SCHEME AND SYLLABUS FOR
CHOICE BASED CREDIT SYSTEM
FOR B.Sc. HONOURS ZOOLOGY

Sem	Core Course(14)	Ability Enhancement Compulsory Course (2)	Skill Enhancement Course SEC (2)	Discipline Specific Elective DCE (4)	Generic Elective GE (4)
I	**C-1:** Non-chordates I: Protista to Pseudocoelomates	English/Hindi/ MIL Communication			**GE-1:** Animal Diversity
	C-2: Principles of Ecology				
II	**C-3:** Non-chordates II: Coelomates	Environmental Science			**GE- 2:** Human Physiology
	C-4: Cell Biology				
III	**C-5:** Diversity of Chordates		**SEC-1:** Sericulture		**GE- 3:** Animal Cell Biotechnology
	C-6: Physiology: Controlling and Coordinating Systems				
	C-7: Fundamentals of Biochemistry				
IV	**C-8:** Comparative Anatomy of Vertebrates		**SEC-2:** Aquarium Fish Keeping		**GE-4:** Aquatic Biology
	C-9: Physiology: Life Sustaining Systems				
	C-10: Biochemistry of Metabolic Processes				
V	**C-11:** Molecular			**DSE-1:**	

	Biology			Immunology	
	C-12: Principles of Genetics			**DSE-2**: Animal Bio-technology	
VI	**C-13:** Developmental Biology			**DSE–3:** Fish and Fisheries	
	C-14: Evolutionary Biology			**DSE-4:** Endo-crinology	

Semester	**Course Opted**	**Course Name**	**Credits**
I	Ability Enhancement Compulsory Course-I	English Communications	2
	Core course-1	Non-chordates I: Protista to Pseudocoelomates	4
	Core Course-1 Practical		2
	Core course-2	Principles of Ecology	4
	Core Course-2 Practical		2
	Generic Elective –1	Botany 1/Chemistry 1/Other Discipline	4
	Generic Elective –1 Practical/Tutorial		2
II	Ability Enhancement Compulsory Course-II	Environmental Science	2
	Core course-3	Non-chordates II: Coelomates	4
	Core Course-3Practical		2
	Core course-4	Cell Biology	4
	Core Course-4 Practical		2
	Generic Elective –2	Botany 2/Chemistry 2/Other Discipline	4
	Generic Elective –2 Practical		2
III	Core course-5	Diversity of chordates	4
	Core Course-5 Practical		2

	Core course-6	Physiology: Controlling and Coordinating systems	4
	Core Course-6 Practical		2
	Core course-7	Fundamentals of Biochemistry	4
	Core Course-7 Practical		2
	Skill Enhancement Course-1	Sericulture	4
	Generic Elective –3	Botany 3/Chemistry 3/ Other Discipline	4
	Generic Elective –3 Practical		2
IV	Core course-8	Comparative anatomy of vertebrates	4
	Core Course-8 Practical		2
	Core course-9	Physiology: Life Sustaining Systems	4
	Core Course-9 Practical		2
	Core course-10	Biochemistry of Metabolic Processes	4
	Core Course- 10 Practical		2
	Skill Enhancement Course- 2	Aquarium Fish Keeping	4
	Generic Elective –4	Botany 4/Chemistry 4/ Other Discipline	4
	Generic Elective – 4 Practical		2
V	Core course-11	Molecular Biology	4
	Core Course-11 Practical		2
	Core course-12	Principles of Genetics	4
	Core Course-12 Practical		2
	Discipline Specific Elective –1	Immunology	4
	Discipline Specific Elective –1 Practical		2
	Discipline Specific Elective –2	Animal Biotechnology	4
	Discipline Specific Elective- 2		2

	Practical/Tutorial		
VI	Core course-13	Developmental Biology	4
	Core Course-13 Practical/Tutorial		2
	Core course-14	Evolutionary Biology	4
	Core Course-14 Practical/Tutorial		2
	Discipline Centric Elective –3	Fish and Fisheries	4
	Discipline Centric Elective –3 Practical/Tutorial		2
	Discipline Centric Elective-4	Endocrinology	4
	Discipline Centric Elective –4 Practical/Tutorial		2
		Total:	**140**

CORE COURSES	
C-1	Non-chordates I: Protista to Pseudocoelomates
C-2	Principles of Ecology
C-3	Non-chordates II: Coelomates
C-4	Cell Biology
C-5	Diversity of Chordates
C-6	Physiology: Controlling and Coordinating Systems
C-7	Fundamentals of Biochemistry
C-8	Comparative Anatomy of Vertebrates
C-9	Physiology: Life Sustaining Systems
C-10	Biochemistry of Metabolic Processes
C-11	Molecular Biology
C-12	Principles of Genetics
C-13	Developmental Biology
C-14	Evolutionary Biology

