Gauhati University

Syllabus for B.Sc.(Honors)

ZOOLOGY

Choice Based Credit System (CBCS)

Course effective from academic year 2019-20

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Gauhati University

Guwahati::Assam

Contents

Preamble

The choice based credit system is naturally the next logical step in a credit based semester system. This makes the system the more learner-centric. A CBCS offers the student a diversity of courses to choose from and the autonomy to decide on the place, pace and the time of learning.

The Gauhati University has decided to introduce the CBCS system at the under graduate level from the session 2019-20. The CBCS syllabus for the B.Sc. (Honours) is prepared in the model of syllabus prepared by theUGC.

A student opting for honors course in ZOOLOGY must have and passed the BIOLOGY as a subject in the Senior Secondary level examination.

Course Structure	
Course	***Credits** Theory+ Practical
I. Core Course **(14 Papers)** **Core Course Practical / Tutorial*** **(14 Papers)**	14×4= 56 14×2= 28
II. Elective **Course (8 Papers)** **A.1.** Discipline Specific Elective **(4Papers)** **A.2.** Discipline Specific Elective Practical/Tutorial***(4Papers)**	4×4=16 4×2=8
B.1. Generic Elective/ Interdisciplinary **(4 Papers)** B.2. Generic Elective Practical/ Tutorial* **(4 Papers)**	4×4=16 4×2=8
III. Ability Enhancement Courses 1. **Ability Enhancement** **Compulsory (2 Papers of 2 credit** **each)** Environmental Studies English/MIL Communication 2. **Ability Enhancement** **Elective**(SkillBased) (Minimum2) **(2 Papers of 2 credit each)**	2×4=8 2×4=8
Total	**148**

***Core and DSE courses without practicals will have tutorial and have credit distribution of: 5credits for theory and 1credit for tutorial, total6credits,sameasthe papers with practical**

Structure of BSc Honours(ZOOLOGY) Programme

Semester	Type / Credits	Core 14 × 6 = 84	AECC 2 × 4 = 8	SEC 2 × 4 = 8	DSE 4 × 6 = 24	GEN 4 × 6 = 24
I		ZOO-HC-1016 ZOO-HC-1026	ENG-AE-1014			XXX-HG-1XX6
II		ZOO-HC-2016 ZOO-HC-2026	ENV-AE-2014			XXX-HG-2XX6
III		ZOO-HC-3016 ZOO-HC-3026 ZOO-HC-3036		ZOO-SE-3YY4†		XXX-HG- 3XX6
IV		ZOO-HC-4016 ZOO-HC-4026 ZOO-HC-4036		ZOO-SE-4YY4†		XXX-HG- 4XX6
V		ZOO-HC-5016 ZOO-HC-5026			ZOO-HE-5YY6‡ ZOO-HE-5YY6‡	
VI		ZOO-HC-6016 ZOO-HC-6016			ZOO-HE-6YY6‡ ZOO-HE-6YY6‡	

SCHEME FOR CHOICE BASED CREDIT SYSTEM IN B. Sc. Honours (ZOOLOGY)

SEMESTER	COURSE CODE	COURSE NAME	Credits
I	ENG-AE-1014	English Communications	4
	ZOO-HC-1016	Non Chordates I: Protista to Pseudocoelomates	4+2=6
		NON Chordates-I Lab	
	ZOO-HC-1026	Principles of Ecology	4+2=6
		Principles of Ecology Lab	
	AAA-HG-1YY6	GE-1	4/5
		Generic Elective 1 Practical/Tutorial	2/1
		Total Credits in Semester I	22
II	Ability Enhancement Compulsory Course-II**	Environmental Studies	4
	ZOO-HC-2016	Non Chordates-II: Coelomate	4+2=6
		NON Chordates-II Lab	
	ZOO-HC-2026	Cell Biology	4+2=6
		Cell Biology Lab	
	AAA-HG-2YY6*	GE-2	4/5
		Generic Elective 2 Practical/Tutorial	2/1
		Total Credits in Semester II	22
III	ZOO-HC-3016	Diversity of Chordates	4+2=6
		Diversity of Chordates Lab	
	ZOO-HC-3026	Physiology: Controlling and Coordinating Systems	4+2=6
		Physiology Controlling and Coordinating Systems Lab	
	ZOO-HC-3036	Fundamental of Biochemistry	4+2=6
		Fundamental of Biochemistry Lab	
	ZOO-SE-3YY4†	SEC-1	4
	AAA-HG-3YY6*	GE-3	4/5

		Generic Elective 3 Practical/Tutorial	2/1
Total Credits in Semester III			**28**
IV	ZOO-HC-4016	Comparative anatomy of Vertebrate	4+2=6
		Comparative Anatomy of Vertebrate Lab	
	ZOO-HC-4026	Physiology Life Sustaining systems	4+2=6
		Physiology Life Sustaining systems Lab	
	ZOO-HC-4036	Biochemistry of Metabolic process	4+2=6
		Biochemistry of Metabolic Process Lab	
	ZOO-SE-4YY4†	SEC -2	4
	AAA-HG-4YY 6*	GE-4	4/5
		Generic Elective Practical/tutorial	2/1
Total Credits in Semester IV			**28**
V	ZOO-HC-5016	Molecular Biology	4+2=6
		Molecular Biology Lab	
	ZOO-HC-5026	Principles of Genetics	4+2=6
		Principles of genetics Lab	
	ZOO-HE-5YY6‡	DSE-1	4+2=6
		DSE-1 Lab	
	ZOO-HE-5YY6‡	DSE-2	4+2=6
		DSE-2 Lab	
Total Credits in Semester V			**24**
VI	ZOO-HC-6016	Developmental Biology	4+2=6
		Developmental Biology Lab	
	ZOO-HC-6026	Evolutionary Biology	4+2=6
		Evolutionary Biology Lab	
	ZOO-HE-6YY6‡	DSE-3	4+2=6
		DSE-3 Lab	
	ZOO-HE-6YY6‡	DSE-4	4+2=6

	DSE-4 Lab	
Total Credits in Semester VI		**24**
Grand Total Credits		**148**

Generic Electives (Other Discipline) - GE 1 to GE 4

1. Botany (4) + Lab(4)
2. Chemistry (4)+ Lab (4)
3. Anthropology (4)+ Lab (4)
4. Geography (4)+ Lab (4)
5. Geology (4)+ Lab (4)
6. Biotechnology (4)+ Lab (4)
7. Computer Science (4)+Lab (4)
8. STATISTICS (4)+ Lab (2)
9. MATHEMATICS
10. MICROBIOLOGY (4)+ Lab (2)
11. PHYSICS (4)+ Lab (2)

a)Generic Electives(GE) are to be taken preferably from Botany and Chemistry disciplines.
b) Students can choose minimum of two GE papers from different disciplines.

‡ Discipline Specific Elective Papers: (Credit: 06 each) (4 papers to be selected)-
DSE for Semester V DSE-1 (Any One from the following)

1. **ZOO-HE-5016:** Computational Biology and Biostatistics (4) + Lab(2) (Compulsory)

DSE-2(Any One from the following)

2. **ZOO-HE-5026:** Animal biotechnology (4) + Lab(2)
3. **ZOO-HE-5036:** Endocrinology (4) + Lab(2)
4. **ZOO-HE-5046:** Parasitiology (4) + Lab(2)

DSE for Semester VI

DSE-3(Any One from the following)

5. **ZOO-HE-6016:** Biology of Insect (4) + Lab(2)
6. **ZOO-HE-6026:** FISH and Fisheries (4) + Lab(2)

DSE-4 (Any One from the following)

7. **ZOO-HE-6046:** Reproductive Biology (4) + Lab(2)
8. **ZOO-HE-6056:**Wildlife Conservation and Management (4)+ Lab (2)
9. **ZOO-HE-6066**: Dissertation in any Zoology Specific Subject (6)

†Skill Enhancement Courses (04papers)(Credit:04each)

SEC for SemesterIII

Any One from the following

1. **ZOO-SE-3014:** Ornamental fish and Fisheies
2. **ZOO-SE-3024:** Apiculture

SEC for Semester IV

Any One from the following

3. **ZOO-SE-4014:** Non Mulberry sericuture
4. **ZOO-SE-4024:** Wildlife Photography and Ecotourism
5. **ZOO-**SE-4034: Research Methodology

****Ability Enhancement Compulsory Courses (02 papers) (Credit: 04 each)**

AECC for Semester I

1. **ENG-AE-1014: English Communications**

AECC for Semester II

2. **ENV-AE-2014: Environmental Science**

CORE COURSE I

CODE: ZOO-HC-1016

NON-CHORDATES I: PROTISTS TO PSEUDOCOELOMATES

THEORY **(Credits 4)**

Unit 1: Protista, Parazoa and Metazoa **19**

General characteristics and Classification upto classes Study of *Euglena*, *Amoeba* and *Paramecium*

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

Locomotion and Reproduction in Protista

Evolution of symmetry and segmentation of Metazoa

Unit 2: Porifera **7**

General characteristics and Classification upto classes Canal system and spicules in sponges

Unit 3: Cnidaria **12**

General characteristics and Classification upto classes Metagenesis in *Obelia*

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* and *Taeniasolium*

Unit 6: Nemathelminthes **8**

General characteristics and Classification up to classes

Lifecycle, and pathogenicity of *Ascaris lumbricoides* and *Wuchereri abancrofti*

Parasitic adaptations in helminthes

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

NON-CHORDATES I: PROTISTS TO PSEUDOCOELOMATES

PRACTICALS **(Credits 2)**

1. Study of whole mount of *Euglena, Amoeba* and *Paramecium,* Binary fission and Conjugation in *Paramecium*
2. Examinationofpondwatercollectedfromdifferentplacesfordiversityinprotista
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 anyctenophore
6. Study of adult *Fasciola hepatica, Taenia solium* and their life cycles (Slides/micro- photographs)
7. Study of adult *Ascaris lumbricoides* and its life stages(Slides/micro-photographs)
8. To submit a Project Report on any related topic on life cycles.

