

Q2. Staining: 2 marks, Drawing: I mark, labelling: 1 mark

Suggested readings:

Ghosh, K.C. and Manna, B. (2015): Practical Zoology, New Central Book Agency, Kolkata

Poddar T. K., S. Mukherjee & S. K. Das (2002) An Advanced Laboratory Manual of Zoology, Laxmi Publications

Sinha, J.K. , Chatterjee, A.K. and P. Chattopadhyay (2015) Advanced Practical Zoology, Books & Allied (P) Ltd

3.3 Core T2 - Perspectives in Ecology **4 Credits**

Perspectives in Ecology

Unit 1: Introduction to Ecology
History of ecology, Scope of Ecology, Autecology and synecology, Levels of organization, Laws of limiting factors, Study of Physical factors, The Biosphere.

Unit 2: Population
Unitary and Modular populations
Population: Characteristics, growth forms, geometric, exponential and logistic growth, equation and patterns, r and K strategies
Population regulation - density-dependent and independent factors
Population Interactions, Gause's Principle with laboratory and field examples, Lotka-Volterra equation for competition.

Unit 3: Community
Community characteristics: species diversity, abundance, dominance, richness
Concept of community stratification, Ecotone and edge effect. Ecological succession with one example(Forest)

Unit 4: Ecosystem
Types of ecosystem w.r.t forest and marine ecosystem; Food chain: Detritus and grazing food chains, Linear and Y-shaped food chains, Food web, Energy flow through the ecosystem, Ecological pyramids and Ecological efficiencies
Biogeochemical cycle w.r.t. Nitrogen cycle
Agro ecosystem and its impact

Unit 5: Applied Ecology
Concept of wild life
Wildlife Conservation (in-situ and ex-situ conservation)
Management strategies for tiger conservation; Wild life protection act (1972)

Reference Books

Cain, Bowman & Hacker (2014) Ecology, 3rd edition. Sinauer associates
Chapman, R. L. and Reiss, M. J. (2000). Ecology - Principles & Application. Cambridge University Press
Dash, M. C., (2001). Fundamental of Ecology. 2nd Ed. Tata McGraw-Hill Company
Kormondy, E. J. (2002). Concepts of Ecology. 4th Indian Reprint, Pearson Education
Krebs, C. J. (2001). Ecology. VI Edition. Benjamin Cummings.
Odum, E.P., (2008). Fundamentals of Ecology. Indian Edition. Brooks/Cole
Robert Leo Smith Ecology and field biology Harper and Row publisher
Russel, P.J., Wolfe, L. S., Hertz, P.E. Starr, C. & McMillan, B. (2008). Ecology
Stilling P (2009) Ecology: Theories & Application 4th Edition, Prentice Hall of India.
Van Dyke, F. (2008). Conservation Biology: Foundations, Concepts, Application. 2nd Ed. Springer Science and Business Media.

3.4 Core P2 - Perspectives in Ecology Lab **2 Credits**

Perspectives in Ecology

Practicals

1. Determination of population density in a natural/hypothetical community by quadrate method and calculation of Shannon-Weiner diversity index for the same community

2. Study of an aquatic ecosystem: Zooplankton, Measurement of turbidity/penetration of light, determination of pH, and Dissolved Oxygen content (Winkler's method), Chemical Oxygen Demand and free CO_2

3. Report on a visit to National Park/Biodiversity Park/Wild life sanctuary

4. Submission of Laboratory Note Book

Distribution of Marks:

	Full marks: 15
1. Experiment (from Item no. 1):	5
2. Experiment (from Item no. 2; pH or free O_2 or free CO_2 estimation)	5 (2+3)*
3. Report on Excursion:	3
4. Submission of Laboratory note book:	2

***Note**

Q 2. Principle: 2 marks and result: 3 marks

Suggested Reading

Desharnais Robert, Jeffrey Bell (2001) 'Ecology Student Lab Manual, Biology Labs', Benjamin Cummings

Darrell S Vodopich,(2009), 'Ecology Lab Manual', McGraw-Hill Higher Education

Sinha, J.K. , Chatterjee, A.K. and P. Chattopadhyay (2015) Advanced Practical Zoology, Books & Allied (P) Ltd

3.5 Core T3 - Non-Chordates II **4 Credits**

Non-Chordates II: Coelomates

Unit 1: Introduction
Coelom: types and significance
Concept of metamerism
Metamerism in Annelida

Unit 2: Annelida
1. General characteristics and classification up to classes
2. Excretion in Annelida through nephridia.
3. Reproduction in earthworm.

Unit 3: Arthropoda
1. General characteristics and classification up to classes
2. Respiration (Gills in prawn and trachea in cockroach)
3. Metamorphosis in Lepidopteran Insects.
4. Social life in termite
5. Compound eye in cockroach and prawn

Unit 4: Onychophora
General characteristics and Evolutionary significance of *Peripatus*

Unit 5: Mollusca
1. General characteristics and Classification up to classes
2. Nervous system and torsion in Gastropoda
3. Feeding and respiration in *Pila* sp

Unit 6: Echinodermata
1. General characteristics and Classification up to classes
2. Water-vascular system in *Asterias*
3. Larval forms in Echinodermata
4. Affinities with Chordates

Unit 7: Hemichordata
1. General characteristics of phylum Hemichordata.
2. Relationship with non-chordates and chordates: Evolutionary significance

Note: Classification to be followed from Barnes and Ruppert 1994,6th Edition

Reference Books
Anderson, D. T. (Ed.) (2001). Invertebrate Zoology. 2nd Ed. Oxford University Press.
Barnes, R. D. & Ruppert, E. E., (1994). Invertebrate Zoology. 6thEd. Brooks Cole
Brusca, R. C. & Brusca, G. J. (2002). Invertebrates. 4th Ed. Sinauer Associates
Mandal FB (2015), Human Parasitology 2nd Edition, PHI Learning
Kapoor, V. C. (2008). Theory and practice of animal taxonomy. 6th Ed. Oxford & IBH Pub
Mayr, E. (1969). Principles of Systematic Zoology. Tata McGraw-Hill.
Mayr, E. & Ashlock, P. D. (1991). Principles of Systematic Zoology. 2nd Ed., McGraw-Hill.
Meglitsch, P. A. & Schram, F. R. (1991). Invertebrate Zoology. Oxford University Press
Pechenik, J. A. (1998). Biology of the Invertebrates, 4th Ed. McGraw Hill
Ruppert and Barnes, R.D. (2006). Invertebrate Zoology, VIII Edition. Holt Saunders International Edition.
Sinha, K. S., Adhikari, S., & Ganguly, B. B. Biology of Animals. Vol. I. New Central Book Agency. Kolkata

3.6 Core P3 - Non-Chordates II **2 Credits**

Non-Chordates II: Coelomates

Practicals

1. Identification of following specimens:

a. Aphrodite, Nereis, Heteronereis, Sabella, Serpula, Chaetopterus, Pheretima, Hirudinaria

b. Carcinoscorpius, Palamnaeus, Palaemon, Daphnia, Balanus, Sacculina, Cancer, Eupagurus, Scolopendra, Peripatus

c. Chiton, Dentalium, Pila, Doris, Unio, Pinctada, Sepia, Octopus, Nautilus, Asterias, Ophiura, Echinus, Cucumaria and Antedon

2. Identification of T.S. through pharynx, gizzard, and typhlosolar intestine of earthworm
3. Dissection, drawing and labelling of digestive system and septal nephridia of earthworm
4. a. Mounting of mouth parts of *Periplaneta*
   b. Dissection: digestive system and nervous system of *Periplaneta*
5. Submission of a Project Report on life cycle stages of any insect.
6. Submission of Laboratory Note Book

Distribution of Marks

Full marks: 15

1. Identification with reasons (any three):	7 [3+3+1]*
(Two from Item No. 1 and one from Item no.2.)	
2. Dissection (any one) (From Item no. 3 or 4):	4{2+1+1]*
3. Submission of a project report along with the life cycle stages of any insect (Item no. 5)	2
4. Submission of laboratory note book:	2

***Note:**

Q1. For Item (1), Sc. name:1 mark and Reasons: 2 marks. For Item (2) 1 mark is allotted for both identification and characters.

Q2. Dissection :2 marks ; drawing and labelling : 1 mark each

Suggested Reading

Ghosh, K.C. and Manna, B. (2015): Practical Zoology, New Central Book Agency, Kolkata

Poddar T. K., S. Mukherjee & S. K. Das (2002) An Advanced Laboratory Manual of Zoology, Laxmi Publications

Sinha, J.K. , Chatterjee, A.K. and P. Chattopadhyay (2015) Advanced Practical Zoology, Books & Allied (P) Ltd

3.7 Core T4 - Cell Biology **4 Credits**

Cell Biology

Unit 1: Overview of Cell
Basic structure of Prokaryotic and Eukaryotic cell

Unit 2: Plasma Membrane
1. Ultra structure of Plasma membrane: Fluid mosaic model
2. Transport across membrane: Active and Passive transport, Facilitated transport
3. Cell junctions: Tight junctions, Gap junctions, Desmosomes

Unit 3: Cytoplasmic organelles
1. Structure and Functions: Endoplasmic Reticulum, Ribosome, Golgi Apparatus, Lysosomes
2. Mitochondria: Structure, Semi-autonomous nature, Endosymbiotic hypothesis, Mitochondrial Respiratory Chain, Chemi-osmotic hypothesis
3. Peroxisomes: Structure and Functions
4. Protein sorting and mechanisms of vesicular transport

Unit 4: Nucleus
1.Structure of Nucleus: Nuclear envelope, Nuclear pore complex, Nucleolus
2. Chromatin: Euchromatin and Hetrochromatin and packaging (nucleosome)

Unit 5: Cell Division
1. Cytoskeletal structures,
2. Centrosome structure and function
3. Accessory proteins of microfilament & microtubule
4. A brief idea about molecular motors
5. Mitosis and Meiosis: Basic process and their significance

Unit 6: Cell cycle and cancer
1. Cell cycle and its regulation
2. Cancer (Concept of oncogenes and tumor suppressor genes with special reference to p53, Retinoblastoma and Ras and APC.