DISCIPLINE SPECIFIC ELECTIVE COURSES

DSE-1	Immunology
DSE-2	Animal Biotechnology
DSE-3	Fish and Fisheries
DSE-4	Endocrinology
GENERIC ELECTIVE COURSES FOR OTHER DISCIPLINE *(Four papers from any two discipline) the Students of B.Sc. Zoology Honours have to adopt four papers from other two discipline*	
GE-1	Animal Diversity
GE-2	Human Physiology
GE-3	Animal Cell Biotechnology
GE-4	Aquatic Biology
SKILL ENHANCEMENT COURSES	
SEC-1	Sericulture
SEC-2	Aquarium Fish Keeping

*For pursing M.Sc. in Zoology, the students should have Chemistry as Generic Elective (GE) for two semesters.

Bodoland University

Department of Zoology
Curriculum Structures for UG syllabus (B.Sc. Honours)
No. of papers =14+12=26, Total Credits= 140
Total Marks = 2400

SEM-I						
Paper Code	**Course**	**Credit**	**Credit Distribution (L+T+P)**	**End Sem Marks**	**Internal Marks**	**Total Marks**
ZOO-101H	C-1: Non-chordates I: Protista to Pseudocoelomates	6	4+0+2	60(Theo)+20(Pract)	20	100
ZOO-102H	C-2: Principles of Ecology	6	4+0+2	60(Theo)+20(Pract)	20	100
ZOO-103HR	GE-1: Animal Diversity	6	4+0+2	60(Theo)+20(Pract)	20	100
COMM-104HR	AEC: AECC-1: English/Hind/MIL (Communication)	2	2+0+0	50	-	50
Total		**20**	**20**	**290**	**60**	**350**

SEM-II						
Paper Code	**Course**	**Credit**	**Credit Distribution (L+T+P)**	**End Sem Marks**	**Internal Marks**	**Total Marks**
ZOO-201H	C-3: Non-chordates II: Coelomates	6	4+0+2	60(Theo)+20(Pract)	20	100
ZOO-202H	C-4: Cell Biology	6	4+0+2	60(Theo)+20(Pract)	20	100
ZOO-203HR	GE-2: Human Physiology	6	4+0+2	60(Theo)+20(Pract)	20	100
COMM-204HR	AEC: AECC-2: Environmental Science	2	2+0+0	50	-	50
Total		**20**	**20**	**290**	**60**	**350**

SEM-III						
Paper Code	**Course**	**Credit**	**Credit Distribution (L+T+P)**	**End Sem Marks**	**Internal Marks**	**Total Marks**
ZOO-301H	C-5: Diversity of Chordates	6	4+0+2	60(Theo)+20(Pract)	20	100
ZOO-302H	C-6: Physiology: Controlling and Coordinating Systems	6	4+0+2	60(Theo)+20(Pract)	20	100
ZOO-303H	C-7: Fundamentals of Biochemistry	6	4+0+2	60(Theo)+20(Pract)	20	100
ZOO-304HR	AEC: SEC-1: Sericulture	2	2+0+0	50	-	50
ZOO-305H	GE-3: Animal Cell Biotechnology	6	4+0+2	60(Theo)+20(Pract)	20	100
Total		**26**	**26**	**370**	**80**	**450**

SEM-IV						
Paper Code	**Course**	**Credit**	**Credit Distribution (L+T+P)**	**End Sem Marks**	**Internal Marks**	**Total Marks**
ZOO-401H	C-8: Comparative Anatomy of Vertebrates	6	4+0+2	60(Theo)+20(Pract)	20	100
ZOO-402H	C-9: Physiology: Life Sustaining Systems	6	4+0+2	60(Theo)+20(Pract)	20	100
ZOO-403H	C-10: Biochemistry of Metabolic Processes	6	4+0+2	60(Theo)+20(Pract)	20	100
ZOO-404HR	AEC: SEC-2: Aquarium Fish Keeping	2	2+0+0	50	-	50
ZOO-405 H	GE-4: Aquatic Biology	6	4+0+2	60(Theo)+20(Pract)	20	100
Total		**26**	**26**	**370**	**80**	**450**

SEM-V						
Paper Code	**Course**	**Credit**	**Credit Distribution (L+T+P)**	**End Sem Marks**	**Internal Marks**	**Total Marks**
ZOO-501H	C-11: Molecular Biology	6	4+0+2	60(Theo)+20(Pract)	20	100
ZOO-502H	C-12: Principles of Genetics	6	4+0+2	60(Theo)+20(Pract)	20	100
ZOO-D1HR	DSE-1: Immunology	6	4+0+2	60(Theo)+20(Pract)	20	100
ZOO-D2HR	DSE-2: Animal Bio-technology	6	4+0+2	60(Theo)+20(Pract)	20	100
Total		**24**	**24**	**320**	**80**	**400**