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

CORE COURSE II

CODE: ZOO-HC-1026

PRINCIPLES OF ECOLOGY

THEORY **(Credits 4)**

Unit 1: Introduction to Ecology **6**

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

Unit2:Population **24**

Unitary and Modular populations

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, Gause's Principle with laboratory and field examples, Lotka-Volterra equation for competition and Predation, functional and numerical responses

Unit3:Community **12**

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

Theories pertaining to climax community

Unit4: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 Human modified ecosystem

Unit 5:Applied Ecology **4**

Ecology in Wildlife Conservation and Management

PRINCIPLES OF ECOLOGY

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 methodandcalculationofShannon-Weinerdiversityindexforthesamecommunity
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'smethod).
4. Report on a visit to National Park/Biodiversity Park/Wild life sanctuary

SUGGESTED READINGS

- Colinvaux,P.A.(1993).Ecology.IIEdition.Wiley,JohnandSons,Inc.
- Krebs, C. J. (2001). Ecology. VI Edition. BenjaminCummings.
- Odum,E.P.,(2008).FundamentalsofEcology.IndianEdition.Brooks/Cole
- RobertLeoSmithEcologyandfieldbiologyHarperandRowpublisher
- Ricklefs, R.E., (2000). Ecology. V Edition. ChironPres

CORE COURSE III
CODE: ZOO-HC-2016
NON-CHORDATES II: COELOMATES

THEORY **(Credits 4)**

Unit 1: Introduction to Coelomates **2**

Evolution of coelom and metamerism

Unit 2: Annelida **10**

General characteristics and Classification upto classes Excretion in Annelida

Unit 3: Arthropoda **17**

General characteristics and Classification upto classes Vision and Respiration in Arthropoda
Metamorphosis in Insects
Social life in bees and termites

Unit 4: Onychophora **4**

General characteristics and Evolutionary significance

Unit 5: Mollusca

General characteristics and Classification upto classes Respiration in Mollusca Torsion and detorsion in Gastropoda Pearl formation in bivalves Evolutionary significance of trochophore larva

Unit 6: Echinodermata **12**

General characteristics and Classification upto classes Water-vascular system in Asteroidea Larval forms in Echinodermata
Affinities with Chordates

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

NON-CHORDATES II: COELOMATES

PRACTICAL **(Credits 2)**

1. Study of followingspecimens:

Annelids-*Aphrodite, Nereis, Heteronereis ,Sabella, Serpula, Chaetopterus, Pheretima, Hirudinaria*

Arthropods - *Limulus*, *Palamnaeus, Palaemon, Daphnia, Balanus, Sacculina, Cancer*, *Eupagurus*, *Scolopendra*, *Julus, Bombyx, Periplaneta,* termites and honey bees Onychophora - *Peripatus*

Molluscs - *Chiton, Dentalium*, *Pila*, *Doris, Helix, Unio, Ostrea*, *Pinctada, Sepia, Octopus, Nautilus*

Echinodermates - *Pentaceros*/*Asterias, Ophiura, Clypeaster*, *Echinus, Cucumaria*and *Antedon*

2. Studyofdigestivesystem,septalnephridiaandpharyngealnephridiaofearthworm
3. T.S. through pharynx, gizzard, and typhlosolar intestine ofearthworm
4. Mount of mouth parts and dissection of digestive system and nervous systemof *Periplaneta**
5. To submit a Project Report on any related topic to larval forms (crustacean, mollusc andechinoderm)

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

SUGGESTED READINGS

- Ruppert and Barnes, R.D. (2006). *Invertebrate Zoology*, VIII Edition. Holt Saunders InternationalEdition
- Barnes,R.S.K.,Calow,P.,Olive,P.J.W.,Golding,D.W.andSpicer,J.I.(2002). *TheInvertebrates: A New Synthesis,* III Edition, Blackwell Science
- Barrington, E.J.W. (1979). *Invertebrate Structure and Functions*. II Edition, E.L.B.S. andNelson

CORE COURSE IV

CODE: ZOO-HC-2026

CELL BIOLOGY

THEORY **(Credits4)**

Unit 1: Over view of Cells **3**

Prokaryotic and Eukaryotic cells, Virus, Viroids, Mycoplasma, Prions

Unit 2:Plasma Membrane **7**

Various models of plasma membrane structure
Transportacrossmembranes:ActiveandPassivetransport,Facilitatedtransport Cell junctions: Tight junctions, Desmosomes, Gapjunctions

Unit 3:Endomembrane System **10**

Structure and Functions: Endoplasmic Reticulum, Golgi Apparatus, Lysosomes

Unit 4: Mitochondria and Peroxisomes **8**

Mitochondria:Structure,Semi-autonomousnature,Endosymbiotichypothesis Mitochondrial Respiratory Chain, Chemi-osmotichypothesis
Peroxisomes

Unit5:Cytoskeleton **8**

Structure and Functions: Microtubules, Microfilaments and Intermediate filaments

Unit6:Nucleus **12**

Structure of Nucleus: Nuclearenvelope, Nuclear pore complex, Nucleolus Chromatin: Euchromatin and Hetrochromatin and packaging(nucleosome)

Unit 7:Cell Division **8**

Mitosis, Meiosis, Cell cycle and its regulation

Unit 8:Cell Signaling **4**

GPCR and Role of second messenger (cAMP)

PRACTICAL **(Credits 2)**

1. Preparation of temporary stained squash of onion root tip to study various stages of mitosis
2. Study of various stages of meiosis.
3. Preparation of permanent slide to show the presence of Barrbody in human female blood cells/cheek cells.
4. Preparation of permanent slide to demonstrate: iDNA by Feulgen reaction

ii Mucopolysaccharides by PAS reaction

iii Proteins by Mercuro bromophenol blue/FastGreen

SUGGESTED READINGS

- Karp, G. (2010). *Cell and Molecular Biology: Concepts and Experiments*. VI Edition. John Wiley and Sons.Inc.
- De Robertis, E.D.P. and De Robertis, E.M.F. (2006). *Cell and Molecular Biology*. VIII Edition. Lippincott Williams and Wilkins,Philadelphia.
- Cooper, G.M. and Hausman, R.E. (2009). *The Cell: A Molecular Approach*. V Edition. ASMPressandSunderland,Washington,D.C.;SinauerAssociates,MA.
- Becker, W.M., Kleinsmith, L.J., Hardin. J. and Bertoni, G. P. (2009). *The World of the Cell*.VIIEdition. Pearson Benjamin Cummings Publishing, SanFrancisco.
- Bruce Albert, Bray Dennis, Levis Julian, Raff Martin, Roberts Keith and Watson James (2008).*MolecularBiology of the Cell*,VEdition,GarlandpublishingInc.,NewYorkand London.

CORE COURSE V

DIVERSITY OF

CHORDATA

CODE: ZOO-HC-3016

THEORY **(Credits 4)**

Unit 1: Introduction to Chordates **2**

General characteristics and outline classification

Unit2:Protochordata **8**

General characteristics of Hemichordata, Urochordata and Cephalochordata; Study of larval forms in protochordates*;* Retrogressive metamorphosis in Urochordata

Unit 3: Origin of Chordata **3**

Dipleurula concept and the Echinoderm theory of origin of chordates Advanced features of vertebrates over Protochordata

Unit4:Agnatha **2**

General characteristics and classification of cyclostomes up to class

Unit5:Pisces **8**

GeneralcharacteristicsofChondrichthyesandOsteichthyes,classificationupto order Migration, Osmoregulation and Parental care infishes

Unit6:Amphibia **6**

Origin of terrestrial *Tetrapoda* (Evolution of ectotherms); General characteristics and classification upto order; Parental care in Amphibians

Unit7:Reptilia **7**

General characteristics and classification up to order; Affinities of *Sphenodon*; Poison apparatus and Biting mechanism in snakes

Unit8:Aves **8**

General characteristics and classification up to order *Archaeopteryx*-- a connecting link; Principles and aerodynamics of flight, Flight adaptations and Migration in birds

Unit9:Mammals **8**

General characters and classification up to order; Affinities of Prototheria; Adaptive radiation with reference to locomotory appendages

Unit10:Zoogeography **8**

Zoo geographical realms, Theories pertaining to distribution of animals, Plate tectonic and Continental drift theory, distribution of vertebrates in different realms

DIVERSITY OF CHORDATA

PRACTICAL **(Credits 2)**

1. **Protochordata**

Balanoglossus, Herdmania, Branchiostoma, Colonial Urochordata Sections of *Balanoglossus* through proboscis and branchio genital regions, Sections of *Amphioxus* through pharyngeal, intestinal and caudal regions.Permanent slide of *Herdmania* spicules

2. **Agnatha**

Petromyzon, Myxine

3. **Fishes**

Scoliodon, Sphyrna, Pristis, Torpedo, Chimaera, Mystus, Heteropneustes, Labeo, Exocoetus, Echeneis, Anguilla, Hippocampus, Tetrodon/ Diodon, Anabas, Flat fish

4. **Amphibia**

Ichthyophis/Ureotyphlus, Necturus, Bufo, Hyla, Alytes, Salamandra

5. **Reptilia**

Chelone, Trionyx, Hemidactylus, Varanus, Uromastix, Chamaeleon, Ophiosaurus, Draco, Bungarus, Vipera, Naja, Hydrophis, Zamenis, Crocodylus Key for Identification of poisonous and non-poisonoussnakes

6. **Aves**

Study of six common birds from different orders. Types of beaks and claws

7. **Mammalia**

Sorex, Bat (Insectivorous and Frugivorous), *Funambulus, Loris, Herpestes, Erinaceous.*

Mount of weberian ossicles of *fish*

Power point presentation on study of any two animals from two different classes by students (may be included if dissections not given permission)

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

SUGGESTED READINGS

- Young,J.Z.(2004).*TheLifeofVertebrates*.IIIEdition.Oxforduniversitypress.
- Pough H. *Vertebrate life,* VIII Edition, PearsonInternational.

- DarlingtonP.J.*TheGeographicalDistributionofAnimals*,R.E.KriegerPubCo.
- Hall B.K. and Hallgrimsson B. (2008). *Strickberger's Evolution*.

IV Edition. Jones and Bartlett PublishersInc.

CORE COURSE VI

ANIMAL PHYSIOLOGY: CONTROLLING AND COORDINATING SYSTEMS

CODE: ZOO-HC-3026

THEORY **(Credits 4)**

Unit 1: Tissues **6**

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

Unit 2: Bone and Cartilage **4**

Structure and types of bones and cartilages, Ossification, bone growth and resorption

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; Physiology of hearing and vision.