Unit 7: Cell Signalling
1. Cell signalling transduction pathways; Types of signalling molecules and receptors
2. GPCR and Role of second messenger (cAMP)
3. Extra cellular matrix-cell interactions
4. Apoptosis

Reference Books

Albert Bruce, Bray Dennis, Levis, Julian ,Raff Martin, Roberts Keith and Watson James (2008).Molecular Biology of the Cell, V Edition, Garland publishing Inc., New York and London.
Cooper, G.M. and Hausman, R.E. (2009). The Cell: A MolecularApproach.5thEdition. ASM Press and Sunderland, Washington, D.C.; Sinauer Associates, MA.
Hardin, J. Bertoni, G and Klein smith, J. L. (2012). Becker's World of the Cell. 8th Edn, Pearson Benjamin Cummings, San Francisco.
Harvey, L. (2004). Molecular Cell Biology. 5th Edn. W.H. Freeman

Karp, G. (2008). Cell and Molecular biology: Concepts and Application. 5th Edn, John Wiley.
Lodish, Berk, Matsudaira, Kaiser, Bretscher, Ploegh, Amon, and Martin (2016) Molecular Cell Biology. 8th Edn. W.H. Freeman
Plopper, G, D. Sharp, Siroski, E (2015) Lewin's Cell 3rdEdition—Johns & Bartlett Publishers
Pollard and Earnshaw (2007). Cell Biology. 2nd. Edn Saunders.
Reed, J.C. and Green, D.R. (2011). Apoptosis: Physiology and Pathology. Cambridge Univ. Press
Weinberg R.A. (2014). Biology of Cancer. 2ndedition. Garland Science, Taylor and Francis

3.8 Core P4 - Cell Biology Lab **2 Credits**

Cell Biology

Practicals

1. Drawing of ultrastructure of cell and different organelles (from photographs provided)
2. Familiarization with the student's light microscope and stereo-binocular microscope; preparation of aceto-orcein/ acetocarmine stain
3. Preparation of temporary stained squash of onion root tip to study various stages of mitosis
4. Preparation and identification of various stages of meiosis from grasshopper testis
5. Preparation of permanent slides of Barr body from cheek epithelium
6. Submission of Laboratory Note Book

Distribution of Marks

	Full marks: 15
1. Identification of any ideal stages of mitosis and meiosis (any two):	4 (2+2)*
2. Squash preparation, staining and identification of any stage from mitosis or meiosis	5 (3+2)*
3. Preparation of Barr body	4 (3+1)*
4. Submission of laboratory note book:	2

***Note:**

Q1. Identification of the stage: ½ mark and characters: 1½ marks

Q2. Preparation: 3 marks ; identification and drawing: 2 marks

Q3. Preparation: 3 marks and drawing: 1 mark.

Suggested Reading

Gupta R., Makhija S., Toteja R. (2018) Cell Biology : Practical Manual Paperback, Prestige Publishers

Ghosh, K.C. and Manna, B. (2015): Practical Zoology, New Central Book Agency, Kolkata

Poddar T. K., S. Mukherjee & S. K. Das (2002) An Advanced Laboratory Manual of Zoology, Laxmi Publications

Sinha, J.K. , Chatterjee, A.K. and P. Chattopadhyay (2015) Advanced Practical Zoology, Books & Allied (P) Ltd

3.9 Core T5 - Diversity of Chordata **4 Credits**

Diversity of Chordata

Unit 1: Introduction to Chordates

Concept of Phylum Chordata

Diversity of Chordata and its significance

Unit 2: Urochordata and Cephalochordata

1. General characteristics and classification of Urochordata and Cephalochordata up to Classes.
2. Retrogressive metamorphosis in *Ascidia*.
3. Chordate Features and Feeding in *Branchiostoma*

Unit 3: Origin of Chordata

1. Dipleurula concept and the Echinoderm theory of origin of chordates
2. Advanced features of vertebrates

Unit 4: Agnatha

General characteristics and classification of cyclostomes up to order

Unit 5: Pisces

1. General characteristics and classification of Chondrichthyes and Osteichthyes up to Subclasses
2. Accessory respiratory organ, migration and parental care in fishes
3. Swim bladder in fishes.

Unit 6: Amphibia

1. General characteristics and classification up to living Orders.
2. Metamorphosis and parental care in Amphibia

Unit 7: Reptilia

1. General characteristics and classification up to living Orders.
2. Poison apparatus and biting mechanism in snakes

Unit 8: Aves

1. General characteristics and classification up to Sub-Classes
2. Exoskeleton and migration in birds
3. Principles and aerodynamics of flight

Unit 9: Mammals

1. General characters and classification up to living orders
2. Affinities and phylogeny of Monotremata
3. Exoskeletal derivatives of mammals
4. Adaptive radiation in marsupials
5. Echolocation in micro chiropterans and cetaceans

Unit 10: Zoogeography

Plate tectonic and Continental drift theory; Zoogeographical realms; distribution of birds and mammals in major six realms

Note: Classifications for Protochordata, Agnatha, Reptilia, Aves and Mammalia to be followed from Young (1981), for Pisces to be followed from Romer (1959), for Amphibia to be followed from Nobel (1924).

Reference Books

Darlington P.J. The Geographical Distribution of Animals, R.E. Krieger Pub Co.

Futuyama, D. (1997). Evolutionary Biology. 3rd Ed. Sinauer Associates, INC.

Hall B.K. and Hallgrimsson B. (2008). Strickberger's Evolution. IV Edition. Jones and Bartlett Publishers Inc.

Jordan, E.L. &Verma, P.S. (2003). Chordate Zoology. S. Chand & Company Ltd. New Delhi.

Kardong, K. V. (2002). Vertebrates: Comparative anatomy, function evolution. Tata McGraw Hill.

Kent, G. C. & Carr, R. K. (2001). Comparative anatomy of the Vertebrates. 9th Ed. McGraw Hill.

Mandal FB (2013) Vertebrate Zoology, Oxford and IBH Co Pvt Ltd, New Delhi

Nelson, J.S., (2006): Fishes of the World, 4th Edn., Wiley.

Parker, T. J. &Haswell, W. (1972). Text Book of Zoology, Volume II: Marshall and Wiliam (Eds.) 7th Ed. Macmillan Press,London.

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

Romer, A. S. & Parsons, T. S. (1986). The vertebrate body. 6th Ed. Saunders College Publishing.

Sinha, K. S., Adhikari, S., Ganguly, B. B. &BharatiGoswami, B. D. (2001). Biology of Animals. Vol. II. New Central Book Agency (p) Ltd.

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

3.10 Core P5 - Diversity of Chordata Lab **2 Credits**

Diversity of Chordata

Practicals

1. Identification of following specimen

a. *Balanoglossus, Branchiostoma*

b. *Petromyzon, Myxine*

c. *Scoliodon, Pristis, Torpedo, Chimaera, Mystus, Heteropneustes, Labeo, Exocoetus, Echeneis, Anguilla, Hippocampus, Anabas*

d. *Necturus, Bufo, Hyla, Alytes, Axolotl, Tylototriton*,

e. *Chelone, Hemidactylus, Uromastix, Chamaeleon, Ophiosaurus, Draco, Bungarus, Vipera, Naja, Hydrophis*

f. Pteropus, *Funambulus*, *Bandicota*

2. Dissect out Pecten from Fowl head

3. Dissect out brain and pituitary of carp

4. Submission of Laboratory Note Book

Distribution of marks

Full marks: 15

1. Identification with reasons (any three):	9 [3×3]
(From Item no. 1; maximum 1 from each group)	
2. Dissection (any one) (From Item no. 2 or 3)	4 [2+1+1]
3. Submission of laboratory note book:	2

***Note:**

Q1. Sc. Name:1 mark ; Reasons: 2 marks

Q2. Dissection: 2 marks, drawing and labelling :1 mark each

Suggested Reading

Ghosh, K.C. and Manna, B. (2015): Practical Zoology, New Central Book Agency, Kolkata

Poddar T. K., S. Mukherjee & S. K. Das (2002) An Advanced Laboratory Manual of Zoology, Laxmi Publications

Sinha, J.K. , Chatterjee, A.K. and P. Chattopadhyay (2015) Advanced Practical Zoology, Books & Allied (P) Ltd

3.11 Core T6 - Animal Physiology: Controlling & Coordinating Systems **4 Credits**

Animal Physiology: Controlling & Coordinating Systems

Unit 1: Tissues
Classification, structure and functions of epithelial tissue, connective tissue, muscular tissue and nervous tissue

Unit 2: Bone and Cartilage
Structure and types of bones and cartilages

Unit 3: Muscular system
Histology of different types of muscle; Ultra structure of skeletal muscle; Molecular and chemical basis of muscle contraction; Characteristics of muscle fibre

Unit 4: Nervous System
Structure of neuron, propagation of nerve impulse across the myelinated and unmyelinated nerve fibers; Types of synapse. Synaptic transmission and Neuromuscular junction, role of neurohormone in vertebrates

Unit 5: Reproductive System
Histology of testis and ovary, Spermatogenesis, Oogenesis and their significance, fertilization
Physiology of Reproduction (estrus and menstrual cycle)

Unit 6: Endocrine System
1. Classification of hormones; Mechanism of Hormone action
2. Histology and function of pituitary, thyroid, pancreas and adrenal
3. Signal transduction pathways for steroid and non-steroid hormones in brief
4. Placental hormones

Reference Books

Cormack, D.H (2003). PDQ Histology. B.C. Decker Ins., London 4. Gartner and Hiatt (2011). Concise Histology. Saunders Elsevier

Cui, Naftel, Daley, Lynch, Haines, Yang and Fratkun (2011). Atlas of Histology with Functional and Clinical Correlations. Lippincott, Williams and Wilkins.

David Randall and Warren Burggren (2001) Eckert Animal Physiology, 5th edition. W.H.Freeman.

Fawcett Don, Jensh Ronald (2002) Bloom & Fawcett's Concise Histology 2nd Edition, CRC Press;

Gunasegaran, JP (2010). A Text book of Histology and a Practical Guide. Elsevier

Junqueria and Cameiro (2005). Basic Histology: Text and Atlas.

Randall, D. and Warren Burggren (2001)Eckert Animal Physiology 4th edition. W.H. Freeman.

Ross H & Pawlina W (2015), Histology: A Text and Atlas With Correlated Cell and Molecular Biology 6th Edition, Lippincott Williams & Wilkins.