SEM-VI						
Paper Code	**Course**	**Credit**	**Credit Distribution (L+T+P)**	**End Sem Marks**	**Internal Marks**	**Total Marks**
ZOO-601H	C-13: Developmental Biology	6	4+0+2	60(Theo)+20(Pract)	20	100
ZOO-602H	C-14: Evolutionary Biology	6	4+0+2	60(Theo)+20(Pract)	20	100
ZOO-D3H	DSE-3: Fish and Fisheries	6	4+0+2	60(Theo)+20(Pract)	20	100
ZOO-D4H	DSE-4: Endocrinology	6	4+0+2	60(Theo)+20(Pract)	20	100
Total		**24**	**24**	**320**	**80**	**400**

1ST SEMESTER SYLLABUS (HONOURS)

SEM-I						
Paper Code	**Course**	**Credit**	**Credit Distribution (L+T+P)**	**End Sem Marks**	**Internal Marks**	**Total Marks**
ZOO-101H	CC-1: Non-chordates I: Protista to Pseudocoelomates	6	4+0+2	60(Theo)+20(Pract)	20	100
ZOO-102H	CC-2: Principles of Ecology	6	4+0+2	60(Theo)+20(Pract)	20	100
ZOO-103HR	GE-1: Animal Diversity	6	4+0+2	60(Theo)+20(Pract)	20	100
COMM-104HR	AEC: AECC-1: English/Hind/MIL (Communication)	2	2+0+0	50	-	50
Total		**20**	**20**	**290**	**60**	**350**

CC-1: NON-CHORDATES I: PROTISTS TO PSEUDOCOELOMATES

THEORY **(CREDITS 4)**

Unit 1: Protista, Parazoa and Metazoa **19 Lectures**
General characteristics and Classification up to classes
Amoeba and *Paramecium*
Life cycle and pathogenicity of and *Entamoeba histolytica*
Locomotion in Protista
Evolution of symmetry and segmentation of Metazoa

Unit 2: Porifera **7**
General characteristics and Classification up to classes
Canal system in sponge

Unit 3: Cnidaria **12**
General characteristics and Classification up to classes
Polymorphism in Cnidaria
Corals and coral reefs

Unit 4: Ctenophora **4**
General characteristics and Evolutionary significance

Unit 5: Platyhelminthes **10**
General characteristics and Classification up to classes
Life cycle and pathogenicity of *Fasciola hepatica*

Unit 6: Nemathelminthes **8**
General characteristics and Classification up to classes
Life cycle, and pathogenicity of *Ascaris lumbricoides*
Parasitic adaptations in helminthes

Note: Classification to be followed from "Barnes, R.D. (1982). *Invertebrate Zoology*, V Edition"

PRACTICALS (CREDITS 2)

1. Study of whole mount of *Euglena, Amoeba* and *Paramecium,* Binary fission and Conjugation in *Paramecium*
2. Examination of pond water collected from different places for diversity in protista
3. Study of *Sycon* (T.S. and L.S.), *Hyalonema, Euplectella, Spongilla*
4. Study of *Obelia, Physalia, Millepora, Aurelia, Tubipora, Corallium, Alcyonium, Gorgonia, Metridium, Pennatula, Fungia, Meandrina, Madrepora*
5. One specimen/slide of any ctenophore
6. To submit a Project Report on any related topic on life cycles/coral/ coral reefs.

Note: Classification to be followed from "Ruppert and Barnes (2006) *Invertebrate Zoology*, 8th edition, Holt Saunders International Edition"

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
- Barrington, E.J.W. (1979). *Invertebrate Structure and Functions.* II Edition, E.L.B.S. and Nelson

CC-2: PRINCIPLES OF ECOLOGY

THEORY **(CREDITS 4)**

Unit 1: Introduction to Ecology **6 Lectures**

Autecology and synecology, Levels of organization, Laws of limiting factors, Study of physical factors

Unit 2: Population 24

Unique and group attributes of population: Density, natality, mortality, life tables, fecundity tables, survivorship curves, age ratio, sex ratio, dispersal and dispersion Exponential and logistic growth, equation and patterns, r and K strategies Population regulation - density-dependent and independent factors Population interactions

Unit 3: Community 12

Community characteristics: species richness, dominance, diversity, abundance, vertical stratification, Ecotone and edge effect; Ecological succession with one example

Unit 4: Ecosystem 14

Types of ecosystems with one example in detail, 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 Nutrient and biogeochemical cycle with one example of Nitrogen cycle

Unit 5: Applied Ecology 4

Ecology in Wildlife Conservation and Management

PRACTICALS (CREDITS 2)