Unit 4: Muscle **12**

Histology of different types of muscle; Ultra structure of skeletal muscle; Molecular and chemical basis of muscle contraction; Characteristics of muscle twitch; Motor unit, summation and tetanus

Unit 5: Reproductive System **10**

Histology of testis and ovary; Physiology of male and female reproduction; Puberty, Methods of contraception in male and female

Unit 6: Endocrine System **18**

Histology of endocrine glands - pineal, pituitary, thyroid, parathyroid, pancreas, adrenal; hormones secreted by them and their mechanism of action; Classification of hormones; Regulation of their secretion; Mode of hormoneaction,Signaltransductionpathwaysforsteroidalandnon-steroidal hormones;Hypothalamus(neuroendocrinegland)-principalnucleiinvolved in neuro endocrine control of anterior pituitary and endocrines system;

Placental hormones

ANIMAL PHYSIOLOGY: CONTROLLING AND COORDINATING SYSTEMS

PRACTICALS **(Credits 2)**

*1. Demonstration of the unconditioned reflex action (Deep tendon reflex such as knee jerkreflex)

2. Preparationoftemporarymounts:Squamousepithelium,Striatedmusclefibres and nervecells

3. Study of permanent slides of Mammalian skin, Cartilage, Bone, Spinal cord, Nervecell,Pituitary,Pancreas,Testis,Ovary,Adrenal,ThyroidandParathyroid

4. Microtomy: Preparation of permanent slide of any five mammalian(Goat/ rat/mice)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 Functional correlations. XII Edition. Lippincott W. &Wilkins.

CORE COURSE VII

FUNDAMENTALS OF BIOCHEMISTRY

CODE: ZOO-HC-3036

THEORY **(CREDITS 4)**

Unit1:Carbohydrates **8**

Structure and Biological importance: Monosaccharides, Disaccharides, Polysaccharides and Glycoconjugates

Unit2:Lipids **8**

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

Unit3: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; Denaturation; Introduction to simple and conjugate proteins

Immunoglobulins: Basic Structure, Classes and Function, Antigenic Determinants

Unit 4:NucleicAcids **12**

Structure:Purines and pyrimidines,Nucleosides,Nucleotides,Nucleicacids CotCurves: Base pairing, Denaturation and Renaturation of DNA

Types of DNA and RNA, Complementarity of DNA, Hpyo- Hyperchromaticity of DNA

Unit5:Enzymes **18**

Nomenclature and classification; Cofactors; Specificity of enzyme action; Isozymes; Mechanism of enzyme action; Enzyme kinetics; Factors affecting rate of enzyme-catalyzed reactions; Derivation of Michaelis-Menten equation, Concept of Km and Vmax, Lineweaver-Burk plot; Multi-substrate reactions; Enzyme inhibition; Allosteric enzymes and their kinetics; Regulation of enzyme action

FUNDAMENTALS OF BIOCHEMISTRY

PRACTICAL **(CREDITS2)**

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.
4. Effect of pH, temperature on the action of salivary amylase.
5. Demonstration of proteins separation by SDS-PAGE.

SUGGESTED READING

- Cox, M.M and Nelson, D.L. (2008). *Lehninger's Principles of Biochemistry*, V Edition, W.H. Freeman and Co., NewYork.
- Berg,J.M.,Tymoczko,J.L.andStryer,L.(2007).*Biochemistry*,VIEdition, 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 CompaniesInc.
- 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, PearsonPub.

CORE COURSEVIII COMPARATIVE ANATOMY OF VERTEBRATES

CODE: ZOO-HC-4016

THEORY **(CREDITS 4)**

Unit 1:Integumentary System **8**

Structure, functions and derivatives of integument

Unit 2:Skeletal System **8**

Overview of axial and appendicular skeleton, Jaw suspensorium, Visceral arches

Unit 3:Digestive System **8**

Alimentary canal and associated glands, dentition

Unit 4:Respiratory System **8**

Skin, gills, lungs and air sacs; Accessory respiratory organs

Unit 5:Circulatory System **8**

General plan of circulation, evolution of heart and aortic arches

Unit 6:Urinogenital System **6**

Succession of kidney, Evolution of urinogenital ducts, Types of mammalian uteri

Unit 7:Nervous System **8**

Comparative account of brain
Autonomic nervous system, Spinal cord, Cranial nerves in mammals

Unit 8:Sense Organs **6**

Classification of receptors
Brief account of visual and auditory receptors in man

COMPARATIVE ANATOMY OFVERTEBRATES

PRACTICAL **(CREDITS2)**

1. Study of placoid, cycloid and ctenoid scales through permanent slides/photographs
2. Disarticulated skeleton of Frog, Fowl, Rabbit
3. Carapace and plastron of turtle/tortoise
4. Mammalian skulls: One herbivorous and one carnivorous animal
5. Study of structure of any two organs (heart, lung, kidney, eye and ear) from video recording (may be included if dissection not permitted)
6. Project on skeletal modifications in vertebrates (may be included if dissection not permitted)

SUGGESTED READINGS

- Kardong, K.V. (2005) *Vertebrates' Comparative Anatomy, Function and Evolution*. IV Edition. McGraw-Hill HigherEducation
- Kent, G.C. and Carr R.K. (2000). *Comparative Anatomy of the Vertebrates*. IX Edition. The McGraw-HillCompanies
- Hilderbrand, M and GaslowG.E. *Analysis of Vertebrate Structure*, John Wileyand Sons
- Walter,H.E.andSayles,L.P;*BiologyofVertebrates*,KhoslaPublishingHouse

CORE COURSE IX

ANIMAL PHYSIOLOGY: LIFE SUSTAINING SYSTEMS

CODE: ZOO-HC-4026

THEORY **(Credits 4)**

Unit 1: Physiologyof Digestion **14**

Structural organization and functions of gastrointestinal tract andassociated glands; Mechanical and chemical digestion of food; Absorptions of carbohydrates, lipids, proteins, water, minerals and vitamins; Hormonal control of secretion of enzymes in Gastrointestinaltract.

Unit 2: PhysiologyofRespiration **12**

Histology of trachea and lung; Mechanism of respiration, Pulmonary ventilation; Respiratory volumes and capacities; Transport of oxygen and carbon dioxide in blood; Respiratory pigments, Dissociation curves and the factors influencing it; Carbon monoxide poisoning; Control of respiration

Unit 3:Renal Physiology **8**

Structure of kidney and its functional unit; Mechanism of urine formation; Regulation of water balance; Regulation of acid-base balance

Unit4:Blood **14**

Components of blood and their functions; Structure and functions of haemoglobin

Haemostasis: Blood clotting system, Kallikrein-Kinninogen system, Complement system&Fibrinolytic system,Haemopoiesis

Blood groups: Rh factor, ABO and MN

Unit 5: PhysiologyofHeart **12**

Structure of mammalian heart; Coronary circulation; Structure and working of conducting myocardial fibers.Origin and conduction of cardiac impulses Cardiac cycle; Cardiac output and its regulation, Frank-Starling Law of the heart, nervous and chemical regulation of heart rate. Electrocardiogram, Blood pressure and its regulation

ANIMAL PHYSIOLOGY: LIFE SUSTAINING SYSTEMS

PRACTICALS **(CREDITS 2)**

1. Determination of ABO Blood group
2. Enumeration of red blood cells and white blood cells using haemocytometer
3. Estimation of haemoglobin using Sahli'shaemoglobinometer
4. Preparation of haemin crystals
5. Recording of blood pressure using a sphygmomanometer
6. Examinationofsectionsofmammalianoesophagus,stomach,duodenum,ileum, rectum liver, trachea, lung, kidney

(*Subject to UGC guidelines)

SUGGESTED READINGS

- Guyton,A.C.&Hall,J.E.(2006).TextbookofMedicalPhysiology.XIEdition. Hercourt Asia PTE Ltd. W.B. SaundersCompany.
- Tortora,G.J.&Grabowski,S.(2006).PrinciplesofAnatomy&Physiology.XI Edition John Wiley &sons,
- Victor P. Eroschenko. (2008). diFiore's Atlas of Histology with Functional correlations. XII Edition. Lippincott W. &Wilkins.
- VanderA,ShermanJ.andLucianoD.(2014).Vander'sHumanPhysiology:The Mechanism of Body Function. XIII Edition, McGrawHills

CORE COURSE X BIOCHEMISTRY OF METABOLIC PROCESSES

CODE: ZOO-HC-4036

THEORY **(CREDITS 4)**

Unit 1: Overview of Metabolism **10**

Catabolism *vs* Anabolism, Stages of catabolism, Compartmentalization of metabolic pathways, Shuttle systems and membrane transporters; ATP as "Energy Currency of cell"; coupled reactions; Use of reducing equivalents and cofactors; Intermediary metabolism and regulatory mechanisms

Unit 2:Carbohydrate Metabolism **16**

Sequence of reactions and regulation of glycolysis, Citric acid cycle, Phosphate pentose pathway, Gluconeogenesis, Glycogenolysis and Glycogenesis

Unit 3:Lipid Metabolism **14**

β-oxidation and omega-oxidation of saturated fatty acids with even and odd number of carbon atoms; Biosynthesis of palmiticacid; Ketogenesis

U**nit 4:Protein Metabolism** **10**

Catabolism of amino acids: Transamination, Deamination, Urea cycle; Fate of C-skeleton of Glucogenic and Ketogenic amino acids

Unit 5:OxidativePhosphorylation **10**

Redox systems; Review of mitochondrial respiratory chain, Inhibitors and un-couplers of Electron Transport System

BIOCHEMISTRY OF METABOLIC PROCESS

PRACTICALS **(CREDITS 2)**

1. Estimation of total protein in given solutions by Lowry'smethod.
2. Detection of SGOT and SGPT in serum/tissue
3. To study the enzymatic activity of Trypsin and Lipase.
4. Study of biological oxidation (SDH) [goatliver]
5. To perform the Acid and Alkaline phosphatase assay from serum/tissue.

SUGGESTED READINGS

- Cox, M.M and Nelson, D.L. (2008). *Lehninger Principles of Biochemistry*, V Edition, W.H. Freeman and Co., NewYork.
- Berg,J.M.,Tymoczko,J.L.andStryer,L.(2007).*Biochemistry*,VIEdition, W.H. Freeman and Co., New York.
- Murray, R.K., Bende*r, 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 CompaniesInc.
- Hames, B.D. and Hooper, N.M. (2000). *Instant Notes in Biochemistry*, II Edition, BIOS Scientific Publishers Ltd.,U.K.