Schmidt-Nielsen (2002) Animal Physiology: Adaptation and Environment. 5th Edition. Cambridge University Press

Sembulingam and Sembulingam (2012) Essentials of Medical Physiology. 6th Edn. Jaypee Pub, New Delhi

Vasudeva and Mishra (2014). Inderbir Singh's Text book of Human Histology 7th Edn Jaypee Publisher N. Delhi

3.12 Core P6 - Animal Physiology: Controlling & Coordinating Systems Lab **2 Credits**

Animal Physiology: Controlling & Coordinating Systems

List of Practical

1. Identification of permanent slides: TS of Mammalian Skin, Cartilage, Bone, Pituitary, Pancreas, Testis, Ovary, Adrenal, Thyroid, Intestine, Lung, Liver and Kidney

2. Recording of simple muscle twitch by Kymograph

3. Preparation of temporary mounts: Squamous epithelium, Striated muscle fibres and nerve cells

4. Microtomy: Preparation and submission of permanent slide of mammalian (Goat/white rat) tissues (any two).

5. Submission of Laboratory Note Book

Distribution of Marks

	Full marks: 15
1. Identification with reasons (any two; From Item no. 1):	6 [3+3]
2. Experiment from Item no. 2 **or** preparation (tissue sectioning/ staining) from Item no.4:	4
3. Mounting (any one from Item no. 3):	2
4. Submission of permanent slide (any two mammalian tissues):	1
5. Laboratory note book:	2

***Note:**

Q1. **I**dentification: 1 mark , Reasons: 2 marks

Suggested Reading

Scudamore C.L. (2014). A Practical Guide to the Histology of Mouse. Wiley Blackwell

Pal GK, Pal P (2016) Textbook of Practical Physiology. 4th Edition, University Press

Brancroft JD, Gamble M (2008)Theory and practice of histological techniques .6th edition, Elsevier Publication

3.13 Core T7 - Fundamentals of Biochemistry **4 Credits**

Fundamentals of Biochemistry

Unit 1: Introduction to biochemistry and its scope

Unit 2: Carbohydrates
1. Structure and Biological importance: Monosaccharides, Disaccharides, Polysaccharides: Derivatives of Monosachharides
2. Carbohydrate metabolism: Glycolysis, Citric acid cycle, Pentose phosphate pathway, Gluconeogenesis

Unit 3: Lipids
1.Structure and Significance: Physiologically important saturated and unsaturated fatty acids, Tri-acylglycerols, Phospholipids, Sphingolipid, Glycolipids, Steroids, Eicosanoids and terpenoids.
2. Lipid metabolism: β-oxidation of fatty acids

Unit 4: Proteins
1. Amino acids: Structure, classification, General -and Electro chemical properties of α-amino acids; Physiological importance of essential and non-essential amino acids
2. Proteins: Bonds stabilizing protein structure; Levels of organization
3. Protein metabolism: Transamination, Deamination, Urea cycle, Fate of carbon skeleton of Glucogenic and Ketogenic amino acids

Unit 5: Nucleic Acids
1. Structure: Purines and pyrimidines, Nucleosides, Nucleotides, Nucleic acids
2. Types of DNA and RNA, Complementarity of DNA, Hypo- Hyperchromaticity of DNA
3. Basic concept of nucleotide metabolism

Unit 6: Enzymes
Nomenclature and classification; Cofactors; Specificity of enzyme action; Isozymes; Mechanism of enzyme action; Enzyme kinetics; Michaelis- Menten equation, Lineweaver-Burk plot; Factors affecting rate of enzyme-catalyzed reactions; Enzyme inhibition; Allosteric enzymes and their kinetics

Unit 7: Oxidative Phosphorylation in mitochondrial matrix
Redox systems; Review of mitochondrial respiratory chain, Inhibitors and un-couplers of Electron Transport System

Reference Books

Berg, J.M., Tymoczko, J.L. and Stryer, L.(2007). Biochemistry, VI Edition, W.H. Freeman and Co., New York

Cox, M.M and Nelson, D.L. (2008). Lehninger's Principles of Biochemistry, V Edition, W.H. Freeman and Co., New York.

Das, D. (2000). Biochemistry. Central Book Agency, Kolkata

Hames, B.D. and Hooper, N.M. (2000). Instant Notes in Biochemistry, II Edition, BIOS Scientific Publishers Ltd., U.K.

Murray, R.K., Bender, D.A., Botham, K.M., Kennelly, P.J., Rodwell, V.W. and Well, P.A. (2009). Harper's Illustrated Biochemistry, XXVIII Edition, International Edition, The McGraw- Hill Companies Inc.

Rodwell (2018) Harpers Illustrated Biochemistry, 31st Edn, Mc Graw Hill

Sathyanarayana U. and Chakrapani, (2002). Biochemistry –Books & Allied (P) Ltd, Kolkata

Voet. D & Voet. J.G, Pratt CW (2012). Principles of Biochemistry –4th edition, 2004, John Wiley & Sons, Inc.

Watson, J.D., Baker, T.A., Bell, S.P., Gann, A., Levine, M. and Losick, R. (2008). Molecular Biology of the Gene, VI Edition, Cold Spring Harbor Lab. Press, Pearson Pub.

Zubay G.L, (1998). Biochemistry –4th edition, Mc Graw-Hill

3.14 Core P7 -Fundamentals of Biochemistry Lab **2 Credits**

Fundamentals of Biochemistry Lab

Practicals

1. Qualitative tests of functional groups in carbohydrates (Benedict), proteins (Biuret) and lipids (Saponification).
2. Quantitative estimation of protein by Lowry Method
3. Study the enzymatic activity of salivary amylase (Effect of temperature)
4. Paper chromatography of amino acid.
5. Submission of Laboratory Note Book

Examination Pattern: **Full marks: 15**

1. Qualitative Test (any one; From Item no. 1): 3

2. Quantitative estimation of protein (Item no. 2): 6

3. Experiment (From Item no. 3 or 4) 4

4. Submission of laboratory note book 2

***Note:**

Q1. Principle: 1 mark and result 2 marks

Q2. Principle 2 marks and result 4 marks

Q3. Principle 1 mark and result 3 marks

Suggested Reading:

Damodaran G K (2016). Practical Biochemistry, 2nd edition Jaypee Brothers Medical Publishers;

Singh SP (2013). Practical Manual of Biochemistry. 7th edition, CBS Publishers & Distributors

3.15 Core T8 - Comparative Anatomy of Vertebrates **4 Credits**

Comparative Anatomy of Vertebrates

Unit 1: Integumentary System
Structure, function and derivatives of integument in amphibian, birds and mammals

Unit 2: Skeletal System
General idea of axial and appendicular skeleton; Basic idea of jaw suspension and visceral arches.

Unit 3: Digestive System
Ruminating stomach; dentition in mammals

Unit 4: Respiratory System
Respiratory organs in fish, amphibian, and birds

Unit 5: Circulatory System
Comparative account of heart and aortic arches

Unit 6: Urinogenital System
Archinephros, Pronephros, Mesonephros and Metanephros
Evolution of urinogenital ducts, Types of mammalian uteri

Unit 7: Nervous System
Comparative account of brain, Cranial nerves in mammals

Unit 8: Sense Organs
Classification of receptors

Reference Books

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 (1988) . Analysis of Vertebrate Structure. 3rd Edition, John Wiley and Sons

Saxena, R.K. &Saxena, S.C.(2008): Comparative Anatomy of Vertebrates, Viva Books Pvt. Ltd.

3.16 Core P8 - Comparative Anatomy of Vertebrates Lab **2 Credits**

Comparative Anatomy of Vertebrates

Practicals

1. Identification of disarticulated skeleton of Toad, Pigeon and Guineapig [Skull, Vertebrae (Atlas, Axis) and typical vertebrae of procoelous, heterocoelous and acoelous type]; Pectoral girdle, Pelvic girdle], Skull of Dog

2. Identification of carapace and plastron of turtle (Model/Chart)

3. Staining and mounting of placoid, cycloid and ctenoid scales

4. Dissection: Afferent branchial arterial system and IX and Xth cranial nerves of carp

5. Submission of Laboratory Note Book

Examination Pattern: **Full marks: 15**

1. Identification with reasons (any three; From Item no. 1,2)	6 (2+2+2)*
2. Mounting and staining (Item no. 3).	2
3. Dissection (any one; From Item no. 4):	5 [3+1+1]*
4. Submission of laboratory note book:	2

***Note:**

Q1. Identification: ½ mark and reasons: 1½ marks

Q3. 3 marks for dissection and 1 mark each for drawing and labelling

Suggested Readings:

Ghosh, K.C. and Manna, B. (2015): Practical Zoology, New Central Book Agency, Kolkata

Poddar T. K., S. Mukherjee & S. K. Das (2002) An Advanced Laboratory Manual of Zoology, Laxmi Publications

Sinha, J.K. , Chatterjee, A.K. and P. Chattopadhyay (2015) Advanced Practical Zoology, Books & Allied (P) Ltd

3.17 Core T9 - Animal Physiology: Life Sustaining Systems **4 Credits**

Animal Physiology: Life Sustaining Systems

Unit 1: Physiology of Digestion
Structural organisation and functions of gastrointestinal tract and associated glands: Mechanical and chemical digestion of food along with the role of digestive enzymes; absorption of Carbohydrates, Lipids, Proteins and Nucleic Acids

Unit 2: Physiology of Respiration
Mechanism of Respiration, transport of Oxygen and Carbon dioxide in blood, Dissociation curves and the factors influencing it, carbon monoxide poisoning

Unit 3: Physiology of Circulation
1. Components of Blood and their functions; Structure and functions of haemoglobin
2. Haemostasis; Blood clotting system
3. Haemopoiesis; Basic steps and its regulation
4. Blood groups; ABO and Rh factor

Unit 4: Physiology of Heart
1. Structure of mammalian heart, Coronary Circulation, Structure and working of conducting myocardial fibres, Origin and conduction of cardiac impulses
2. Cardiac Cycle and cardiac output
3. Blood pressure and its regulation

Unit 5: Thermoregulation & Osmoregulation
1. Physiological classification of vertebrates based on thermal biology.
2. Osmoregulation in aquatic vertebrates
3. Extra-renal osmoregulatory organs in vertebrates

Unit 6: Renal Physiology
Structure of Kidney and its functional unit, Mechanism of urine formation, Regulation of acid-base balance

Reference Books

Gunstream, S.E. (2010). Anatomy and Physiology with integrated study guide. 4th Edn., Mc Graw Hill

Guyton, A.C. & Hall, J.E. (2006). Textbook of Medical Physiology. XI Edition. Hercourt Asia PTE Ltd. W.B. Saunders Company.

Randall, D. and Warren Burggren (2001) Eckert Animal Physiology 5th edition. W.H. Freeman.

Schmidt-Nielsen (2002) Animal Physiology: Adaptation and Environment. 5th Edition. Cambridge University Press

Sembulingam and Sembulingam (2012) Essentials of Medical Physiology. 6th Edn. Jaypee Pub, New Delhi

Sherman A J. and Luciano D. (2014). Vander's Human Physiology: The Mechanism of Body Function. XIII Edition, McGraw Hills

Sherwood, L. (2013). Human Physiology from cells to systems. 8th Edn., Brooks & Cole

Tortora, G.J. & Grabowski, S. (2006). Principles of Anatomy & Physiology. XI Edition John Wiley & sons,

Vander A, Sherman J. and Luciano D. (2014). Vander's Human Physiology: The Mechanism of Body Function. XIII Edition, McGraw Hills

Victor P. Eroschenko. (2008). Di Fiore's Atlas of Histology with Functional correlations. XII Edition. Lippincott W. & Wilkins.