1. Study of life tables and plotting of survivorship curves of different types from the hypothetical/real data provided
2. Determination of population density in a natural/hypothetical community by quadrate method and calculation of Shannon-Weiner diversity index for the same community
3. 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 CO2

SUGGESTED READINGS

- Colinvaux, P. A. (1993). Ecology. II Edition. Wiley, John and Sons, Inc.
- 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
- Ricklefs, R.E., (2000). Ecology. V Edition. Chiron Pres

GE- 1: ANIMAL DIVERSITY

THEORY **(CREDITS 4)**

Unit 1. Protista **4 Lectures**
General characters of Protozoa

Unit 2. Porifera **3**
General characters and canal system in Porifera

Unit 3. Radiata **3**
General characters of Cnidarians and polymorphism

Unit 4. Aceolomates **3**
General characters of Helminthes; Life cycle of *Taenia solium*

Unit 5. Pseudocoelomates **3**
General characters of Nemethehelminthes; Parasitic adaptations

Unit 6. Coelomate Protostomes **3**
General characters of Annelida; Metamerism.

Unit 7. Arthropoda **4**
General characters. Social life in insects.

Unit 8. Mollusca **3**
General characters of mollusca

Unit 9. Coelomate Deuterostomes **3**
General characters of Echinodermata, Water Vascular system in Starfish.

Unit 10. Protochordata **2**
Salient features

Unit 11. Pisces **4**
Osmoregulation

Unit 12. Amphibia **4**
General characters, Parental care in Amphibia.

Unit 13. Reptilia **5**
Amniotes; Origin of reptiles. Terrestrial adaptations in reptiles.

Unit 14. Aves **5**
The origin of birds; Flight adaptations

Unit 15. Mammalia **6**
Dentition in mammals.

PRACTICAL **(CREDITS 2)**

1. Study of following specimens:
   a) **Non Chordates:** *Euglena, Noctiluca, Paramecium, Sycon, , Physalia, Tubipora, Metridium, Taenia, Ascaris, Nereis, Aphrodite, Leech, Peripatus, Limulus, ,* Hermitcrab*, Daphnia,* Millipede, Centipede, Beetle, *Chiton, Dentalium, Octopus, Asterias, and Antedon.*
   b) **Chordates***: Balanoglossus, Amphioxus, Petromyzon, Pristis, Hippocampus, Labeo, Icthyophis/ Uraeotyphlus, Salamander, Rhacophorus Draco, Uromastix, Naja, Viper, model of Archaeopteryx,* any three common birds-*(Crow, duck, Owl),* Squirrel and Bat.
2. Study of following Permanent Slides:
   Cross section of Sycon, Sea anemone and *Ascaris (*male and female*).* T. S. of Earthworm passing through pharynx, gizzard, and 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 of
   a) Digestive and nervous system of Cockroach.
   b) Urinogenital system of Rat

SUGGESTED BOOKS

- Barnes, R.D. (1992). Invertebrate Zoology. Saunders College Pub. USA.
- Ruppert, Fox and Barnes (2006) Invertebrate Zoology. A functional Evolutionary Approach 7th Edition, Thomson Books/Cole
- 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.

3RD SEMESTER

3RD SEMESTER SYLLABUS (HONOURS)

SEM-III						
Paper Code	**Course**	**Credit**	**Credit Distribution (L+T+P)**	**End Sem Marks**	**Internal Marks**	**Total Marks**
ZOO-301H	C-5: Diversity of Chordates	6	4+0+2	60(Theo)+20(Pract)	20	100
ZOO-302H	C-6: Physiology: Controlling and Coordinating Systems	6	4+0+2	60(Theo)+20(Pract)	20	100
ZOO-303H	C-7: Fundamentals of Biochemistry	6	4+0+2	60(Theo)+20(Pract)	20	100
ZOO-304HR	AEC: SEC-1: Sericulture	2	2+0+0	50	-	50
ZOO-305H	GE-3: Animal Cell Biotechnology	6	4+0+2	60(Theo)+20(Pract)	20	100
Total		**26**	**26**	**370**	**80**	**450**

C-5: DIVERSITY OF CHORDATA

THEORY (CREDITS 4)

Unit 1: Introduction to Chordates **2 Lectures**
General characteristics and outline classification

Unit 2: Protochordata **8**
General characteristics of Hemichordata, Urochordata and Cephalochordata; Retrogressive metamorphosis in Urochordata

Unit 3: Origin of Chordata **3**
Advanced features of vertebrates over Protochordata

Unit 4: Agnatha **2**
General characteristics and classification of cyclostomes up to class

Unit 5: Pisces **8**
General characteristics of Chondrichthyes and Osteichthyes, classification up to order Migration

Unit 6: Amphibia **6**
Origin of *Tetrapoda* (Evolution of terrestrial ectotherms); General characteristics and classification up to order; Parental care in Amphibians