CORE COURSE XI

MOLECULAR

BIOLOGY

CODE: ZOO-HC-5016

THEORY **(CREDITS 4)**

Unit 1:NucleicAcids **4**

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

Unit 2:DNAReplication **12**

DNA Replication in prokaryotes and eukaryotes, mechanism of DNA replication, Semi-conservative, bidirectional and semi-discontinuous replication, RNA priming, Replication of circular and linear *ds*-DNA, replication of telomeres

Unit3:Transcription **10**

RNA polymerase and transcription Unit, mechanism of transcription in prokaryotes and eukaryotes, synthesis of rRNA and mRNA, transcription factors

Unit4:Translation **12**

Geneticcode,DegeneracyofthegeneticcodeandWobbleHypothesis;Processof protein synthesis in prokaryotes: Ribosome structure and assembly in prokaryotes, fidelity of protein synthesis, aminoacyl tRNA synthetases and charging of tRNA; Proteins involved in initiation, elongation and termination of polypeptidechain;Inhibitorsofproteinsynthesis;Differencebetweenprokaryotic and eukaryotic translation

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

Structure of globin mRNA; Split genes: concept of introns and exons, splicing mechanism, alternative splicing, exon shuffling, and RNA editing, Processing of tRNA

Unit 6:GeneRegulation **10**

Transcription regulation in prokaryotes: Principles of transcriptional regulation with examples from *lac* operon and *trp*operon; Transcription regulation in eukaryotes: Activators, repressors, enhancers, silencer elements; Gene silencing, Genetic imprinting

Unit 7: DNA Repair Mechanisms **3**

Pyrimidine dimerization and mismatch repair

Unit 8: Regulatory RNAs **3**

Ribo-switches, RNA interference, miRNA, siRNA

MOLECULAR BIOLOGY

PRACTICAL **(CREDITS 2)**

1. Study of Polytene chromosomes from Chironomous / Drosophilalarvae
2. Preparation of liquid culture medium(LB)andraisecultureof*E.coli*
3. Estimation of the growth kinetics of *E. coli* by turbidity method
4. Quantitative estimation DNA using colorimeter (Diphenylamine reagent)
5. Quantitative estimation of RNA using Orcinolreaction
6. Study and interpretation of electron micrographs/ photographshowing
   (a) DNA replication
   (b) Transcription
   (c) Splitgenes

SUGGESTED READINGS

- Becker,W.M.,Kleinsmith,L.J.,Hardin.J.andBertoni,G.P.(2009).*TheWorld 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*, IVEdition.
- CooperG.M.andRobertE.HausmanR.E.*TheCell:AMolecularApproach***,**V Edition, ASM Press and SinauerAssociates.
- De Robertis, E.D.P. and De Robertis, E.M.F. (2006). *Cell and Molecular Biology*.VIIIEdition.LippincottWilliamsandWilkins,Philadelphia.
- Karp, G. (2010) *Cell and Molecular Biology: Concepts and Experiments*. VI Edition. John Wiley and Sons.Inc.
- Lewin B. (2008). *Gene XI*, Jones andBartlett
- McLennanA.,BatesA.,Turner,P.andWhiteM.(2015).*MolecularBiology*IV Edition.GS,TaylorandFrancisGroup,NewYorkandLondon.

CORE COURSE XII

PRINCIPLES OF

GENETICS

CODE: ZOO-HC-5026

THEORY **(CREDITS 4)**

Unit 1: Mendelian Genetics and its Extension **8**

Principles of inheritance, Incomplete dominance and co-dominance, Multiple alleles, Lethal alleles, Epistasis, Pleiotropy, Sex-linked, sex- influenced and sex-limited characters inheritance.

Unit 2: Linkage, Crossing Over and Chromosomal Mapping **12**

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

Unit3:Mutations **10**

Typesofgenemutations(Classification),Typesofchromosomalaberrations (Classification, figures and with one suitable example of each), Molecular basisofmutationsinrelationtoUVlightandchemicalmutagens;Detection of mutations: CLB method, attached *X* method.

Unit 4:SexDetermination **4**

Chromosomal mechanisms of sex determination in Drosophila and Man

Unit 5:Extra-chromosomalInheritance **6**

Criteria for extra-chromosomal inheritance, Antibiotic resistance in *Chlamydomonas*, Mitochondrial mutations in *Saccharomyces*, Infective heredity in *Paramecium* and Maternal effects

Unit 6:PolygenicInheritance **3**

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

Unit 7: Recombination in BacteriaandViruses **9**

Conjugation, Transformation, Transduction, Complementation test in Bacteriophage

Unit 8: TransposableGeneticElements **8**

Transposons in bacteria, Ac-Ds elements in maize and P elements in *Drosophila*, Transposons in humans

PRINCIPLES OF GENETICS

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. WileyIndia
- Snustad, D.P., Simmons, M.J. (2009). *Principles of Genetics*. V Edition. John Wiley and SonsInc
- Klug, W.S., Cummings, M.R., Spencer, C.A. (2012). *Concepts of Genetics*. X Edition. BenjaminCummings
- Russell, P. J. (2009). *Genetics- A Molecular Approach.*III Edition. BenjaminCummings
- 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 andLondon.

CORE COURSE XIII

DEVELOPMENTAL

BIOLOGY

CODE: ZOO-HC-6016

THEORY **(CREDITS 4)**

Unit1:Introduction **4**

Historical perspective and basic concepts: Phases of development, Cell-Cell interaction, Pattern formation, Differentiation and growth, Differentialgene expression, Cytoplasmic determinants and asymmetric cell division

Unit 2: Early Embryonic Development **28**

Gametogenesis, Spermatogenesis, Oogenesis; Types of eggs, Egg membranes; Fertilization (External and Internal): Changes in gametes, Blocks to 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 **8**

Fate of Germ Layers; Extra-embryonic membranes in birds; Implantation of embryo in humans, Placenta (Structure,types and functions of placenta)

Unit 4: PostEmbryonicDevelopment **12**

Metamorphosis: Changes, hormonal regulations in amphibians and insects; Regeneration: Modes of regeneration, epimorphosis, morphallaxis and compensatory regeneration (with one example each); Ageing: Concepts and Theories

Unit 5: Implications ofDevelopmentalBiology **8**

Teratogenesis: Teratogenic agents and their effects on embryonic development; *In vitro* fertilization, Stem cell (ESC), Amniocentesis

DEVELOPMENTAL BIOLOGY

PRACTICALS **(CREDITS 2)**

1. Study of whole mounts and sections of developmental stages of frog through permanent slides: Cleavage stages, blastula, gastrula, neurula, tail-bud stage, tadpole (external and internal gillstages)
2. Study of whole mounts of developmental stages of chick through permanent slides: Primitive streak (13 and 18 hours), 21, 24, 28, 33, 36, 48, 72, and 96 hours of incubation (Hamilton and Hamburgerstages)
3. Study of the developmental stages and life cycle of *Drosophila* from stock culture
4. Study of different sections of placenta (photomicropgraph/slides)
5. Project report on *Drosophila* culture/chick embryodevelopment

SUGGESTED READINGS

- Gilbert, S. F. (2010). Developmental Biology, IX Edition, Sinauer Associates, Inc., Publishers, Sunderland, Massachusetts,USA
- Balinsky B. I. and Fabian B. C. (1981). An Introduction to Embryology, V Edition, International Thompson ComputerPress
- Carlson, R. F. Patten's Foundations ofEmbryology
- Kalthoff (2008). Analysis of Biological Development, II Edition, McGraw-Hill Publishers
- LewisWolpert(2002).PrinciplesofDevelopment.IIEdition,Oxford University Press

CORE COURSE XIV

EVOLUTIONARY

BIOLOGY

CODE: ZOO-HC-6026

THEORY **(CREDITS 4)**

Unit1: **7**

Life'sBeginnings: Chemogeny, RNAworld, Biogeny, Origin of photosynthesis, Evolution of eukaryotes

Unit2: **4**

Historical review of evolutionary concept: Lamarckism, Darwinism, Neo-Darwinism

Unit3: **10**

Evidences of Evolution: Fossil record (types of fossils, transitional forms, geological time scale, evolution of horse, Molecular (universality of genetic code and protein synthesising machinery, three domains of life, neutral theory of molecular evolution, molecular clock ,example of globin gene family, rRNA/cyt c

Unit4: **8**

Sources of variations: Heritable variations and their role in evolution

Unit5: **13**

Population genetics: Hardy-Weinberg Law (statement and derivation of equation, application of law to human Population); Evolutionary forces upsetting H-W equilibrium;Naturalselection(conceptoffitness,selectioncoefficient,derivationof one unit of selection for a dominant allele, genetic load, mechanism of working, types of selection, density-dependent selection, heterozygous superiority, kin selection, adaptive resemblances, sexual selection. Genetic Drift (mechanism, founder's effect, bottleneck phenomenon;RoleofMigrationandMutationinchangingallelefrequencies

Unit6: **7**

Product of evolution: Micro evolutionary changes (inter-population variations, clines, races, Species concept, Isolating mechanisms, modes of speciation—allopatric, sympatric, Adaptive radiation / macroevolution (exemplified by Galapagos finches

Unit7: **2**

Extinctions,Backgroundandmassextinctions(causesandeffects),detailedexamp leof K-Textinction

Unit8: **6**

Origin and evolution of man, Unique hominin characteristics contrasted with primate characteristics, primate phylogeny from *Dryopithecus*leading to *Homo*

sapiens, molecular analysis of human origin

Unit9: 2

Phylogenetic trees, Multiple sequence alignment, construction of phylogenetic trees, interpretation of trees

EVOLUTIONARY BIOLOGY

PRACTICALS **(CREDITS2)**

1. Study of fossils from models/pictures
2. Study of homology and analogy from suitable pecimens
3. Study and verification of Hardy-Weinberg Law by chi square analysis
4. Graphicalrepresentationandinterpretationofdataofheight/weightofasample of 100 humans in relation to their age andsex.
5. Construction of phylogenetic trees with the help of bioinformatics tools(Clustal X, Phylip, NJ) and its interpretation.