3.18 Core P9 - Animal Physiology: Life Sustaining Systems Lab **2 Credits**

Animal Physiology: Life Sustaining Systems Lab

Practicals

1. Enumeration of red blood cells and white blood cells using haemocytometer (TC)
2. Estimation of haemoglobin using Sahli's haemoglobinometer
3. Determination of ABO Blood group
4. Preparation of haemin crystals
5. Recording of blood pressure using a sphygmomanometer
6. Submission of Laboratory Note Book

Distribution of Marks

Examination Pattern:	**Full marks: 15**
1. Experiment (any one; From Item no. 1 or 2):	8 [6+2] *
2. Experiment (any one; From Item no. 3 or 4 or 5):	5 [(3+1+1)/ (4+1)] *
3. Submission of laboratory note book:	2

***Note:**

Q1. For preparation 6 marks and for result 2 marks

Q2. For item no. (3 and 4): preparation 3 marks and 1 mark each for drawing and labelling. For item no. (5), 4 marks for procedure and 1 mark for comment.

Pal GK, Pal P (2016) Textbook of Practical Physiology. 4th Edition, University Press

Sinha, J.K. , Chatterjee, A.K. and P. Chattopadhyay (2015) Advanced Practical Zoology, Books & Allied (P) Ltd

3.19 Core T 10 Immunology **4 Credits**

Immunology

Unit 1: Overview of Immune System
Basic concepts of health and diseases, Historical perspective of Immunology

Unit 2: Innate and Adaptive Immunity
Anatomical barriers, Inflammation, Cell and molecules involved in innate immunity, Adaptive immunity (Cell mediated and humoral).

Unit 3: Antigens
Antigenicity and immunogenicity, Immunogens, Adjuvants and haptens, Factors influencing immunogenicity, B and T-Cell epitopes

Unit 4: Immunoglobulins
Structure and functions of major classes of immunoglobulins, Antigen- antibody interactions, Immunoassays (ELISA and RIA), Hybridoma technology, concept of monoclonal antibody

Unit 5: Major Histocompatibility Complex
Structure and functions of MHC molecules.
Structure of T cell Receptor and its signalling

Unit 6: Cytokines
Types, properties and functions of cytokines.

Unit 7: Complement System
Components and pathways of complement activation.

Unit 8: Hypersensitivity
Gell and Coombs' classification and brief description of various types of hypersensitivities.

Unit 9: Immunology of diseases
Malaria, Filariasis, and Tuberculosis

Unit 10: Vaccines
Various types of vaccines. Active & passive immunization (Artificial and natural).

Reference Books

Abbas, K. Abul and Lechtman H. Andrew (2003.) Cellular and Molecular Immunology. V Edition. Saunders Publication.

Abbas, K.Abul and Lechtman H. Andrew (2011.) Basic Immunology: Functions and Disorders of Immune System. Saunders Elsevier Publication.

Delves, Martin, Burton and Roitt (2006). Roitt's Essential Immunology. 11th Edn. Blackwell Pub.

Khan FH (2011) The Elements of Immunology Pearson

Kindt, T. J., Goldsby, R.A., Osborne, B. A. and Kuby, J (2006). Immunology, VI Edition. W.H. Freeman and Company.

Mohanty, SK and Leela, KS (2014). Text book of Immunology. 2nd Edn. Jaypee Pub. N. Delhi

Parija, SC (2012). Text book of Microbiology and Immunology. 2nd Edn. Elsevier.

Playfair, JHL and Chain, BM (2001) Immunology at a glance. 7 th Edn. Blackwell Pub.

Shetty, N. (2005). Immunology: Introductory Textbook. 2nd Edn. , New Age Internatl. Pub. N. Delhi 9. Virella, G (2007). Medical Immunology 6th Edn. Informa Healthcare

3.20 Immunology Lab **2 Credits**

Immunology

Practicals

1. Identification of lymphoid organs of human (Model/Photograph).
2. Identification of histological slides: T.S of spleen, thymus and lymph nodes
3. Preparation of stained blood film to study various types of white blood cells.
4. Clotting time (CT), Bleeding time (BT) of human blood
5. Submission of Laboratory Note Book

Distribution of Marks

	Full marks: 15
1. Identification with reasons (any two; From Item no. 1 & 2)	4 (2+2) *
2. Preparation of stained blood film [from item 3]	6 (4+1+1) *
3. Experiment (any one; From Item no. 4):	3 (2+1) *
4. Laboratory note book:	2

***Note:**

Q1. Identification: ½ mark and reasons: 1½ marks

Q2. 4 marks for preparation and 1 mark each for identification and drawing

Q3. Experiment: 2 marks and result: 1 mark

3.21 Core T11 - Molecular Biology **4 Credits**

Molecular Biology

Unit 1: Overview of molecular Biology
Emergence, Historical growth of the discipline and scope

Unit 2: Nucleic Acids
Salient features of DNA and RNA Watson and Crick Model of DNA

Unit 3: DNA Replication
Mechanism of DNA Replication in Prokaryotes, Semi-conservative, bidirectional and discontinuous Replication, RNA priming, Replication of telomeres

Unit 4: Transcription
Mechanism of Transcription in prokaryotes and eukaryotes, Transcription factors, Difference between prokaryotic and eukaryotic transcription.

Unit 5: Translation
Mechanism of protein synthesis in prokaryotes, fidelity of protein synthesis, aminoacyl tRNA synthetases and charging of tRNA; Proteins involved in initiation, elongation and termination of polypeptide chain; Genetic code, Degeneracy of the genetic code and Wobble Hypothesis; Inhibitors of protein synthesis; Difference between prokaryotic and eukaryotic translation

Unit 6: Post Transcriptional Modifications and Processing of Eukaryotic RNA
Capping and Poly A tail formation in mRNA; Split genes: concept of introns and exons, splicing mechanism, alternative splicing, and RNA editing

Unit 7: Gene Regulation
Regulation of Transcription in prokaryotes: lac operon and trp operon;
Regulation of Transcription in eukaryotes: Activators, enhancers, silencer, repressors, miRNA mediated gene silencing, Genetic imprinting

Unit 8: DNA Repair Mechanisms
Types of DNA repair mechanisms, Rec BCD model in prokaryotes, nucleotide and base excision repair, SOS repair

Unit 9: Molecular Techniques
Basic concept of PCR, Western and Southern blot, Northern Blot

Reference Books

Albert Bruce, Bray Dennis, Levis Julian, Raff Martin, Roberts Keith and Watson James (2008). Molecular Biology of the Cell, V Edition, Garland publishing Inc., NY and London.

Cooper, G.M. and Hausman, R.E. (2009). The Cell: A Molecular Approach. 5th Edition.ASM Press and Sunderland, Washington, D.C.; Sinauer Associates, MA.

Harvey, L. (2004). Molecular Cell Biology. 5th Edn. W.H. Freeman

Karp, G. (2008). Cell and Molecular biology: Concepts and Application. 5th Edn, John Wiley.

Lackie, J.M. (2013). Dictionary of Molecular Biology. 5th Edn. Academic Press.

Lewin, B. (2008). Gene IX. 9th edition, Joned and Barlett. Jones and Bartlett Publishers

Lodish, Berk, Matsudaira, Kaiser, Bretscher, Ploegh, Amon, and Martin (2016) Molecular Cell Biology. 8th Edn. W.H. Freeman

Pal, A. (2011). Textbook of Cell and Molecular Biology 3rd Edn, Books and Allied, Kolkata.

Russel, P.J. (2010). Genetics: A Molecular Approach 3rd edition. Pearson Benjamin

Turner, McLennan, Bales & White (2005). Instant Notes in Molecular Biology. Taylor Francis

Twyman (2002) Advanced Molecular Biology. Viva Publication.

Verma & Agarwal. Cell Biology, Genetics, Molecular Biology, Evolution & Ecology. S. Chand

Watson, Baker, Bell, Gann, Lewin, Losick (2014). Molecular Biology of the Gene. 7th Edn. Pearson.

3.22 Core P II - Molecular Biology Lab **2 Credits**

Molecular Biology Lab

Practicals

1. Study and interpretation of electron micrograph/photograph showing
   a. Lampbrush chromosome
   b. DNA replication
   c. Transcription
   d. Split gene
2. Preparation of polytene chromosome from Chironomus or Drosophila larva
3. Preparation of solid culture media (LB) and growth of *E.coli* by spreading and Streaking methods
4. Submission of Laboratory Note Book

Examination Pattern: **Full marks: 15**

1. Identification with reasons (any two; From Item no.1)	5 (2 ½ ×2) *
2. Preparation of polytene chromosome (Item no 2)	8 (6+1+1) *
3. Submission of laboratory note book:	2

***Note:**

Q1. Identification: 1 mark and reasons: 1½ marks

Q2. Preparation: 6 marks and drawing and labelling:1 mark each

3.23 Core T 12 Principles of Genetics **4 Credits**

Principles of Genetics

Unit 1: Mendelian Genetics and its Extension
History of Genetics and its scope
Principles of inheritance; Incomplete dominance and co-dominance; Epistasis Multiple alleles; Lethal alleles; Pleiotropy; sex-linked, sex-influenced and sex-limited inheritance; Polygenic Inheritance.

Unit 2: Linkage, Crossing Over and Chromosomal Mapping
Linkage and Crossing Over; molecular basis of crossing over; Measuring recombination frequency and linkage intensity using three-factor crosses; Interference and coincidence

Unit 3: Mutations
Types of gene mutations (Classification), Types of chromosomal aberrations (Classification with one suitable example of each), Non-disjunction and variation in chromosome number; Molecular basis of mutations in relation to UV light and chemical mutagens

Unit 4: Sex Determination
1. Mechanisms of sex determination in *Drosophila*, Genic balance theory
2. Sex determination in human
3. Dosage compensation in *Drosophila* & Human
4. Environmental factors and sex determination

Unit 5: Extra-chromosomal Inheritance
1. Criteria for extra chromosomal inheritance, Antibiotic resistance in *Chlamydomonas*,
2. Kappa particle in *Paramoecium*
3. Shell spiralling in snail

Unit 6: Recombination in Bacteria and Viruses
Conjugation, Transformation, Transduction, Complementation test in Bacteriophage

Unit 7: Transposable Genetic Elements
Transposons in bacteria, Ac-Ds elements in maize, LINE, SINE, Alu elements in humans