Unit 7: Reptilia **7**
General characteristics and classification up to order; Poison apparatus and Biting mechanism in snakes

Unit 8: Aves **8**
General characteristics and classification up to order *Archaeopteryx*—a connecting link; Flight adaptations and Migration in birds

Unit 9: Mammals **8**
General characters and classification up to order;

Unit 10: Zoogeography **8**
Zoogeographical realms, Theories pertaining to distribution of animals, Plate tectonic and Continental drift theory

PRACTICAL (CREDITS 2)

1. **Protochordata**
   Balanoglossus, Herdmania, Branchiostoma, Permanent slide of *Herdmania* spicules
2. **Agnatha**
   Petromyzon, Myxine
3. **Fishes**
   Scoliodon, Pristis, Torpedo, Mystus, Heteropneustes, Labeo, Exocoetus, Echeneis, Anguilla, Hippocampus, Tetrodon/ Diodon, Anabas
4. **Amphibia**
   Ichthyophis/Ureotyphlus, Bufo, Hyla, Alytes, Salamandra
5. **Reptilia**
   Chelone, Trionyx, Hemidactylus, Varanus, Chamaeleon, Ophiosaurus, Draco, Bungarus, Vipera, Naja, Hydrophis, Zamenis, Crocodylus
   Key for Identification of poisonous and non-poisonous snakes
6. **Aves**
   Study of six common birds from different orders.
7. **Mammalia**
   Bat (Insectivorous and Frugivorous), *Funambulus*
   Mount of weberian ossicles of *Mystus*

Classification from Young, J. Z. (2004) to be followed

SUGGESTED READINGS

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

- Pough H. *Vertebrate life,* VIII Edition, Pearson International.
- Darlington P.J. *The Geographical Distribution of Animals*, R.E. Krieger Pub Co.
- Hall B.K. and Hallgrimsson B. (2008). *Strickberger's Evolution.* IV Edition. Jones and Bartlett Publishers Inc.2015

C-6: ANIMAL PHYSIOLOGY: CONTROLLING AND COORDINATING SYSTEMS

THEORY (CREDITS 4)

Unit 1: Tissues **6 Lectures**

Structure, location, classification and functions of epithelial tissue, muscular tissue and nervous tissue

Unit 2: Bone and Cartilage **4**

Structure and types of bones and cartilages, Ossification

Unit 3: Nervous System **10**

Structure of neuron, resting membrane potential, Origin of action potential and its propagation across the myelinated and unmyelinated nerve fibers; Types of synapse, Synaptic transmission and, Neuromuscular junction; Reflex action and its types – reflex arc

Unit 4: Muscle **12**

Histology of different types of muscle; Ultra structure of skeletal muscle; Molecular and chemical basis of muscle contraction

Unit 5: Reproductive System **10**

Histology of testis and ovary; Physiology of male and female reproduction; Puberty

Unit 6: Endocrine System **18**

Histology of endocrine glands - pituitary, thyroid, pancreas,
adrenal; hormones secreted by them and their mechanism of action
Regulation of their secretion; Mode of hormone action, Hypothalamus (neuroendocrine gland) - principal nuclei involved in neuroendocrine control of anterior pituitary and endocrine system

PRACTICALS (CREDITS 2)

1. Study of permanent slides of Mammalian skin, Cartilage, Bone, Spinal cord, Nerve cell, Pituitary, Pancreas, Testis, Ovary, Adrenal, Thyroid and Parathyroid
2. Microtomy: Preparation of permanent slide of any five mammalian (Goat/white rat) tissues

(*Subject to UGC guidelines)

SUGGESTED BOOKS

- Guyton, A.C. & Hall, J.E. (2006). Textbook of Medical Physiology. XI Edition. Hercourt Asia PTE Ltd. /W.B. Saunders Company.
- Tortora, G.J. & Grabowski, S. (2006). Principles of Anatomy & Physiology. XI Edition John Wiley & sons
- Victor P. Eroschenko. (2008). diFiore's Atlas of Histology with Functionaln correlations. XII Edition. Lippincott W. & Wilkins.