SUGGESTED READINGS

- Ridley,M (2004) Evolution III Edition Blackwellpublishing
- Hall, B.K. and Hallgrimson, B (2008). Evolution IV Edition. Jones and Barlett Publishers.
- Campbell,N.A.andReeceJ.B(2011).Biology.IXEdition.Pearson, Benjamin, Cummings.
- Douglas, J. Futuyma (1997). Evolutionary Biology. SinauerAssociates.
- Snustad. S Principles ofGenetics.
- Pevsner, J (2009). Bioinformatics and Functional Genomics. II Edition Wiley- Blackwell

DISCIPLINE CENTRIC ELECTIVE COURSES

CODE: ZOO-HE-5016

COMPUTATIONAL BIOLOGY and BIOSTATICS

THEORY **(Credits 4)**

Unit 1: Introduction to Bioinformatics **5**

Importance, Goal, Scope; Genomics, Transcriptomics, Systems Biology, Functional Genomics, Metabolomics, Molecular Phylogeny; Applications and Limitations of Bioinformatics

Unit 2:BiologicalDatabases **10**

Introduction to biological databases; Primary, secondary and composite databases; Nucleic acid databases (GenBank, DDBJ, EMBL and NDB); Protein databases (PIR, SWISS-PROT, TrEMBL, PDB); Metabolic pathway database (KEGG, EcoCyc, and MetaCyc); Small molecule databases (PubChem, Drug Bank, ZINC, CSD)

Unit 3: Data Generation andDataRetrieval **14**

Generation of data (Gene sequencing, Protein sequencing, Mass spectrometry, Microarray), Sequence submission tools (BankIt, Sequin, Webin); Sequence file format (flat file, FASTA, GCG, EMBL, Clustal, Phylip, Swiss-Prot); Sequence annotation; Data retrieval systems (SRS, Entrez)

Unit 3: Basic Concepts of Sequence Alignment **14**

Scoring Matrices (PAM, BLOSUM), Methods of Alignment (Dot matrix, Dynamic Programming, BLAST and FASTA); Local and global alignment, pair wise and multiple sequence alignments; Similarity, identity and homology of sequences.

Unit 4: Applications of Bioinformatics **7**

Structural Bioinformatics (3-D protein, PDB), Functional genomics (genome- wide and high throughput approaches to gene and protein function), Drug discovery method (Basic concepts)

Unit5:Biostatistics **10**

Introduction, calculation of standard deviation, standard error, Co-efficient of Variance, Chi-square test, Z test, t-Test

COMPUTATIONAL BIOLOGY

PRACTICAL **(Credits 2)**

1. Accessing biological databases
2. Retrieval of nucleotide and protein sequences from the databases.
3. To perform pair-wise alignment of sequences (BLAST) and interpret the output
4. Predict the structure of protein from its amino acid sequence.
5. To perform a "two-sample t- test" for a given set ofdata
6. Tolearngraphicalrepresentationsofstatisticaldatawiththehel pofcomputers (e.g. MSExcel).

SUGGESTED READINGS

- Ghosh Z and Mallick B. (2008). Bioinformatics: *Principles and Applications,* Oxford UniversityPress.
- Pevsner J. (2009). *Bioinformatics and Functional Genomic*s, II Edition, Wiley Blackwell.
- Zvelebil,MarketaandBaumO.Jeremy(2008).*Understanding Bioinformatics*, Garland Science, Taylor and Francis Group,USA.
- Zar, Jerrold H. (1999). *Biostatistical Analysis*, IV Edition, Pearson Education Inc and Dorling Kindersley Publishing Inc.USA
- Antonisamy, B., Christopher S. and Samuel, P. P. (2010). *Biostatistics: PrinciplesandPractice*.TataMcGrawHillEducationPrivateLimited,India.
- Pagana,M.andGavreau,K.(2000).*PrinciplesofBiostatistics,* DuxberryPress, USA

CODE: ZOO-HC-5026

ANIMAL BIOTECHNOLOGY

THEORY **(Credits 4)**

Unit 1. Introduction **8**

Concept and scope of biotechnology

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

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

Restriction enzymes: Nomenclature, detailed study of Type II.

Transformation techniques: Calcium chloride method and electroporation.

Construction of genomic and cDNA libraries and screening by colony and plaque hybridization

Southern, Northern and Western blotting

DNA sequencing: Sanger method

Polymerase Chain Reaction, DNA Finger Printing and DNA micro array

Unit 3. Genetically Modified Organisms **18**

Production of cloned and transgenic animals: Nuclear Transplantation, Retroviral Method, DNA microinjection

Applications of transgenic animals: Production of pharmaceuticals, production of donor organs, knock outmice.

Production of transgenic plants: *Agrobacterium* mediated transformation.

Applications of transgenic plants: insect and herbicide resistant plants.

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

Animalcellculture,Expressingclonedgenesinmammaliancells,Molecular diagnosis of genetic diseases (Cysticfibrosis,Sicklecellanemia)

Recombinant DNA in medicines: Recombinant insulin and human growth hormone, Gene therapy

ANIMAL BIOTECHNOLOGY

PRACTICAL **(Credits 2)**

1. Genomic DNA isolation from *E.coli*
2. Plasmid DNA isolation (pUC 18/19) from *E.coli*

3. Restriction digestion of plasmid DNA.

4. Construction of circular and linear restriction map from the data provided.

5. Calculation of transformation efficiency from the data provided..

6. To study following techniques through photographs

   a. Southern Blotting

   b. Northern Blotting

   c. Western Blotting

   d. DNA Sequencing (Sanger'sMethod)

   e. PCR

   f. DNA fingerprinting

7. Projectreportonanimalcellculture

10

SUGGESTED READINGS

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

- Glick,B.R.andPasternak,J.J.(2009).*MolecularBiotechnology-Principlesand ApplicationsofRecombinantDNA*.IVEdition,ASMpress,Washington,USA.

- Griffiths, A.J.F., J.H. Miller, Suzuki, D.T., Lewontin, R.C. and Gelbart, W.M. (2009).*AnIntroductiontoGeneticAnalysis*.IXEdition.FreemanandCo.,N.Y., USA.

- Snustad,D.P.andSimmons,M.J.(2009).*PrinciplesofGenetics.*VEdition,John Wiley and SonsInc.
- Watson,J.D.,Myers,R.M.,Caudy,A.andWitkowski,J.K.(2007).*Recombinant DNA- Genes and Genomes- A Short Course*. III Edition, Freeman and Co., N.Y.,USA.

- Beauchamp,T.I.andChildress,J.F.(2008).*PrinciplesofBiomedical Ethics.*VI Edition, Oxford University Press.

CODE: ZOO-HE-5036
ENDOCRINOLOGY

THEORY **(Credits 4)**

Unit 1: **Introduction to Endocrinology** **12**

History of endocrinology, Classification, Characteristic and Transport of Hormones, Neuro secretions and Neuro hormones

Unit 2: Epiphysis, Hypothalamo-hypophysialAxis **15**

Structure of pineal gland, Secretions and their functions in biological rhythm sand reproduction.

Structure of hypothalamus, Hypothalamic nuclei and their functions, Regulation of neuroendocrine glands, Feed back mechanisms

Structure of pituitary gland, Hormones and their functions, Hypothalamo- hypophysial portal system, Disorders of pituitary gland.

Unit3:Peripheral Endocrine Glands **18**

Structure, Hormones, Functions and Regulation of Thyroid gland, Parathyroid, Adrenal, Pancreas, Ovary and Testis

Hormones in homeostasis, Disorders of endocrine glands

Unit4: Regulation of Hormone Action **15**

Hormone action at Cellular level: Hormone receptors, transduction and regulation Hormone action at Molecular level: Molecular mediators, Genetic control of hormone action

ENDOCRINOLOGY

PRACTICAL **(Credits 2)**

1. Dissect and display of Endocrine glands in laboratory bred rat* 2.Study of the permanent slides of all the endocrine glands
3. Demonstration of Castration/ovariectomy in laboratory bred rat* 4. Designing of primers of any hormone

SUGGESTED READINGS

- General Endocrinology C. Donnell Turner Pub- SaundersToppan
- Endocrinology: An Integrated Approach; Stephen Nussey andSaffron Whitehead.
- Oxford: BIOS Scientific Publishers;2001.
- Hadley, M.E. and Levine J.E. 2007. Endocrinology, 6th Edition. Pearson Prentice-Hall, Pearson Education Inc., NewJersey.
- Vertebrate Endocrinology by David O.Norris,

CODE: ZOO-HE-5046
PARASITOLOGY

THEORY **(CREDITS 4)**

Unit I: Introduction to Parasitology **3**

Brief introduction of Parasitism, Parasite, Parasitoid and Vectors (mechanical and biological vector) Host parasite relationship

Unit II: Parasitic Protists **15**

Study of Morphology, Life Cycle, Prevalence, Epidemiology, Pathogenicity, Diagnosis, Prophylaxis and Treatment of *Entamoeba histolytica, Giardia intestinalis, Trypanoso magambiense, Leishmania donovani, Plasmodium vivax*

Unit III: Parasitic Platyhelminthes **15**

Study of Morphology, Life Cycle, Prevalence, Epidemiology, Pathogenicity, Diagnosis, Prophylaxis and Treatment of *Fasciolopsis buski, Schistosoma haematobium, Taenia solium* and *Hymenolepis nana*

Unit IV: Parasitic Nematodes **15**

Study of Morphology, Life Cycle, Prevalence, Epidemiology, Pathogenicity, Diagnosis, Prophylaxis and Treatment of *Ascarislumbricoides, Ancylostomaduodenale*,*Wuchereriabancrofti*and*Trichinellaspiralis.*Study ofstructure,life cycle and importance of *Meloidogyne*(root knot nematode), *Pratylencus*(lesion nematode)

Unit IV: Parasitic Arthropoda **10**

Biology, importance and control of ticks, mites, *Pediculushumanus*(head and body louse), *Xenopsyllacheopis*and *Cimexlectularius*

Unit V: Parasitic Vertebrates **2**

A brief account of parasitic vertebrates; Cookicutter Shark, Candiru, Hood Mockingbird and Vampire bat

PARASITOLOGY

PRACTICAL **(Credits 2)**

- Study of life stages of *Entamoeba histolytica, Giardia intestinalis, Trypanosoma gambiense, Leishmania donovani* and *Plasmodium vivax* through permanent slides/microphotographs
- Study of adult and life stages of *Fasciolopsis buski, Schistoso mahaematobium, Taenia solium* and *Hymenolepis nana* through permanent slides/microphotographs
- Study of adult and life stages of *Ascarislumbricoides, Ancylostomaduodenale, Wuchereriabancrofti*and *Trichinellaspiralis*through permanent slides/microphotographs
- Study of plant parasitic root knot nematode, *Meloidogyne*from the soil sample
- Study of *Pediculushumanus*(Head louse and Body louse), *Xenopsyllacheopis*and*Cimexlectularius*throughpermanentslides/photographs
- Study of monogenea from the gills of fresh/marine fish [Gills can be procured from fish market as by product of theindustry]
- Study of nematode/cestode parasites from the intestines of Poultry bird [Intestine can be procured from poultry/market as a byproduct]