Reference Books

Brooker, R.J. (2012). Genetics Analysis and Principles. 4th Edn. McGraw Hill.
Dale, J.W. and Park, S. F. (2004). Molecular Genetics of Bacteria. 4 th Edn. John Wiley.
Dudek, E.W. (2013). BRS Genetics. Lippincoat, Walker and Wilson
Griffiths, A.J.F., Wessler, S.R., Lewontin, R.C. and Carroll, S.B. (2010). Introduction to Genetic Analysis WH Freeman.
Hartl D.L. and Jones, E. W. (1998). Genetics: Principles and Analysis. 4th Edn. Jones and Barlett
Hartwell, Hood, Goldberg, Reynolls and Sikver (2011). Genetics: From Genes to Genome. 4th Edn. McGraw Hill.
Hyde, D. (2009). Introduction to Genetic Principle. McGraw Hill.
Jorde, Carey and Bamshad (2010). Medical Genetics. 4th Edn. Mosby.
Klug, W.S., Cummings, M.R., Spencer, C.A. (2012). Concepts of Genetics. X Edition. Benjamin Cummings
Pierce, B.A. (2013). Genetics Essentials: Concepts abd Connections. 2nd Edn. Freeman W.H.
Russell, P.J. (2009).Genetics-A Molecular Approach. III Edition. Benjamin Cummings
Scott. F. Gilbert (2010) Developmental biology, 9th edition, Sinauer Associates Inc
Snustad, D.P.Simmons,M.J.(2009).PrinciplesofGenetics.VEdition.JohnWileyandSonsInc
Tamarin, R.F (1998). Principles of Genetics. William C Brown Pub
Verma PS, Agarwal VK (2016). Genetics, 9th edition. S. Chand and Company Pvt. Ltd

3.24 Core P12- Principles of Genetics Lab **2 Credits**

Principles of Genetics Lab

Practicals

1. Identification of chromosomal aberration in Drosophila (inversion, ring chromosome, paracentric inversion) and man (Normal karyotype, Down, Klinefelter's, Turner, Cri-du-Chat syndrome) from photograph
2. Chi-square analyses
3. Linkage maps based on Drosophila crosses
4. Pedigree analysis of some human inherited traits
5. Demonstration of techniques of handling Drosophila, identifying males and females; observing wild type and mutant flies (slide/photograph), and setting up cultures
6. Submission of Laboratory Note Book

Distribution of marks

	Full marks: 15
1. Identification with reasons (any two; From Item no.1)	5 (2 ½ ×2)*
2. Any one problem (From Item no. 2 or 3 or 4):	8
3. Submission of laboratory note book:	2

***Note:**

Q1. Identification: 1 mark for reasons: 1½ marks

Suggested reading

1. Banerjee Pranab Kumar (2007) Introduction to Bio-Statistics, 3rd Edn, S Chand & Company
2. Banerjee Pranab Kumar (2011) Problems on Genetics Molecular Genetics and Evolutionary Genetics 2nd edition, New Central Book Agency

3.25 Developmental Biology **4 Credits**

Developmental Biology

Unit 1: Introduction
Basic concepts: Phases of Development, Cell cell interaction, Differentiation and growth, Differential gene expression

Unit 2: Early Embryonic Development
Gametogenesis; Spermatogenesis, Oogenesis; Types of eggs, Egg membranes; Fertilization (External and Internal), prevention of polyspermy; Planes and patterns of cleavage; Types of Blastula; Fate maps (including Techniques); Early development of frog and chick up to gastrulation; Embryonic induction and organizers

Unit 3: Late Embryonic Development
Fate of Germ Layers; Extra-embryonic membranes in birds; Implantation of embryo in human, Placenta (Structure, types and functions)
Unit 4: Post Embryonic Development
Development of brain and Eye in Vertebrate
Brief idea of regeneration

Unit 5: Implications of Developmental Biology
Teratogenesis: Teratogenic agents and their effects on embryonic development; In vitro fertilization, Stem cell (ESC), Basic concept of Amniocentesis

Reference Books

Carlson, B.M. (2014). Human Embryology and Developmental Biology. 5th Edn. Elsvier.

Carlson, B.M. (2014). Patten's Embryology. 6th edn, McGraw Hill Education

De Jonge, C.J. and Barratt, CLR (2006). The Sperma cell. Cambridge Univ Press.

Dudek, R.W. And Fix, J.D. (2013). BRS Embryology. 3rd Edn. Lippincoat Williams Wilkins

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

Schoenwolf, G.C., Bleyl, S.B., Brauer, P.R. and Francis-West, P.H. (2009). Ladesn's Human Embryology. 4th Edn. Elsvier

Slack JMW (2006). Essential Developmental Biology. 2nd Edn. Blackwell Pub.

Verma and Agarwal. Developmental Biology. S. Chand Pub. New Delhi.

Wolpert, L. (2002). Principles of Development. 2nd Edn. Oxford Univ. Press

3.26 Core P13 Developmental Biology Lab **2 Credits**

Developmental Biology

Practicals

1. Identification of whole mounts of developmental stages of chick through permanent slides: 24, 48 and 72 hours of incubation.
2. Identification of the developmental stages and life cycle of Drosophila from stock culture
3. Identification of different sections of placenta (epitheliochorial, endotheliochorial and hemochorial) (photomicrograph/ slides)
4. Project report on Drosophila culture/chick embryo development
5. Submission of Laboratory Note Book

Distribution of marks

	Full marks: 15
1. Identification with reasons (any three) (From Item no. 1,2 & 3)	9 (3× 3) *
2. Project Report (From Item no. 4):	4
3. Laboratory note book:	2

***Note:**

Q1. Identification: 1 mark and reasons: 2 marks

3.27 Core T 14 Evolutionary Biology **4 Credits**

Evolutionary Biology

Unit 1
Basic concept of origin of life, Evolution of life forms and present state of biodiversity

Unit 2
Historical review of Evolutionary concepts, Lamarkism, Darwinism and Neo Darwinism

Unit 3
1. Geological time scale, Fossil records of hominids (from Australopithecus to Homo sapiens), evolution of horse
2. Neutral theory of molecular evolution, Molecular clock

Unit 4
Sources of evolutionary variations: Heritable variations and their role in evolution

Unit 5
1.Population genetics: Hardy-Weinberg Law (statement and derivation of equation, application of law to bi-allelic Population); Evolutionary forces upsetting H-W equilibrium; Natural selection (concept of fitness, types of selection, selection coefficient, mode of selection heterozygous superiority).
2. Genetic Drift mechanism (founder's effect, bottleneck phenomenon)
3. Role of migration and mutation in changing allele frequencies.

Unit 6
Species concept, Isolating mechanisms, modes of speciation
Adaptive radiation, macroevolution (exemplified by Galapagos finches), microevolution

Unit 7
Basic concept of extinctions, Back ground and mass extinctions (causes and effects), detailed example of K-T extinction

Unit 8
Origin and Evolution of Man, comparative account of hominid characteristics and primate characteristics

Unit 9
Phylogenetic trees, Convergent & Divergent evolution.

Reference Books

Barton, N.H., Birggs, D.E.G., Elsen, J.A. Goldstein, D.B. and Patel, N.H. (2007). Evolution. CSHL Press
Bergstorm, C.T. And Dujatkin, L.A. (2012). Evolution. 1st Edn. W.W. Norton and Co.
Campbell, N.A. and Reece J.B (2011). Biology. IX Edition. Pearson, Benjamin, Cummings.
Dobzhansky T., Ayala, F.J., Stebbins, J.L. & Valentine, J.W. (1977). Evolution. Surajeet Pub., N.Delhi
Douglas, J. Futuyma (1997). Evolutionary Biology. Sinauer Associates.
Freeman, S., Herron, J. C. (2016). Evolutionary Analysis.Pearson Education Limited, Noida, India.
Gillespie, J.H. (1998). Population Genetics: a Concise Guide. John Hopkins Univ Press.
Hall, B.K. and Hallgrimson, B. (2008). Stirckberger's Evolution. 4th Edn. Jones and Barlett.
Kardong, K. (2004). An Introduction to Biological Evolution. McGraw Hill.
Mitchell, T.N. (2010). Chemical Evolution and the Origin of Life. Springer.
Page, R.D.M. and Holmes E.C. (1998). Molecular Evolution: A Phylogenetic Approach. Blackwell Sc
Ridley, M. (1996). Evolution. 2nd Edn. Blackwell Science.
Russell P.J. (2016) iGeneics: A Molecular Approach. 3rd edition, Pearson Education India
Scientific American Special Issue (2006). Becoming Human: Evolution and the rise of intelligence.
Smith, J.M. (1998). Evolutionary Genetics. 2nd Edn. Oxford Univ Press. 15. Volpe, E.P. and Rossenbaum, P.A. (1999). Evolution. McGraw Hill.

3.28 Core P 14 Evolutionary Biology Lab **2 Credits**

Evolutionary Biology

Practicals

1. Identification of major group of fossils from models/ pictures (Petrified fossil, molds, casts, carbon film, trace fossil)
2. Study of homology and analogy from suitable specimens (Birds and mammals)
3. Study and verification of Hardy-Weinberg Law by chi square analysis
4. Graphical representation and interpretation of data of height/ weight of a sample of 50 humans in relation to their age and sex.
5. Submission of Laboratory Note Book

Distribution of marks

Full marks: 15

1. Identification with reasons (any two) (From Item no. 1 & 2)	4 (2× 2)*
2. One Problem (From Item no. 3):	5
3. Project report (From Item no.4)	4
4. Submission of laboratory note book:	2

***Note:**

Q1. Identification: 1 mark and reasons: 1 marks

4. Discipline Specific Electives Subjects Syllabus

4.1 DSE T1 - Animal Behaviour and Chronobiology **4 Credits**

Animal Behaviour and Chronobiology

Unit 1: Introduction to Animal Behaviour
Origin and history of Ethology, Proximate and ultimate causes of behaviour, Methods and recording of a behaviour
Role of behaviour in conservation biology

Unit 2: Patterns of Behaviour
Stereotyped Behaviours (Orientation, Reflexes); Individual Behavioural patterns; Instinct vs. Learned Behaviour; Associative learning, classical - and operant conditioning, Habituation, Imprinting.

Unit 3: Social and Sexual Behaviour
Social Behaviour: Concept of Society; various modes of animal communication
Altruism; Insects' society with Honey bee as example; Foraging in honey bee and the waggle dance.
Sexual Behaviour: Asymmetry of sex, Sexual dimorphism, Mate choice, Intra-sexual selection (male rivalry), Inter-sexual selection (female choice), Sexual conflict in parental care.

Unit 4: Introduction to Chronobiology
Biological oscillation
Adaptive significance of biological clocks

Unit 5: Biological Rhythm
Types and characteristics of biological rhythms: Short- and Long- term rhythms; Circadian rhythms; Tidal rhythms and Lunar rhythms; Circannual rhythms; Concept of synchronization and masking; Photic and non-photic zeitgebers; Photoperiod and regulation of seasonal reproduction of vertebrates; Role of melatonin and serotonin

Reference Books

Alcock John (2013) Animal Behaviour, 10th Edition, OUP, USA.