C-7: FUNDAMENTALS OF BIOCHEMISTRY

THEORY (CREDITS 4)

Unit 1: Carbohydrates **8 Lectures**

Structure and Biological importance: Monosaccharides, Disaccharides, Polysaccharides

Unit 2: Lipids **8**

Structure and Significance: Physiologically important saturated and unsaturated fatty acids, Tri-acylglycerols, Phospholipids, Glycolipids

Unit 3: Proteins **14**

Amino acids: Structure, Classification and General properties of α-amino acids; Physiological importance of essential and non-essential α-amino acids

Proteins: Bonds stabilizing protein structure; Levels of organization in proteins;

Immunoglobulins: Basic Structure, Classes and Function

Unit 4: Nucleic Acids **12**

Structure: Purines and pyrimidines, Nucleosides, Nucleotides, Nucleic acids

Base pairing, Denaturation and Renaturation of DNA, Types of DNA and RNA

Unit 5: Enzymes **18**

Nomenclature and classification; Cofactors; Isozymes;

Mechanism of enzyme action; Enzyme kinetics; Factors affecting rate of enzyme -catalyzed reactions; Derivation of Michaelis-Menten equation, Enzyme inhibition; Allosteric enzymes and their kinetics; Regulation of enzyme action

PRACTICAL (CREDITS 2)

1. Qualitative tests of functional groups in carbohydrates, proteins and lipids.
2. Paper chromatography of amino acids.
3. Action of salivary amylase under optimum conditions.

SUGGESTED READING

- Cox, M.M and Nelson, D.L. (2008). *Lehninger's Principles of Biochemistry*, V Edition, W.H. Freeman and Co., New York.
- Berg, J.M., Tymoczko, J.L. and Stryer, L. (2007). *Biochemistry*, VI Edition, W.H. Freeman and Co., New York.
- 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.
- Hames, B.D. and Hooper, N.M. (2000). *Instant Notes in Biochemistry*, II Edition, BIOS Scientific Publishers Ltd., U.K.
- 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.

SEC-1: SERICULTURE

THEORY **(CREDITS 2)**

Unit 1: Introduction **(3 Lectures)**

Sericulture: Definition, history and present status
Types of silkworms, Distribution and Races
Mulberry and non-mulberry Sericulture

Unit 2: Biology of Silkworm **(3)**

Life cycle of *Bombyx mori*
Structure of silk gland and secretion of silk

Unit 3: Rearing of Silkworms **(13)**

Rearing house and rearing appliances
Disinfectants: Formalin, bleaching powder, RKO
Silkworm rearing technology: Early age and Late age rearing
Spinning, harvesting and storage of cocoons

Unit 4: Pests and Diseases **(4)**

Pests of silkworm: vertebrates
Pathogenesis of silkworm diseases: Protozoan, viral, fungal and bacterial
Control and prevention of pests and diseases

Unit 5: Entrepreneurship in Sericulture **(2)**

Prospectus of Sericulture in India: employment,
potential in mulberry and non-mulberry sericulture.

SUGGESTED READINGS

- 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.

GE-3: ANIMAL CELL BIOTECHNOLOGY

THEORY (CREDITS 4)

UNIT 1: Introduction **5 Lectures**

Concept and Scope of Biotechnology

UNIT2: Techniques in Gene manipulation **15**

Outline process of genetic engineering and recombinant DNA technology, Isolation of genes, Concept of restriction and modification: Restriction endonucleases, DNA modifying enzymes;
Cloning Vectors: Plasmids, Phage vectors, Cosmids
Construction of Genomic libraries and cDNA
Libraries; Transformation techniques: microbial, Cloning in
Mammalian cells, Integration of DNA into mammalian genome- Electroporation

UNIT 3: Animal cell Culture **12**

Basic techniques in animal cell culture and organ culture, Primary Culture and Cell lines, Culture media- Natural and Synthetic, Cryopreservation of cultures.
Agarose and Polyacrylamide Gel Electrophoresis, Southern, Northern and Western blotting, Polymerase chain reaction

UNIT 4: Fermentation **8**

Different types of Fermentation: Submerged & Solid state; batch, Fed batch & Continuous.
Downstream Processing: Filtration, centrifugation, extraction, chromatography

UNIT 5: Transgenic Animal Technology

Production of transgenic animals: nuclear transplantation, Retroviral method, DNA microinjection method

UNIT6: Application in Health **8**

Development of recombinant Vaccines, Hybridoma technology, Gene Therapy.

UNIT 7: Bio safety Physical and Biological containment **4**

PRACTICAL (CREDITS 2)

1. Packing and sterilization of glass and plastic wares for cell culture.
2. Preparation of culture media.
3. Preparation of genomic DNA from *E. coli*/animals/ human.
4. Techniques: Western Blot, Southern Hybridization

SUGGESTED READINGS

- Animal Cells Culture and Media, D.C. Darling and S.J. Morgan, 1994. BIOS Scientific Publishers Limited.
- Methods in Cell Biology, Volume 57, Jennie P. Mathur and David Barnes,1998. Animal Cell Culture Methods Academic Press.
- P.K. Gupta: Biotechnology and Genomics, Rastogi publishers (2003).
- B.D. Singh: Biotechnology, Kalyani publishers, 1998 (Reprint 2001).
- T.A. Brown: Gene cloning and DNA analysis: An Introduction, Blackwell Science (2001).
- Bernard R. Click & Jack J. Pasternak: Molecular Biotechnology, ASM Press, Washington (1998).
- Methods in Gene Biotechnology, W. Wu, M.J. Welsh, P.B. Kaufman & H.H. Zhang, 1997, CRC Press, New York
- 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 & Co., N.Y., USA