Submission of a brief report on parasitic vertebrates SUGGESTEDREADINGS

- Arora, D. R and Arora, B. (2001) *Medical Parasitology*. II Edition. CBS Publications andDistributors
- E.R. Noble and G.A. Noble (1982) Parasitology: The biology of animal parasites. V Edition, Lea &Febiger
- Ahmed,N.,Dawson,M.,Smith,C.andWood,Ed.(2007)*BiologyofDisease.* Taylor and Francis Group
- Parija, S. C. Textbook of medical parasitology, protozoology & helminthology (Text and colour Atlas), II Edition, All India Publishers & Distributers, Medical Books Publishers, Chennai,Delhi
- RattanLalIchhpujaniandRajeshBhatia.MedicalParasitology ,IIIEdition,Jaypee Brothers Medical Publishers (P) Ltd., NewDelhi

- Meyer, Olsen & Schmidt's Essentials of Parasitology, Murray, D. Dailey, W.C. BrownPublishers

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

CODE: ZOO-HE-6016

BIOLOGY OF INSECTA

THEORY **(Credits 4)**

UnitI: Introduction **4**

General Features of Insects

Distribution and Success of Insects on the Earth

Unit II:Insect Taxonomy **4**

Basis of insect classification; Classification of insects up to orders

Unit III: General Morphology of Insects **8**

External Features; Head – Eyes, Types of antennae, Mouth parts w.r.t. feeding habits

Thorax:Wings and wing articulation, Types of Legs adapted to

diverse habitat Abdominal appendages and genitalia

Unit IV: Physiology of Insects **28**

Structure and physiology of Insect body systems - Integumentary, digestive, excretory, circulatory, respiratory, endocrine, reproductive, and nervous system

Sensory receptors

Growth and metamorphosis

Unit IV: Insect Society **6**

Group of social insects and their social life

Social organization and social behaviour (w.r.t. any one example)

Unit V: Insect Plant Interaction **4**

Theory of co-evolution, role of allele chemicals in host plant

mediation Host-

plantselectionbyphytophagousinsects,Insectsasplantpests

Unit VI: InsectsasVectors **6**

Insects as mechanical and Biological vectors, Brief discussion on houseflies and mosquitoes as important insect vectors

BIOLOGY OF INSECTA

PRACTICAL **(CREDITS 2)**

1. Study of one specimen from each insect order
2. Study of different kinds of antennae, legs and mouth parts of insects
3. Study of head and sclerites of any one insect
4. Study of insect wings and theirvenation.
5. Study of insect spiracles
6. Methodology of collection, preservation and identification of insects.
7. Morphological studies of various castes of *Apis*, *Camponotus* and *Odontotermes*
8. Study of any three insect pests and theirdamages
9. Study of any three beneficial insects and theirproducts

Field study of insects and submission of a project report on the insect diversity

SUGGESTED READINGS

- Ageneraltextbookofentomology,Imms,A.D.,Chapman&Hall,UK
- The Insects: Structure and function, Chapman, R. F., Cambridge University Press,UK
- PrinciplesofInsectMorphology,Snodgrass,R.E.,CornellUniv.Press,USA
- Introduction to the study of insects, Borror, D. J., Triplehorn, C. A., and Johnson, N. F., M Saunders College Publication,USA
- The Insect Societies, Wilson, E. O., Harward Univ. Press,UK
- HostSelectionbyPhytophagousinsects,Bernays,E.A.,andChapman,R.F., Chapman and Hall, New York,USA
- Physiological system in Insects, Klowden, M. J., Academic Press,USA
- The Insects, An outline of Entomology, Gullan, P. J. , and Cranston, P. S., Wiley Blackwell,UK

Insect Physiology and Biochemistry, Nation, J. L., CRC Press,USA

CODE: ZOO-HE-6026

FISH AND FISHERIES

THEORY **(Credits 4)**

UNIT 1: Introduction and Classification: **6**

General description of fish; Account of systematic classification of fishes (upto classes); Classification based on feeding habit, habitat and manner of reproduction.

UNIT 2: Morphology and Physiology: **18**

Types of fins and their modifications; Locomotion in fishes; 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 fishes); Electric organs; Bioluminiscience; Mechanoreceptors; Schooling; Parental care; Migration

UNIT3:Fisheries **12**

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; Fisheries law and regulations

Unit4:Aquaculture **20**

Sustainable Aquaculture; Extensive, semi-intensive and intensive culture offish; Pen and cage culture; Polyculture; Composite fish culture; Brood stock management; Induced breeding of fish; Management of finfish hatcheries; Preparationandmaintenanceoffishaquarium;Preparationofcompounddietsf or fish; Role of water quality in aquaculture; Fish diseases: Bacterial, viral and parasitic;Preservationandprocessingofharvestedfish,Fisheryby-products

UNIT 5: Fish in research **4**

Transgenic fish, Zebra fish as a model organism in research

FISH AND FISHERIES

PRACTICAL **(Credits 2)**

1. Morphometric and meristic characters of fishes
2. Study of *Petromyzon, Myxine, Pristis, Chimaera, Exocoetus, Hippocampus, Gambusia, Labeo, Heteropneustes ,Anabas*
3. Study of different types of scales (through permanent slides/photographs).
4. Study of crafts and gears used in Fisheries
5. WaterqualitycriteriaforAquaculture:AssessmentofpH,conductivity,Total solids, Total dissolved solids
6. Study of air breathing organs in *Channa, Heteropneustes, Anabas* and *Clarias*
7. Demonstration of induced breeding in Fishes(video)
8. Demonstration of parental care in fishes(video)
9. ProjectReportonavisittoanyfishfarm/pisciculture unit/Zebra fishrearing Lab.

SUGGESTED READINGS

- QBone and R Moore, Biology of Fishes, Talyor and Francis Group, CRCPress, U.K.
- D. H. Evans and J. D. Claiborne, The Physiology of Fishes, Taylor and Francis Group,CRCPress,UKvonderEmde,R.J.MogdansandB.G.Kapoor.TheSensesof Fish:AdaptationsfortheReceptionofNaturalStimuli,Springer,Netherlands
- C.B.L. Srivastava, Fish Biology, Narendra Publishing House
- J.R. Norman, A history of Fishes, Hill and Wang Publishers
- S.S. Khanna and H.R. Singh, A text book of Fish Biology and Fisheries, Narendra Publishing House

CODE: ZOO-HE-6036
REPRODUCTIVE BIOLOGY

THEORY **(CREDITS 4)**

Unit 1: Reproductive Endocrinology

Gonadalhormonesandmechanismofhormoneaction,steroids,glycoproteinhormones ,and prostaglandins, hypothalamo – hypophyseal – gonadal axis, regulation of gonado trophin secretion in male and female; Reproductive System: Development and differentiation of gonads, genital ducts, external genitalia, mechanism of sex differentiation.

Unit 2: Functional anatomy of male reproduction

Outline and histological of male reproductive system in rat and human; Testis: Cellular functions, germ cell, system cell renewal; Spermatogenesis: kinetics and hormonal regulation; Androgen synthesis and metabolism; Epididymal function and sperm maturation; Accessory glands functions; Sperm transportation in male tract

Unit 3: Functional anatomy of female reproduction

Outline and histological of female reproductive system in rat and human; Ovary: folliculogenesis, ovulation, corpus luteum formation and regression; Steroidogenesis and secretion of ovarian hormones; Reproductive cycles (rat and human) and their regulation, changes in the female tract; Ovum transport in the fallopian tubes; Sperm transport in the female tract, fertilization; Hormonal control of implantation; Hormonal regulation of gestation, pregnancy diagnosis, foeto – maternal relationship; Mechanism of parturition and its hormonal regulation; Lactation and its regulation

Unit 4: Reproductive Health

Infertility in male and female: causes, diagnosis and management; Assisted Reproductive Technology: sex selection, sperm banks, frozen embryos, in vitro fertilization, ET,EFT, IUT, ZIFT, GIFT, ICSI, PROST; Modern contraceptive technologies; Demographic terminology used in family planning

REPRODUCTIVE BIOLOGY

PRACTICAL (CREDITS 2)

1. Study of animal house: set up and maintenance of animal house, breeding techniques, care of normal and experimental animals.
2. Examination of vaginal smear rats from live animals.
3. Examination of histological sections from photomicrographs/ permanent slides of rat/human: testis, epididymis and accessory glands of male reproductive systems; Sections of ovary, fallopian tube, uterus (proliferative and secretory stages), cervix and vagina.
4. Sperm count and sperm motility in rat
5. Study of modern contraceptive devices

SUGGESTED READINGS

- Austin,C.R.andShort,R.V.reproductioninMammals.CambridgeUniversityPress.
- Degroot,L.J.andJameson,J.L.(eds).Endocrinology.W.B.SaundersandCompany.
- Knobil,E.etal.(eds).ThePhysiologyofReproduction.RavenPressLtd.
- Hatcher, R.A. et al. The Essentials of Contraceptive Technology. Population Information Programme.

CODE: ZOO-HE-6046
WILD LIFE CONSERVATION AND MANAGEMENT

THEORY (CREDITS 4)

Unit 1: Introduction to Wild Life

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

Unit 2: Evaluation and management of wild life

Habitat analysis, Physical parameters :Topography, Geology, Soil and water; Biological Parameters: food, cover, forage, browse and cover estimation; Standard evaluation procedures: remote sensing and GIS.

Unit 3: Management of habitats

Setting back succession; Grazing logging; Mechanical treatment; Advancing the successionalprocess;Coverconstruction;Preservationofgeneralgeneticdiversity; Restoration of degradedhabitats

Unit 4: Population estimation

Population density, Natality, Birth rate, Mortality, fertility schedules and sex ratio computation; Faecal analysis of ungulates and carnivores: Faecal samples, slide preparation, Hair identification, Pug marks and census method.

Unit 5: Management planning of wild life in protected areas

Estimationofcarryingcapacity;Ecotourism/wildlifetourisminforests;Conceptofclimax persistence; Ecology of perturbence.

Unit 7: Management of excess population

Bio-telemetry; Care of injured and diseased animal; Quarantine; Common diseases of wild animal

Unit 8: Protected areas

Nationalparks&sanctuaries,Communityreserve;ImportantfeaturesofprotectedareasinIndia; Tigerconservation-TigerreservesinIndia;ManagementchallengesinTigerreserve.