Davis, Krebs, West (2012) An introduction to behavioural ecology, Willey Blackwell

Drickamar, Vessey, Jakob (2001), Animal Behaviour , Mc Graw Hill

Jay. C. Dunlap, Jennifer. J. Loros, Patricia J (2004) Chronobiology Biological Timekeeping,De Coursey (ed). Sinauer Associates, Inc. Publishers,

Mandal, F. (2010). A Text Book of Animal Behaviour. Prentice Hall India

Manning and Dawkins (2012) An Introduction to Animal Behaviour, Cambridge University Press

Sherman Paul W. and John Alcock (2005) Exploring Animal Behaviour, Sinauer Associate Inc., Massachusetts, USA.

Shukla JP (2009) Fundamentals of Animal Behaviour, Atlantic

Sunderland, MA, USA Insect Clocks D.S. Saunders, C.G.H. Steel, X., Afopoulou (ed.) R.D. Lewis. (3rdEd) 2002 Barens and Noble Inc. New York, USA

Vinod Kumar (2002),Biological Rhythms, Narosa Publishing House, Delhi/ Springer-Verlag, Germany.

4.2 DSE PI - Animal Behaviour and Chronobiology Lab **2 Credits**

Animal Behaviour and Chronobiology Lab

Practicals

1. Study of nests and nesting habits of the birds and social insects.
2. Study of the behavioural responses of wood lice to dry and humid conditions.
3. Study of geotaxis behaviour in earthworm.
4. Study of the phototaxis behaviour in insect larvae.
5. Study of circadian functions in humans (daily eating, sleep and temperature patterns).
6. Visit to Forest/ Wild life Sanctuary/Biodiversity Park/Zoological Park to study behavioural activities of animals and prepare a short report
7. Submission of Laboratory Note Book

Distribution of marks

	Full marks: 15
1. One experiment (From 3 or 4)	3
2. Project report (any one from item no. 1 or 2)	5
3. Report on excursion (Item 6)	5
4. Laboratory note book (From 3,4 or 5)	2

4.3 DSE T2 Biology of Insecta **4 Credits**

Biology of Insecta

Unit 1: Introduction
General Features of Insects
Success of Insects on the Earth
Role of insect in human welfare

Unit 2: Insect Taxonomy
Basis of insect classification; Classification of insects up to orders (according to Ruppert and Barnes)

Unit 3: General Morphology of Insects
1. External Features; Head - Eyes, Types of antennae, Mouth parts w.r.t. feeding habits
2. Thorax: Wings and wing articulation, Types of Legs adapted to diverse habitat ; spiracles and genitalia

Unit 4: Physiology of Insects
1. Structure and physiology of Insect - Integumentary, digestive, excretory, circulatory, respiratory, endocrine, reproductive, and nervous system
2. Photoreceptors: Types, Structure and Function
3. Types of metamorphosis along with neuroendocrine control

Unit 5: Insect Society
1. Social insects with special reference to termites
2. Trophallaxis in social insects such as ants

Unit 6: Insect Plant Interaction
Theory of co-evolution; role of allelochemicals in host plant mediation; Host-plant selection by phytophagous insects

Unit 7: Insects as Vectors
Brief discussion on Diptera as a carrier of disease and control

Note: Classification to be followed from IMMS A. D. (1938)

Reference Books

Bernays, E. A., and Chapman, R. F. ( )Host Selection by Phytophagous insects, , Chapman and Hall, New York, USA

Borror, D. J., Triplehorn, C. A., and Johnson, N. F. M (1989) Introduction to the study of insects Saunders College Publication, USA

Chandra G (2000) Insect Physiology and Biochemistry, Nation, J. L., CRC Press, USA Mosquito,Sribhumi Pub. Co.

Chapman, R. F (2012) The Insects: Structure and function, Cambridge University Press, UK

Gullan P J and Cranston, PS (2000) The Insects, An outline of Entomology, Wiley Blackwell, UK

Hati A. K (2010) Medical Entomology, Allied Book Agency,

Imms A D Richards, O.W., Davies, R.G. (1977) Imms' general text book of entomology, Springer Netherlands

Klowden, M. J (2013) Physiological system in Insects, Academic Press, USA

Snodgrass, R. E. (2004) Principles of Insect Morphology, Cornell Univ. Press, USA

Wilson, EO (1971) The Insect Societies, Harward Univ. Press, UK

4.4 DSE P2 Biology of Insecta Lab **2 Credits**

Biology of Insecta

Practicals

1. Identification of life cycle of Mosquito
2. Identification of different kinds of antennae, legs and mouth parts of insects (Cockroach, Praying Mantis, Mosquito)
3. Mounting of wings, larval spiracles and genitalia of any insects (House Fly)
4. Methodology of collection, preservation of insects.
5. Project report: morphological studies of various castes of *Apis sp, Camponotus sp, Odontotermes sp*
6. Identification of any three major insect pests of paddy (*Scirpophaga, Leptocoriza, and Hispa*) and their damages
7. Identification of Mulberry silk moth (life cycle stages)
8. Submission of Laboratory Note Book.

Distribution of marks

	Full marks: 15
1. Spot identification with economic importance (any 2; one from each Item no.6 & 7)	4 (2×2)*
2. Identification with reason (any two, from 1 and 2)	4 (2×2)*
3. Mounting (any one from Item no. 3)	2
4. Project report (any one from Item 5)	3
5. Submission of laboratory note book:	2

***Note**

Q 1. 1 mark for identification and 1 mark for economic importance.

Q2. ½ mark for identification and 1½ mark for reasons.

4.5 DSE T3 – Endocrinology **4 Credits**

Endocrinology

Unit 1: Introduction to Endocrinology
General idea of Endocrine systems, Classification, Characteristic and Transport of Hormones, Neurosecretions and Neurohormones;

Unit 2: Epiphysis, Hypothalamo-hypophysial Axis
1. Structure of pineal gland, Secretions and their functions in biological rhythms and reproduction.
2. Structure and functions of hypothalamus and Hypothalamic nuclei, Regulation of neuroendocrine glands, Feedback mechanisms
3. Structure of pituitary gland, its hormones and their functions, Hypothalamo-hypophysial portal system, disorders of pituitary gland.

Unit 3: Peripheral Endocrine Glands
1. Structure, Hormones, Functions and Regulation : Thyroid gland, Parathyroid, Adrenal, Pancreas, Ovary and Testis
2. Hormones in homeostasis; Disorders of endocrine glands

Unit 4: Regulation of Hormone Action
1. Mechanism of action of steroidal, non-steroidal hormones with receptors
2. Bioassays of hormones using RIA & ELISA
3. Estrous cycle in rat and menstrual cycle in human
4. Role of Vasopressin & Oxytocin. Hormonal regulation of parturition.

Reference Books

David O Norris (2013) Vertebrate Endocrinology, Elsevier

Fox T., Brooks, A. And Baidya, B. (2015). Endocrinology. JP Medical, London.

Gardner, D.G. And Shoback, D. (2011). Greenspan's Basic and Clinical Endocrinology. 9th Edn. McGraw Hill Lange.

Goodman, H.M. (2000). Basic Medical Endocrinology. 4th Edn. Academic Press.

Hall John E. (2015) Guyton and Hall Textbook of Medical Physiology. 13th Edition

Jameson, J.L. (2010). Harrison's Endocrinology. 2nd Edn. McGraw Hill.

Melmed, Polonsky, Larsen and Kronenberg (2016). William's Text Book of Endocrinology. 13th Edn. Elsevier.

Melmed, S. And Conn, P.M. (2005). Endocrinology: Basic and Clinical Principles. 2nd Edn. Humana Press.

Molina, P.E. (2013). Endocrine Physiology. 4th Edn. McGraw Hill Lange.

Neal, J.M. (2000). Basic Endocrinology; An Interactive Approach. Blackwell Science.

Norris, D.O. (2007). Vertebrate Endocrinology. 4th Edn. Elsevier Academic Press.

Ross & Pawlina (2010) Histology: A Text and Atlas. 6th Edition, Lippincott Williams & Wilkins.

Strauss, J.F. and Barbieri, R.L. (2014). Yen & Jaffe's Reproductive Endocrinology. Elsevier Saunders

4.6 DSE P3 Endocrinology Lab **2 Credits**

Endocrinology Lab

Practicals

1. Dissect and display of Endocrine glands in laboratory bred rat.
2. Identification of all the endocrine glands, Pituitary, Pineal, Thyroid, Parathyroid, Adrenal, Pancreas, Testis, Ovary through permanent slides
3. Tissue fixation, embedding in paraffin, microtomy and slide preparation of any endocrine gland
4. Demonstration of hormone assay through ELISA from teaching Kit
5. Submission of laboratory Note Book

Distribution of marks

	Full marks: 15
1. Identification of endocrine gland from dissected specimen (any one, Item 1)	2*
2. Identification with reasons (any two) (From Item no.2)	4 (2×2)*
2. Microtomy (Tissue sectioning/staining) (From item 3)	7
3. Submission of laboratory note book:	2

***Note**

Q1. 1 mark for identification and 1 mark for function

Q2. ½ mark for identification and 1½ mark for characters.

Suggested reading

Scudamore C.L. (2014). A Practical Guide to the Histology of Mouse. Wiley Blackwell

Brancroft JD, Gamble M (2008)Theory and practice of histological techniques .6th edition, Elsevier Publication

4.7 DSE T4 - Fish and Fisheries **4 Credits**

Fish and Fisheries

Unit 1: Introduction and Classification
1. General description of fish
2. Feeding habit, habitat and manner of reproduction

Unit 2: Morphology and Physiology
Types of fins and their modifications; Locomotion in fish; Hydrodynamics; Types of Scales, Use of scales in Classification and determination of age of fish; Gills and gas exchange; Swim Bladder: Types and role in Respiration, buoyancy; Osmoregulation in Elasmobranchs; Reproductive strategies (special reference to Indian fish); Electric organ, Bioluminescence

Unit 3: Fisheries
Inland Fisheries; Marine Fisheries; Environmental factors influencing the seasonal variations in fish catches in the Arabian Sea and the Bay of Bengal; Fishing crafts and Gears; Depletion of fisheries resources; Application of remote sensing and GIS in fisheries

Unit 4: Aquaculture
Sustainable Aquaculture; Extensive, semi-intensive and intensive culture of fish; Pen and cage culture; Polyculture; Composite fish culture; Brood stock management; Induced breeding of fish; Management of finfish hatcheries; Preparation and maintenance of fish aquarium; Preparation of compound diets for fish; Role of water quality in aquaculture; Fish diseases: Bacterial, viral and parasitic; Preservation and processing of harvested fish, Fishery by-products

Unit 5: Fish in research
Transgenic fish
Zebrafish as a model organism in research

Note: Classification to be followed from: Romer A. S. (1959)

Reference Books

Bone Q and R Moore (2008) Biology of Fishes, Talyor and Francis Group, CRC Press, U.K.