5TH SEMESTER SYLLABUS (HONOURS)

SEM-V						
Paper Code	**Course**	**Credit**	**Credit Distribution (L+T+P)**	**End Sem Marks**	**Internal Marks**	**Total Marks**
ZOO-501H	C-11: Molecular Biology	6	4+0+2	60(Theo)+20(Pract)	20	100
ZOO-502H	C-12: Principles of Genetics	6	4+0+2	60(Theo)+20(Pract)	20	100
ZOO-D1HR	DSE-1: Immunology	6	4+0+2	60(Theo)+20(Pract)	20	100
ZOO-D2HR	DSE-2: Animal Bio-technology	6	4+0+2	60(Theo)+20(Pract)	20	100
Total		**24**	**24**	**320**	**80**	**400**

C-11: MOLECULAR BIOLOGY

THEORY (CREDITS 4)

Unit 1: Nucleic Acids **4 Lectures**

Salient features of DNA and RNA
Watson and Crick model of DNA

Unit 2: DNA Replication **12**

DNA Replication in prokaryotes and eukaryotes, mechanism of DNA replication, Semi-conservative, bidirectional and semi-discontinuous replication

Unit 3: Transcription **10**

RNA polymerase and transcription Unit, mechanism of transcription in prokaryotes and eukaryotes

Unit 4: Translation **12**

Genetic code, Degeneracy of the genetic code and Wobble Hypothesis; Process of protein synthesis in prokaryotes: Ribosome structure and assembly in prokaryotes, aminoacyl tRNA synthetases and charging of tRNA; Proteins involved in initiation, elongation and termination of polypeptide chain

Unit 5: Post Transcriptional Modifications and Processing of Eukaryotic RNA **6**

Structure of globin mRNA; Split genes: concept of introns and exons, splicing mechanism

Unit 6: Gene Regulation **10**

Transcription regulation in prokaryotes: Principles of transcriptional regulation with examples from *lac* operon and *trp* operon; Transcription regulation in eukaryotes:

Unit 7: DNA Repair Mechanisms **3**

Pyrimidine dimerization and mismatch repair

Unit 8: Regulatory RNAs **3**

Ribo-switches, RNA interference, miRNA, siRNA

PRACTICAL (CREDITS 2)

1. Study of Polytene chromosomes from Chironomous / Drosophila larvae
2. Preparation of solid culture medium (LB) and growth of *E. coli* by spreading and streaking
3. Demonstration of antibiotic sensitivity/resistance of *E. coli* to antibiotic pressure and interpretation of results
4. Quantitative estimation of salmon sperm/calf thymus DNA using colorimeter (Diphenylamine reagent) or spectrophotometer (A260 measurement)
5. Quantitative estimation of RNA using Orcinol reaction
6. Study and interpretation of electron micrographs/ photograph showing
    a) DNA replication
    b) Transcription
    c) Split genes

SUGGESTED READINGS

- Becker, W.M., Kleinsmith, L.J., Hardin. J. and Bertoni, G. P. (2009). *The World of the Cell.* VII Edition. Pearson Benjamin Cummings Publishing, San Francisco.
- Bruce Alberts, Alexander Johnson, Julian Lewis, Martin Raff, Keith Roberts,
- Peter Walter: *Molecular Biology of the Cell*, IV Edition.
- Cooper G. M. and Robert E. Hausman R. E. *The Cell: A Molecular Approach***,** V Edition, ASM Press and Sinauer Associates.
- De Robertis, E.D.P. and De Robertis, E.M.F. (2006). *Cell and Molecular Biology*. VIII Edition. Lippincott Williams and Wilkins, Philadelphia.
- Karp, G. (2010) *Cell and Molecular Biology: Concepts and Experiments.* VI Edition. John Wiley and Sons. Inc.
- Lewin B. (2008). *Gene XI*, Jones and Bartlett
- McLennan A., Bates A., Turner, P. and White M. (2015). *Molecular Biology* IV Edition. GS, Taylor and Francis Group, New York and London.

C-12: PRINCIPLES OF GENETICS

THEORY (CREDITS 4)

Unit 1: Mendelian Genetics and its Extension 8 Lectures

Incomplete dominance and co-dominance, Multiple alleles, Lethal alleles, Epistasis, Pleiotropy, Sex-linked, sex-influenced and sex-limite.

Unit 2: Linkage, Crossing Over and Chromosomal Mapping 12

Linkage and crossing over, Cytological basis of crossing over, Recombination frequency as a measure of linkage intensity, Two factor and three factor crosses, Interference and coincidence, Somatic cell hybridization.