WILD LIFE CONSERVATION AND MANAGEMENT

PRACTICALS **(CREDITS 2)**

1. Identification of flora, mammalian fauna, avian fauna, herpeto-fauna
2. Demonstration of basic equipment needed in wildlife studies use, care and maintenance (Compass, Binoculars, Spotting scope, Range Finders, Global Positioning System, Various types of Cameras and lenses)
3. Familiarization and study of animal evidences in the field; Identification of animals through pugmarks, hoofmarks, scats, pellet groups, nest, antlers etc.
4. Demonstration of different field techniques for flora and fauna
5. PCQ,Tentree method,Circular,Square&rectangularplots,Parker's2Stepandot her methods for ground cover assessment, Tree canopy cover assessment, Shrub cover assessment.
6. Trail/transectmonitoringforabundanceanddiversityestimati onofmammalsandbird (direct and indirect evidences)

SUGGESTED READINGS

- Caughley, G., and Sinclair, A.R.E. (1994). *Wildlife Ecology and Management*. Blackwell Science.
- WoodroffeR.,Thirgood,S.andRabinowitz,A.(2005).*Peoplea ndWildlife,Conflict or Co-existence*? Cambridge University.
- Bookhout, T.A. (1996). *Research and Management Techniques for Wildlife and Habitats*, 5 th edition. The Wildlife Society, Allen Press.
- Sutherland, W.J. (2000). *The Conservation Handbook: Research, Management and Policy*. Blackwell Sciences
- HunterM.L.,Gibbs,J.B.andSterling,E.J.(2008).*Problem-SolvinginConservation Biology and Wildlife Management: Exercises for Class, Field, and Laboratory*. Blackwell Publishing.

ZOO-HE-6056

DISSERTATION

Dissertation of Zoology Specific subject

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GENERIC ELECTIVE COURSES

CODE: ZOO-HG-1016

ANIMAL DIVERSITY

THEORY **(CREDITS 4)**

Unit 1:Kingdom Protista **4**

General characters and classification up to classes; Locomotory Organelles and locomotion in Protozoa

Unit 2: Phylum Porifera **3**

General characters and classification up to classes; Canal System in *Sycon*

Unit 3: Phylum Cnidaria **3**

General characters and classification up to classes; Polymorphism in Hydrozoa

Unit 4:Phylum Platyhelminthes **3**

General characters and classification up to classes; Life history of *Taenia solium*

Unit 5: Phylum Nemathelminthes **5**

General characters and classification up to classes; Life history of *Ascaris lumbricoides* and its parasitic adaptations

Unit 6:Phylum Annelida **3**

General characters and classification up to classes; Metamerism in Annelida

Unit 7:Phylum Arthropoda **5**

General characters and classification up to classes; Vision in Arthropoda, Metamorphosis in Insects

Unit 8: Phylum Mollusca **4**

General characters and classification up to classes; Torsion in gastropods

Unit 9: Phylum Echinodermata **4**

General characters and classification up to classes; Water-vascular system in Asteroidea

Unit 10: Protochordates **2**

General features and Phylogeny of Protochordata

Unit 11: Agnatha **2**

General features of Agnatha and classification of cyclostomes up to classes

Unit 12: Pisces **4**

General features and Classification up to orders; Osmoregulation in Fishes

Unit13: Amphibia **4**

General features and Classification up to orders; Parental care

Unit14: Reptiles **4**

General features and Classification up to orders; Poisonous and non-poisonous snakes, Biting mechanism in snakes

Unit15: Aves **5**

General features and Classification up to orders; Flight adaptations in birds

Unit17: Mammals **5**

Classification up to orders; Origin of mammals

Note: Classification of Unit 1-9 to be followed from "Barnes, R.D. (1982). *Invertebrate Zoology*, V Edition"

ANIMAL DIVERSITY

PRACTICAL **(CREDITS2)**

1. Study of the followingspecimens:
Amoeba, Euglena, Plasmodium, Paramecium, Sycon, Hyalonema, and *Euplectella, Obelia, Physalia, Aurelia, Tubipora, Metridium, Taeniasolium,* Male and female *Ascarislumbricoides, Aphrodite, Nereis, Pheretima, Hirudinaria, Palaemon, Cancer, Limulus, Palamnaeus, Scolopendra, Julus, Periplaneta, Apis, Chiton, Dentalium, Pila, Unio, Loligo, Sepia, Octopus, Pentaceros, Ophiura, Echinus, Cucumaria*and *Antedon, Balanoglossus, Herdmania, Branchiostoma, Petromyzon, Sphyrna, Pristis, Torpedo, Labeo, Exocoetus, Anguilla, Ichthyophis/Ureotyphlus, Salamandra, Bufo, Hyla, Chelone, Hemidactylus, Chamaeleon, Draco, Vipera, Naja, Crocodylus, Gavialis,* Any six common birds from different orders, *Sorex,* Bat, *Funambulus,Loris*

2. Study of the following permanent slides:
T.S. and L.S. of *Sycon*, Study of life history stages of *Taenia*, T.S. of Male and female *Ascaris*

3. Key for Identification of poisonous and non-poisonous snakes

An "**animal album**" containing photographs, cut outs, with appropriate write up about the above mentioned taxa. Different taxa/ topics may be given to different sets of students for thispurpose.

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, BlackwellScience
- Young, J. Z. (2004). *The Life of Vertebrates*. III Edition. Oxford universitypress.
- Pough H. *Vertebrate life*, VIII Edition, PearsonInternational.
- Hall B.K. and Hallgrimsson B. (2008). *Strickberger's Evolution*. IV Edition. Jones and Bartlett PublishersInc.

COMPARATIVE ANATOMY AND DEVELOPMENTAL BIOLOGY OF VERTEBRATES

CODE: ZOO-HG-2016

THEORY **(CREDITS 4)**

Unit 1: Integumentary System **4**

Derivatives of integument w.r.t. glands and digital tips

Unit 2: Skeletal System **3**

Evolution of visceral arches

Unit 3:Digestive System **4**

Brief account of alimentary canal and digestive glands

Unit 4:RespiratorySystem **5**

Brief account of Gills, lungs, air sacs and swim bladder

Unit 5: Circulatory System **4**

Evolution of heart and aortic arches

Unit 6:Urinogenital System **4**

Succession of kidney, Evolution of urinogenital ducts

Unit 7:Nervous System **3**

Comparative account of brain

Unit 8: Sense Organs **3**

Types of receptors

Unit 9: Early Embryonic Development **12**

Gametogenesis: Spermatogenesis and oogenesis w.r.t. mammals, vitellogenesis in birds; Fertilization: external (amphibians), internal (mammals), blocks to polyspermy; Early development of frog and humans (structure of mature egg and its membranes, patterns of cleavage, fate map, up to formation of gastrula);types of morphogenetic movements; Fate of germ layers; Neurulation in frog embryo.

Unit 10: Late Embryonic Development **10**

Implantation of embryo in humans, Formation of human placenta and functions, other types of placenta on the basis of histology; Metamorphic events in frog life cycle and its hormonal regulation.

Unit 11: Control of Development **8**

Fundamental processes in development (brief idea) – Gene activation, determination, induction, Differentiation, morphogenesis, intercellular communication, cell movements and cell death

COMPARATIVE ANATOMY AND DEVELOPMENTAL BIOLOGY OF VERTEBRATES

PRACTICAL **(CREDITS 2)**

1. Osteology:
   a) Disarticulated skeleton of fowl and rabbit
   b) Carapace and plastron of turtle/tortoise
   c) Mammalian skulls: One herbivorous and one carnivorous animal.

2. Frog - Study of developmental stages - whole mounts and sections through permanent slides – cleavage stages, blastula, gastrula, neurula, tail bud stage, tadpole external and internal gill stages.

3. Study of the different types of placenta- histological sections through permanent slides or photomicrographs.

4. Examination of gametes - frog/rat - sperm and ova through permanent slides or photomicrographs.

SUGGESTED READINGS

- Kardong, K.V. (2005) *Vertebrates' Comparative Anatomy, Function and Evolution*. IV Edition. McGraw-Hill Higher Education.
- Kent, G.C. and Carr R.K. (2000). *Comparative Anatomy of the Vertebrates*. IX Edition. The McGraw-Hill Companies.
- Hilderbrand, M and Gaslow G.E. *Analysis of Vertebrate Structure*, John Wiley and Sons.
- Walter, H.E. and Sayles, L.P; *Biology of Vertebrates*, Khosla Publishing House.
- Gilbert, S. F. (2006). Developmental Biology, VIII Edition, Sinauer Associates, Inc., Publishers, Sunderland, Massachusetts,USA.
- Balinsky, B.I. (2008). An introduction to Embryology, International Thomson Computer Press.
- Carlson, Bruce M (1996). Patten's Foundations of Embryology, McGraw Hill, Inc.

CORE COURSE III
PHYSIOLOGY AND BIOCHEMISTRY

CODE: ZOO-HG-3016

THEORY **(CREDITS 4)**

Unit 1: Nerveandmuscle **8**

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

Unit2: Digestion **5**

Physiology of digestion in the alimentary canal; Absorption of carbohydrates, proteins, lipids

Unit3: Respiration **5**

Pulmonary ventilation, Respiratory volumes and capacities, Transport of Oxygen and carbon dioxide in blood

Unit 4: Excretion **5**

Structure of nephron, Mechanism of Urine formation, Counter-current Mechanism

Unit 5: Cardiovascular system **6**

Composition of blood, Hemostasis, Structure of Heart, Origin and conduction of the cardiac impulse, Cardiac cycle

Unit 6: Reproduction andEndocrineGlands **7**

Physiology of male reproduction: hormonal control of spermatogenesis; Physiology of female reproduction: hormonal control of menstrualcycle

Structure and function of pituitary, thyroid, Parathyroid, pancreas and adrenal

Unit 7: Carbohydrate Metabolism **8**

Glycolysis, Krebs Cycle, Pentose phosphate pathway, Gluconeogenesis, Glycogen metabolism, Review of electron transport chain

Unit 8: Lipid Metabolism **5**

Biosynthesis and β oxidation of palmitic acid

Unit 9: Protein metabolism **5**

Transamination, Deamination and Urea Cycle

Unit 10: Enzymes **6**

Introduction, Mechanism of action, Enzyme Kinetics, Inhibition and Regulation

PHYSIOLOGY AND BIOCHEMISTRY

PRACTICAL **(CREDITS2)**

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

SUGGESTED READINGS

- Tortora, G.J. and Derrickson, B.H. (2009). *Principles of Anatomy and Physiology*, XII Edition, John Wiley & Sons,Inc.
- Widmaier, E.P., Raff, H. and Strang, K.T. (2008) *Vander's Human Physiology*, XI Edition., McGrawHill
- Guyton, A.C. and Hall, J.E. (2011). T*extbook of Medical Physiology*, XII Edition, Harcourt Asia Pvt. Ltd/ W.B. SaundersCompany
- Berg, J. M., Tymoczko, J. L. and Stryer, L. (2006). *Biochemistry*. VI Edition. W.H Freeman andCo.
- Nelson, D. L., Cox, M. M. and Lehninger, A.L. (2009). *Principles of Biochemistry*. IV Edition. W.H. Freeman andCo.
- Murray, R.K., Granner, D.K., Mayes, P.A. and Rodwell, V.W. (2009). *Harper's Illustrated Biochemistry*. XXVIII Edition. Lange Medical Books/McGraw3Hill.