Evans D. H. and J. D. Claiborne (2013) The Physiology of Fishes, CRC Press, UK

Khanna S.S and H.R. Singh (2017) A text book of Fish Biology and Fisheries, Narendra Publishing House

Norman J.R (1988) A history of Fishes, Asiatic Publishing House

Srivastava C.B.L. (1999) Fish Biology, Narendra Publishing House

von der Emde, R.J. Mogdans and B.G. Kapoor (2004)The Senses of Fish: Adaptations for the Reception of Natural Stimuli, Springer, Netherlands

4.8 DSE P4 - Fish and Fisheries Lab **2 Credits**

Fish and Fisheries Lab

Practicals

1. Identification of *Petromyzon, Myxine, Pristis, Chimaera, Exocoetus, Hippocampus, Gambusia, Labeo, Heteropneustes, Anabas*
2. Identification of different types of scales (through permanent slides).
3. Morphometric and meristic characters of fishes
4. Water quality criteria for Aquaculture: Assessment of pH, conductivity, Total solids, Total dissolved solids
5. Dissect and display of air breathing organs in *Channa, Heteropneustes, Anabas* and *Clarias*
6. Project Report on a visit to any fish farm/ pisciculture unit/Zebrafish rearing Lab.
7. Submission of Laboratory Note Book.

Distribution of Marks

Full marks: 15

1. Identification with reasons (any three)	
(two from Item No.1 & one from Item 2)	6 [2×3] *
2. One dissection from Item 5 **or** one experiment from Item 4:	3
3. Project Report	4
4. Submission of laboratory note book:	2

***Note**

Q1. ½ mark for identification and 1½ marks for characters. In case of Item (1) only genus characters have to be mentioned

Suggested Readings

Ghosh, K.C. and Manna, B. (2015): Practical Zoology, New Central Book Agency, Kolkata

Poddar T.K.S. Mukherjee & S. K. Das (2002) An Advanced Laboratory Manual of Zoology, Laxmi Publications

Sinha, J.K. , Chatterjee, A.K. and P. Chattopadhyay (2015) Advanced Practical Zoology, Books & Allied (P) Ltd

4.9 DSE T5 Parasitology **4 Credits**

Parasitology

Unit 1: Introduction to Parasitology
Brief introduction of Parasitism, Parasite, Parasitoid and Vectors (mechanical and biological vector) and parasitic disease of human;
Host parasite relationship

Unit 2: Parasitic Protozoans
Study of *Giardia Intestinalis*, *Trypanosoma gambiense*, *Leishmania donovani* : Morphology, Life Cycle, Epidemiology, Pathogenicity, and control.

Unit 3: Parasitic Platyhelminthes
Study of *Schistosoma haematobium, Taenia sajinata* : Morphology, Life Cycle, Epidemiology, Pathogenicity and control

Unit 4: Parasitic Nematodes
Study of *Ascaris lumbricoides*, *Ancylostoma duodenale, Wuchereria bancrofti* and *Trichinella spiralis*: Morphology, Life Cycle, Epidemiology, Pathogenicity and control
Nematode plant interaction; Gall formation

Unit 5: Parasitic Arthropods
Biology, importance and control of ticks (Soft tick *Ornithodoros*, Hard tick Ixodes), mites (*Sarcoptes*), Lice (*Pediculus*), Flea (*Xenopsylla*) and Bug (*Cimex*)

Unit 5: Parasite Vertebrates
Brief account of vampire ground finch, Vampire bat

Reference Books

Ahmed, N., Dawson, M., Smith, C. and Wood, Ed. (2007) Biology of Disease. Taylor and Francis Group

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

Chatterjee K.D. (2009). Parasitology: Protozoology and Helminthology. XIII Edition, CBS Publishers & Distributors (P) Ltd.

Dailey M D. and Schmidt GD (1996) Meyer, Olsen & Schmidt's Essentials of Parasitology, W.C. Brown Publishers

Mandal FB (2015), Human Parasitology 2nd Edition, PHI Learning

Noble E.R. and G.A. Noble (1982) Parasitology: The biology of animal parasites. V Edition, Lea & Febiger

Parija S.C (2013) Textbook of medical parasitology, protozoology & helminthology, 4th Edition, All India Publishers & Distributers, New Delhi

Rattan Lai Ichhpujani and Rajesh Bhatia. (2010) Medical Parasitology, 4th Edition, Jaypee Brothers Medical Publishers (P) Ltd., New Delhi

4.10 DSE P5 Parasitology Lab **2 Credits**

Parasitology Lab

List of Practicals

1. Identification of life cycle stages of *Giardia sp., Trypanosoma sp, Leishmania sp* through permanent slides/micro photographs
2. Identification of adult and life stages of *Schistosoma sp,* through permanent slides/micro photographs
3. Identification of adult and life stages of *Ancylostoma sp*, through permanent slides/micro photographs
4. Identification of plant parasitic root knot nematode, *Meloidogyne* through permanent slides/micro photographs
5. Identification of *Pediculus sp, and Cimex sp* through permanent slides/ photographs
6. Identification of monogenea from the gills of fresh/marine fish [Gills can be procured from fish market]
7. Identification of nematode/cestode parasites from the intestines of fowl
8. Submission of a brief report on any parasite on vertebrates
9. Submission of Laboratory Note Book

Distribution of marks

	Full marks: 15
1. Identification with reasons (any three) (From Item 1,2,3,4,5)	6 (2×3)*
2. Temporary preparation of any parasite from gill of fish/ intestine of fowl (From Item 6 or 7)	5 [3+1+1]*
3. Project Report (Item 8)	2
4. Submission of laboratory note book	2

*Note

Q1. Maximum 1 from each group. ½ mark for identification and 1½ marks for characters. only genus characters have to be mentioned.

Q2. For dissection 3 marks and 1 mark each for drawing and labelling

5. Skill Enhancement Course

5.1 SEC T1 – Apiculture **2 Credits**

Apiculture

Unit 1: Biology of Bees
History, Classification and Biology of Honey Bees
Social Organization of Bee Colony

Unit 2: Rearing of Bees
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 3: Diseases and Enemies
Bee Diseases and Enemies
Control and Preventive measures

Unit 4: Economic Importance
Products of Apiculture Industry and its Uses (Honey, Bees Wax, Propolis), Pollen etc

Unit 5: Entrepreneurship in Apiculture
Bee Keeping Industry - Recent Efforts, Modern Methods in employing artificial Beehives for cross pollination in horticultural gardens

Reference Books

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, NewDelhi.

5.2 SEC T2 Sericulture

Sericulture	2 Credits

Unit 1: Introduction
Sericulture: Definition, history and present status: Silk route
Types of silkworms, Distribution and Races
Exotic and indigenous races
Mulberry and non-mulberry Sericulture

Unit 2: Biology of Silkworm
Life cycle of *Bombyx mori*
Structure of silk gland and secretion of silk

Unit 3: Rearing of Silkworms
Selection of mulberry variety and establishment of mulberry garden
Rearing house and rearing appliances.
Disinfectants: Formalin, bleaching powder, RKO
Silkworm rearing technology: Early age and Late age rearing
Types of mountages
Spinning, harvesting and storage of cocoons

Unit 4: Pests and Diseases
Pests of silkworm: Uzi fly, dermestid beetles and vertebrates
Pathogenesis of silkworm diseases: Protozoan, viral, fungal and bacterial
Control and prevention of pests and diseases

Unit 5: Entrepreneurship in Sericulture
Prospectus of Sericulture in India: Sericulture industry in different states, employment, potential in mulberry and non-mulberry sericulture
Visit to various sericulture centres.

Reference Books

Manual on Sericulture; Food and Agriculture Organisation, Rome 1976

Handbook of Practical Sericulture: S.R. Ullal and M.N. Narasimhanna CSB, Bangalore

Silkworm Rearing and Disease of Silkworm, 1956, Ptd. By Director of Ptg., Stn. & Pub. Govt. Press, Bangalore

Appropriate Sericultural Techniques; Ed. M. S. Jolly, Director, CSR & TI, Mysore.

Handbook of Silkworm Rearing: Agriculture and Technical Manual-1, Fuzi Pub. Co. Ltd., Tokyo, Japan1972.

Manual of Silkworm Egg Production; M. N. Narasimhanna, CSB, Bangalore 1988.

Silkworm Rearing; Wupang—Chun and Chen Da-Chung, Pub. By FAO, Rome 1988.

A Guide for Bivoltine Sericulture; K. Sengupta, Director, CSR & TI, Mysore 1989.

Improved Method of Rearing Young age silkworm; S. Krishnaswamy, reprinted CSB, Bangalore, 1986

5.3 SEC T3 Aquarium Fish Keeping

Aquarium Fish Keeping	**2 Credits**

Unit 1: Introduction to Aquarium Fish Keeping

The potential scope of Aquarium Fish Industry as a Cottage Industry, Exotic and Endemic species of Aquarium Fishes

Unit 2: Biology of Aquarium Fishes

Common characters and sexual dimorphism of Fresh water and Marine Aquarium fishes such as Guppy, Molly, Sword tail, Gold fish, Angel fish, Blue morph, Anemone fish and Butterfly fish

Unit 3: Food and feeding of Aquarium fishes

Use of live fish feed organisms. Preparation and composition of formulated fish feeds, Aquarium fish as larval predator

Unit 4: Fish Transportation

Live fish transport - Fish handling, packing and forwarding techniques.

Unit 5: Maintenance of Aquarium

General Aquarium maintenance - budget for setting up an Aquarium Fish Farm as a Cottage Industry

6. Generic Elective

6.1 GE T1- Animal Diversity

Animal Diversity	**4 Credits**

Unit 1: Protozoa

Protozoa

General characters of Protozoa; Life cycle of Plasmodium

Unit 2: Porifera

General characters and canal system in Porifera

Unit 3: Cnidaria

General characters of Cnidarians and polymorphism in siphonophorans

Unit 4: Aceolomates

General characters of Helminthes

Unit 5: Pseudocoelomates

General characters of Nematoda

Parasitic adaptations

Unit 6: Annelida

General characters of Annelida

Metamerism

Unit 7: Arthropoda

General characters

Social life in insects (Termite)

Unit 8: Mollusca

General characters of mollusc

Pearl Formation

Unit 9: Echinodermata

General characters of Echinodermata

Water Vascular system in Starfish

Unit 10: Urochordata and Cephalochordata

Salient features

Unit 11: Pisces

General Characters

Osmoregulation, Migration of Fish

Unit 12: Amphibia

General characters, Adaptations for terrestrial life, Parental care

Unit 13: Reptilia

General Characters

Amniotes; Origin of reptiles. Terrestrial adaptations in reptiles.