Unit 3: Mutations 10

Types of gene mutations (Classification), Types of chromosomal aberrations (Classification, figures and with one suitable example of each), Molecular basis of mutations in relation to UV light and chemical mutagens

Unit 4: Sex Determination 4

Chromosomal mechanisms of sex determination in Drosophila and Man

Unit 5: Extra-chromosomal Inheritance 6

Criteria for extra-chromosomal inheritance, Infective heredity in *Paramecium* and Maternal effects

Unit 6: Polygenic Inheritance 3

Polygenic inheritance with suitable examples; simple numericals based on it.

Unit 7: Recombination in Bacteria and Viruses 9

Conjugation, Transformation, Transduction, Complementation test in Bacteriophage

Unit 8: Transposable Genetic Elements 8

Transposons in bacteria, P elements in *Drosophila,*
Transposons in humans

PRACTICALS (CREDITS 2)

1. To study the Mendelian laws and gene interactions.
2. Chi-square analyses using seeds/beads/*Drosophila*.
3. Linkage maps based on data from conjugation, transformation and transduction.
4. Linkage maps based on data from *Drosophila* crosses.
5. Study of human karyotype (normal and abnormal).
6. Pedigree analysis of some human inherited traits.

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
- Russell, P. J. (2009). *Genetics- A Molecular Approach.*III Edition. Benjamin Cummings
- Griffiths, A.J.F., Wessler, S.R., Lewontin, R.C. and Carroll, S.B. *Introduction to Genetic Analysis.* IX Edition. W. H. Freeman and Co
- Fletcher H. and Hickey I. (2015). *Genetics.* IV Edition. GS, Taylor and Francis Group, New York and London.

DSE- 1: IMMUNOLOGY

THEORY (CREDITS 4)

Unit 1: Overview of Immune System **10 Lectures**

Historical perspective of Immunology, Cells and organs of the Immune system

Unit 2: Innate and Adaptive Immunity **10**

Anatomical barriers, Inflammation, Cell and molecules involved in innate immunity, Adaptive immunity (Cell mediated and humoral), Passive: natural Immunity, Active: natural Immunity

Unit 3: Antigens **8**

Antigenicity and immunogenicity, Immunogens, Factors influencing immunogenicity

Unit 4: Immunoglobulins **10**

Structure and functions of different classes of immunoglobulins, Antigenantibody interactions, Immunoassays (ELISA)

Unit 5: Major Histocompatibility Complex **6**

Structure and functions of MHC molecules. Endogenous and exogenous pathways of antigen processing and presentation

Unit 6: Cytokines **4**

Properties and functions of cytokines

Unit 7: Complement System **4**

Components and pathways of complement activation.

Unit 8: Hypersensitivity **3**

brief description of various types of hypersensitivities

Unit 9: Vaccines **5**

Various types of vaccines.

PRACTICAL (CREDITS 2)

1. Histological study of spleen, thymus and lymph nodes through slides/ photographs
2. Preparation of stained blood film to study various types of blood cells.
3. Ouchterlony's double immuno-diffusion method.
4. ABO blood group determination.
5. Demonstration of :
   a) ELISA
   b) Immunoelectrophoresis

* The experiments can be performed depending upon usage of animals in UG courses.

SUGGESTED READINGS

- 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-2: ANIMAL BIOTECHNOLOGY

THEORY (CREDITS 4)

Unit 1. Introduction **8 Lectures**

Concept and scope of biotechnology

Unit 2. Molecular Techniques in Gene manipulation **24**

Cloning vectors: Plasmids, Cosmids, Lambda Bacteriophage
Restriction enzymes: Nomenclature, detailed study of Type II.
Transformation techniques: electroporation.
Construction of genomic; Southern, and Western blotting
DNA sequencing: Polymerase Chain Reaction, DNA Finger Printing

Unit 3. Genetically Modified Organisms **18**

Production of cloned and transgenic animals: Retroviral
Method, DNA microinjection, knock out mice.
Applications of transgenic plants: insect and herbicide resistant plants.

Unit 4. Culture Techniques and Applications **10**

Animal cell culture, Expressing cloned genes in mammalian cells, Recombinant DNA in medicines: Recombinant insulin

PRACTICAL (CREDITS 2)

1. Construction of circular and linear restriction map from the data provided.
2. Calculation of transformation efficiency from the data provided.
3. To study following techniques through photographs
   a) Southern Blotting
   b) Western Blotting
   c) PCR
   d) DNA fingerprinting
4. Project report on animal cell culture

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.
- Snustad, D.P. and Simmons, M.J. (2009). *Principles of Genetics.* V Edition, John Wiley and Sons Inc.