GENETICS AND EVOLUTIONARY BIOLOGY

CODE: ZOO-HG-4016

THEORY **(CREDITS 4)**

Unit 1: Introduction to Genetics **3**

Mendel's work on transmission of traits, Genetic Variation, Molecular basis of Genetic Information

Unit 2: Mendelian Genetics and its Extension **8**

Principles of Inheritance, Chromosome theory of inheritance, Incomplete dominance and co-dominance, Multiple alleles, Lethal alleles, Epistasis, Pleiotropy, sex linked inheritance, extra-chromosomal inheritance

Unit 3: Linkage, Crossing Over and Chromosomal Mapping **9**

Linkage and crossing over, Recombination frequency as a measure of linkage intensity, two factor and three factor crosses, Interference and coincidence, Somatic cell genetics - an alternative approach to gene mapping

Unit4: Mutations **7**

Chromosomal Mutations: Deletion, Duplication, Inversion, Translocation, Aneuploidy and Polyploidy; Gene mutations: Induced versus Spontaneous mutations, Back versus Suppressor mutations,

Unit 5: Sex Determination **4**

Chromosomal mechanisms, dosage compensation

Unit 6: History of Life **2**

Major Events in History of Life

Unit 7: Introduction to Evolutionary Theories **5**

Lamarckism, Darwinism, Neo-Darwinism

Unit 8: Direct Evidences of Evolution **5**

Types of fossils, Incompleteness of fossil record, Dating of fossils, Phylogeny of horse

Unit 9: Processes of Evolutionary Change **9**

Organic variations; Isolating Mechanisms; Natural selection (Example: Industrial melanism); Types of natural selection (Directional, Stabilizing, Disruptive), Artificial selection

Unit 10:Species Concept **6**

Biological species concept (Advantages and Limitations); Modes of speciation (Allopatric, Sympatric)

Unit11:Macro-evolution **5**

Macro-evolutionary Principles (example: Darwin's Finches)

Unit 12: Extinction **6**

Mass extinction (Causes, Names of five major extinctions, K-T extinction in detail), Role of extinction in evolution

GENETICS AND EVOLUTIONARY BIOLOGY

PRACTICAL **(CREDITS 2)**

1. Study of Mendelian Inheritance and gene interactions (Non Mendelian Inheritance) using suitable examples. Verify the results using Chi-square test.
2. Study of Linkage, recombination, gene mapping using the data.
3. Study of Human Karyotypes (normal and abnormal).
4. Study of fossil evidences from plaster cast models and pictures
5. Study of homology and analogy from suitable specimens/pictures
6. Charts:
   a) Phylogeny of horse with diagrams/ cut outs of limbs and teeth of horse ancestors
   b) Darwin's Finches with diagrams/ cut outs of beaks of different species
7. Visit to Natural History Museum and submission of report

SUGGESTED READINGS

- Gardner, E.J., Simmons, M.J., Snustad, D.P. (2008). *Principles of Genetics*. VIII Edition. WileyIndia.
- Snustad, D.P., Simmons, M.J. (2009). *Principles of Genetics*. V Edition. John Wiley and SonsInc.
- Klug, W.S., Cummings, M.R., Spencer, C.A. (2012). *Concepts of Genetics*. X Edition. BenjaminCummings.
- 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 andCo.
- Ridley, M. (2004). *Evolution*. III Edition. BlackwellPublishing
- Barton, N. H., Briggs, D. E. G., Eisen, J. A., Goldstein, D. B. and Patel, N. H.(2007). *Evolution*. Spring, Harbour Laboratory Press.
- Hall, B. K. and Hall grimsson, B. (2008). *Evolution*. IV Edition. Jones and Bartlett Publishers
- Campbell, N. A. and Reece J. B. (2011). *Biology*. IX Edition, Pearson, Benjamin, Cummings.
- Douglas, J. Futuyma (1997). *Evolutionary Biology*. Sinauer Associates.

SKILL ENHANCEMENT COURSES

CODE: ZOO-SE-3014 **Credit-4**

Ornamental Fish & Fisheries

1. Ornamental Fish Diversity of North East India.
2. Aquarium plant diversity in the wetland of Assam.
3. Construction and management of Home Aquarium.
4. Natural feed of Ornamental Fish
5. Strategies for maintenance of natural colour of Ornamental Fish
6. Natural Breeding of Tricogaster species
7. Health management of Ornamental Fish
8. Feed formulation of Ornamental Fish
9. Development of Biological filtration in Aquarium
10. Pure culture of planktons

Practical's

11. Identification of Ornamental Fish
12. Culture of Indigenous ornamental fish in Aquarium
13. Estimation of Physico-chemical characteristics of Aquarium water
14. Biological filter for removal of Ammonia from Aquarium
15. Culture of Planktons

APICULTURE

CODE: ZOO-SE-3024

(CREDITS4)

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:Bee Economy

Products of Apiculture Industry and its Uses (Honey, Bees Wax, Propolis), Pollen etc

Unit5:EntrepreneurshipinApiculture

Bee Keeping Industry–Recent Efforts, Modern Methods in employing artificial Beehives for cross pollination in horticultural gardens

SUGGESTED READINGS

- Prost, P. J. (1962). *Apiculture*. Oxford and IBH, New Delhi.
- Bisht D.S., *Apiculture,* ICAR Publication.
- SinghS., *Bee keeping in India*, Indian council of Agricultural Research, NewDelhi.

CODE: ZOO-SE-4014

SEC 2 N0N-

MULBERRY

SERICULTURE

(CREDITS 4)

Unit 1: Introduction

Sericulture: Definition, history and present status of Mulberry and Non-Mulberry Sericulture; Silk route Varieties of Silk; Types and distribution of non-mulberry or wild or vanya sericigenous insects in N-E India

Unit 2: Biology of Non-mulberry Silkworm:

Life cycle of silkworm- Eri and Muga
Structure of silk gland and Nature of Silk

Unit 3: Rearing of Silkworms (Eri and Muga Silkworm):

Food plants of Eri and Muga Silkworm

Rearing Operation:

Rearing house/Site and rearing appliances
Disinfectants: Formalin, bleaching powder
Rearing technology: Early age and Late age rearing
Environmental conditions in rearing-Temperature, Humidity, Light and Air
Types of mountages
Harvesting and storage of cocoons
Spinning and Reeling of silk

Unit 4: Pests and Diseases:

Pests of eri and muga silkworm
Pathogenesis of eri and muga silkworm diseases: Protozoan, viral, fungal and bacterial
Prevention and control measures of pests and diseases

Unit 5: Entrepreneurship in Non-Mulberry Sericulture:

Varieties of Non-Mulberry Silk products and economics in India

Prospectus of Non-Mulberry Sericulture in India: Non-Mulberry Sericulture industry in different states, employment generation and potential

Visit to various sericulture Govt. /Private Farm/ Centers.

SUGGESTED READINGS

- Jolly, M. S., S. K. Sen, T.N. Sonwalkar and G.K. Prashad 1979. ***Non-Mulberry Sericulture.*** *In*: Manual ofSericulture, Rome, **FAO**, 4 (29)
- Chowdhury, S.N. 1981. ***Muga Silk Industry***. Directorate of Sericulture, Govt. of Assam, Guwahati-781005, Assam.
- Chowdhury, S.N. 1982. ***Eri Silk Industry***. Directorate of Sericulture, Govt. of Assam, Guwahati-781005, Assam.
- Chowdhury, S.N. 1992. ***Silk and Sericulture***. Directorate of Sericulture and Weaving, Govt. of Assam, Guwahati-781005, Assam.

CODE: ZOO-SE-4024

Wildlife Photography and

Ecotourism

CREDITS 4

Unit-I Tools and Technique of Photography **Credit-1**

- Introduction to Photography
- Still && Video Photography
- To develop expertise in Photography
- Field trips for photography in different periods (Light and Dark),seasons and places(Wetlands, Wildlife sanctuaries, National parks, Industrial sites)
- Methods of documentation

Practical

- Submission of Photography
- Preparation of Poster and Calendar

Unit-2 Eco-tourism

- Introduction of Eco-tourism
- Scope of Eco-tourism with special reference to North East region of India
- Management of Eco-tourism & hospitality
- Development of Eco-tourism with innovative Eco-restoration ideas.

Practical

- Field visit to Wildlife sanctuaries, Eco-park, Historical and religious places, Cultural museum etc.
- Preparation of report and seminar presentation

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CODE: ZOO-SE-4034
RESEARCH METHODOLOGY
Credit:4

Unit 1:

Foundations of Research:

Meaning, Objectives, Motivation: Research Methods vs Methodology, Types of Research: Analytical vs Descriptive, Quantitative vs Qualitative, Basic vs Applied

Unit 2:

Research Design Need for research design:

Features of good design, Important concepts related to good design- Observation and Facts, Prediction and Explanation, Development of Models. Developing a research plan: Problem identification, Experimentation, Determining experimental and sample designs

Unit 3:

Data Collection, Analysis and Report Writing

Observation and Collection of Data-Methods of data collection- Sampling Methods, Data Processing and Analysis Strategies, Technical Reports and Thesis writing, Preparation of Tables and Bibliography. Data Presentation using digital technology

Unit 4:

Ethical Issues

Intellectual property Rights, Commercialization, Copy Right, Royalty, Patent law, Plagiarism, Citation, Acknowledgement

SUGGESTED READINGS

- Anthony, M, Graziano, A.M. and Raulin, M.L. 2009. Research Methods: A Process of Inquiry, Allyn and Bacon.
- Walliman, N. 2011.Research Methods- The Basics.Taylor and Francis, London, New York.
- Wadhera, B.L.: Law Relating to Patents, Trade Marks, Copyright Designs and Geographical Indications, 2002, Universal Law publishing
- C.R.Kothari: Research Methodology, New Age International, 2009 • Coley, S.M. and Scheinberg, C.A. 1990, "Proposal writing".Stage Publications.