Unit 14: Aves

General Characters

The origin of birds; Flight adaptations

Unit 15: Mammalia

General Characters

Early evolution of mammals; Primates; Dentition in mammals.

Reference Books

Barnes, R.D. (1992). Invertebrate Zoology. Saunders College Pub. USA.

Campbell & Reece (2005). Biology, Pearson Education, (Singapore) Pvt. Ltd.

Kardong, K. V. (2002). Vertebrates Comparative Anatomy. Function and Evolution. Tata McGraw Hill Publishing Company. New Delhi.

Raven, P. H. and Johnson, G. B. (2004). Biology, 6th edition, Tata McGraw Hill Publications. New Delhi.

Ruppert, Fox and Barnes (2006) Invertebrate Zoology. A functional Evolutionary Approach 7th Edition, Thomson Books/Cole

6.2 GE P1 - Animal Diversity Lab

Animal Diversity Lab	**2 Credits**

List of Practical

1. Identification of following specimens:

a. Non Chordates: *Euglena, Noctiluca, Paramecium, Sycon, Physalia, Tubipora, Metridium, Taenia, Ascaris, Nereis, Aphrodite, Leech, Peripatus, Limulus, Eupagurus, Buthus, Daphnia, Chiton, Dentalium, Octopus, Asterias, and Antedon.*

b. Chordates: *Balanoglossus, Amphioxus, Petromyzon, Pristis, Hippocampus, Labeo, Icthyophis/Uraeotyphlus, Salamander, Rhacophorus, Draco, Uromastix, Naja,* Viper, *Alcedo*, *Dinopium, Funambulus, Pteropus*.

2. Identification of following Permanent Slides:

Cross section of *Ascaris* (male and female), T. S. of Earthworm passing through typhlosolar intestine, Bipinnaria and Pluteus larva.

3. Temporary mounts of:

a. Septal & pharyngeal nephridia of earthworm.

b. Unstained mounts of Placoid, cycloid and ctenoid scales.

4. Dissections : Digestive and nervous system of Cockroach, Afferent branchial arterial system of carp/lata

5. Submission of Laboratory Note Book

Distribution of marks

	Full marks: 15
1. Identification with reasons (any three):	6 [2×3]*
[From Item 1 (any two) and Item 2 (any one)]	
2. Dissection (From Item 4)	5 [3+1+1]*
3. Mounting (any one) (From Item 3):	2
4. Submission of laboratory note book:	2

*Note

Q 1. ½ mark for identification and 1½ marks for characters

Q 2. 3 marks for dissection and 1 mark each for drawing and labelling

6.3 GE T2- Aquatic Biology **4 Credits**

Aquatic Biology

Unit 1: Aquatic Biomes

Brief introduction to the aquatic biomes: Freshwater ecosystem (lakes, wetlands, streams and rivers), estuaries, intertidal zones, oceanic pelagic zone, marine benthic zone

Unit 2: Freshwater Biology

Lakes: types, Lake as an Ecosystem, Lake morphometry, Physico-chemical Characteristics: Light, Temperature, Thermal stratification, Dissolved Solids, Carbonate, Bicarbonates, Phosphates and Nitrates, Turbidity, dissolved gases (Oxygen, Carbon dioxide). Nutrient Cycles in Lakes (Nitrogen, Sulphur and Phosphorous).

Streams: Different stages of stream development, Physico-chemical environment, Adaptation of hill-stream fishes.

Unit 3: Marine Biology

Salinity and density of Sea water, Continental shelf, Adaptations of deep sea organisms, Coral reefs, Sea weeds.

Unit 4: Management of Aquatic Resources

Causes of pollution: Agricultural, Industrial, Sewage, Thermal and Oil spills, Eutrophication, Management and conservation (legislations), Sewage treatment Water quality assessment- BOD and COD.

Reference Books

Anathakrishnan : Bioresources Ecology 3rd Edition
Goldman : Limnology, 2nd Edition
Odum and Barrett: Fundamentals of Ecology, 5th Edition
Pawlowski: Physicochemical Methods for Water and Wastewater Treatment, 1st Edition Wetzel: Limnology, 3rd edition
Trivedi and Goyal: Chemical and biological methods for water pollution studies Welch: Limnology Vols. I-II

6.4 GE P2 - Aquatic Biology Lab **2 Credits**

Aquatic Biology Lab

List of Practical

1. Identify the important zooplanktons present in a lake ecosystem.

2. Determine the amount of Turbidity/transparency, Dissolved Oxygen, and Free Carbon dioxide, Alkalinity (carbonates & bicarbonates) in water collected from a nearby lake / water body.

3. Instruments used in limnology (Secchi disc, Van Dorn Bottle, Conductivity meter, Turbidity meter, PONAR grab sampler) and their significance.

4. A Project Report on a visit to a Sewage treatment plant/Marine bio- reserve/Fisheries Institute/freshwater ecosystem

5. Submission of Laboratory Note Book

Distribution of marks

Full marks: 15

1. Identification with reasons (any three) [From Item 1 and Item 3]	6 [2×3]*
2. One experiment (pH/ free CO_2)	5 [2+3] *
3. Project Report (From Item 4):	2
4. Submission of laboratory note book:	2

*Note

Q 1. ½ mark for identification and 1½ marks for characters

Q 2. For Principle 2 marks and for result 3 marks

6.5 GE T3 Environment and Public Health **4 Credits**

Environment and Public Health

Unit 1: Introduction

Sources of Environmental hazards, Hazard identification and accounting, Fate of toxic and persistent substances in the environment, Dose response evaluation, Exposure assessment, Persistent organic pollutant

Unit 2: Climate Change

Greenhouse gases and global warming, Acid rain, Ozone layer destruction, Effect of climate change on public health

Unit 3: Pollution

Air, water, Land, noise pollution sources and effects, Pollution control

Unit 4: Waste Management Technologies

Sources of waste, types and characteristics, Sewage disposal and its management, Solid waste disposal, Biomedical waste handling and disposal, e-waste management, nuclear waste handling and disposal, Waste from thermal power plants.

Unit 5: Diseases

Causes, symptoms and control of tuberculosis, Asthma, Cholera, Minamata disease, typhoid, filariasis

Reference Books

Cutter, S.L., Environmental Risk and Hazards, Prentice-Hall of India Pvt. Ltd., New Delhi, 1999.
Joseph F Louvar and B Diane Louver Health and Environmental Risk Analysis fundamentals with applications, Prentice Hall, New Jersey 1997.
Kasperson, J.X. and Kasperson, R.E. and Kasperson,R.E., Global Environmental Risks, V.N.University Press, New York, 2003.
Kofi Asante Duah "Risk Assessment in Environmental management", John Wiley and sons, Singapore, 1998.
Kolluru Rao, Bartell Steven, Pitblado R and Stricoff "Risk Assessment and Management Handbook", McGraw Hill Inc., New York, 1996.

6.6 GE P3 - Environment and Public Health Lab **2 Credits**

Environment and Public Health Lab

List of Practical

1. To determine pH, Cl, SO_4, NO_3 in soil and water samples from different locations by using soil and water testing kit.

2. Submission of laboratory Note Book

Examination Pattern: **Full marks: 15**

1. One experiment with water sample 6 [2+2+2]*

2. One experiment with soil sample 7 [2+3+2]*

3. Submission of laboratory note book: 2

***Note**

Q 1. 2 marks each for procedure, result and comment

Q 2. 3 marks for procedure and 2 marks each for result and comment

6.7 GE T4 - Insect Vectors and Diseases **4 Credits**

Insect Vectors and Diseases

Unit 1: Introduction to Insects

General Features of Insects, Morphological features, Head - Eyes, Types of antennae, Mouth parts

Unit 2: Concept of Vectors

Brief introduction to Vectors (mechanical and biological vectors), Reservoirs, Host-vector relationship, Adaptations as vectors, Host specificity

Unit 3: Insects as Vectors

General features of orders with insects as vectors - Diptera, Siphonaptera, Siphunculata, Hemiptera

Unit 4: Dipteran as Disease Vectors

1. Mosquitoes, Sand fly, Houseflies
2. Study of mosquito-borne diseases - Malaria, Dengue, Chikungunya, Filariasis
3.Study of sand fly-borne diseases -Leishmaniasis
4.Study of house fly as important mechanical vector, Myiasis
5.Control of mosquitoes, Sand fly, house fly

Unit 5: Siphonaptera as Disease Vectors

Fleas as important insect vectors; Host-specificity, Study of Flea-borne diseases - Plague, Typhus fever; Control of fleas

Unit 6: Siphunculata as Disease Vectors

Human louse (Head, Body and Pubic louse) as important insect vectors; Control of human louse

Unit 7: Hempitera as Disease Vectors

Bugs as insect vectors; Blood-sucking bugs; Chagas disease, Bed bugs as mechanical vectors, Control and prevention measures

Reference Books

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

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

Mathews, G. (2011). Integrated Vector Management: Controlling Vectors of Malaria and Other Insect Vector Borne Diseases. Wiley-Blackwell Mosquito (2000) Chandra G, Sribhumi Publication Co. Kolkata Medical Entomology, Hati A. K Allied Book Agency, Kolkata

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

6.8 GE P4 - Insect Vectors and Diseases Lab

Insect Vectors and Diseases Lab	**2 Credits**

List of Practical

1. Identification of following insect vectors through permanent slides/ photographs: *Aedes, Culex, Anopheles, Pediculus, Cimex, Phlebotomus, Musca* through permanent slides
2. Mounting of different kinds of mouth parts of insects (Mosquito/Cockroach)
3. Study of different diseases transmitted by above insect vectors
4. Submission of a project report on any one of the aforesaid insect vectors and disease transmitted
5. Preparation of laboratory note book

Distribution of marks

	Full marks: 15
1. Identification with reasons (any three) [From Item 1]	9 [3×3]*
2. Mounting of mouth parts (From Item 2)	2
3. Project Report (From Item 4):	2
4. Laboratory note book:	2

*Note
Q 1. ½ mark for identification, 1½ marks for characters and 1 mark for name of the disease transmitted

7.Appendix I - Scheme for CBCS Curriculum for Pass Course

Credit Distribution across Courses

'Tutorials of 1 Credit will be conducted in case there is no practical component

All Pass courses will have 3 subjects/disciplines of interest. Student will select 4 core courses each from discipline of choice including Zoology as one of the disciplines. The details for core courses available in Zoology have been detailed in Section 3 of this document

Student will select 2 core courses each from discipline of choice including Zoology as one of the disciplines. The details for elective courses available in Zoology have been detailed in Section 4 and 6 of this document

Student may also choose Skill Enhancement courses in Zoology. The details for skill enhancement courses available in Zoology have been detailed in Section 5 of this document

Scheme for CBCS Curriculum