

**Gauhati University**  
**Syllabus for B.Sc.(Honors)**  
**ZOOLOGY**  
**Choice Based Credit System (CBCS)**

Course effective from academic year 2019-20

# Syllabus for B.Sc.(Honors) Zoology

## Choice Based Credit System (CBCS)

Course effective from academic year 2019-20



# Gauhati University

Guwahati::Assam

## Mapping of Subjects 1st Semester

Type	Core	AEC	SEC	DSE	GEN
<b>Credits</b>	<b>14 × 6 = 84</b>	<b>2 × 4 = 8</b>	<b>2 × 4 = 8</b>	<b>4 × 6 = 24</b>	<b>4 × 6 = 24</b>
<b>Honours</b> <b>Sem I</b>	ZOO-HC-1016	ENG-AE-1014			XXX-HG-1XX6
	ZOO-HC-1026				ZOO-HG-1XX6
					XXX-HG-1XX6
					...
					...

Type	Core	AECC	SEC	DSE
<b>Credits</b>	<b>12 × 6 = 72</b>	<b>2 × 4 = 8</b>	<b>4 × 4 = 16</b>	<b>6 × 6 = 36</b>
<b>Regular</b> <b>Sem I</b>	ZOO-RC-1016	ENG-AE-1014		
	YYY-RC-1016			
	ZZZ-RC-1016			

## 2nd Semester

Type	Core	AEC	SEC	DSE	GEN
<b>Credits</b>	<b>14 × 6 = 84</b>	<b>2 × 4 = 8</b>	<b>2 × 4 = 8</b>	<b>4 × 6 = 24</b>	<b>4 × 6 = 24</b>
<b>Honours</b> <b>Sem II</b>	ZOO-HC-2016	ENV-AE-2014			XXX-HG-2XX6
	ZOO-HC-2026				ZOO-HG-2XX6
					XXX-HG-2XX6
					...
					...

Type	Core	AECC	SEC	DSE
<b>Credits</b>	<b>12 × 6 = 72</b>	<b>2 × 4 = 8</b>	<b>4 × 4 = 16</b>	<b>6 × 6 = 36</b>
<b>Regular</b> <b>Sem II</b>	ZOO-RC-2016	ENV-AE-2014		
	YYY-RC-2016			
	ZZZ-RC-2016			

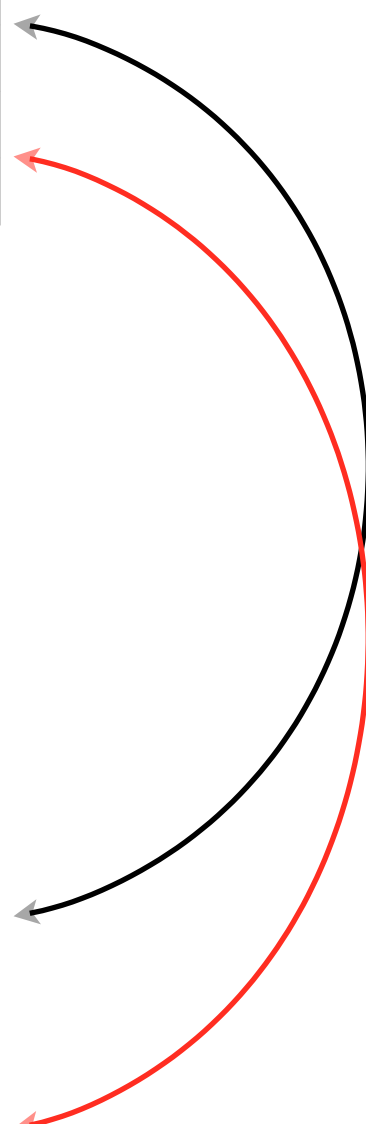
**BSc Courses**  
**3rd - 6th Semesters**

Honours

Type	Core	AEC	SEC	DSE	GEN
Credits	14 × 6 = 84	2 × 4 = 8	2 × 4 = 8	4 × 6 = 24	4 × 6 = 24
Sem III	ZOO-HC- .....		ZOO-SE- 3XX4		ZOO-HC- 2XX6
	ZOO-HC- .....				
	ZOO-HC- .....				
Sem IV	ZOO-HC- .....		ZOO-SE- 4XX4		ZOO-HG- 4XX6
	ZOO-HC- .....				
	ZOO-HC- .....				
Sem V	ZOO-HC- .....			ZOO-HE- .....	
	ZOO-HC- .....			ZOO-HE- .....	
Sem VI	ZOO-HC- .....			ZOO-HE- .....	
	ZOO-HC- .....			ZOO-HE- .....	

Regular

Type	Core	AECC	SEC	DSE
Credits	12 × 6 = 72	2 × 4 = 8	4 × 4 = 16	6 × 6 = 36
Sem III	ZOO-RC-3016		ZOO-SE-3XX4	
	YYY-RC-3016			
	ZZZ-RC-3016			
Sem IV	ZOO-RC-4016		ZOO-SE-4XX4	
	YYY-RC-4016			
	ZZZ-RC-4016			
Sem V			ZOO-SE-5XX4	ZOO-RE-5XX6
				ZOO-RE-5XX6
				ZOO-RE-5XX6
Sem VI			ZOO-SE-6XX4	ZOO-RE-6XX6
				ZOO-RE-6XX6
				ZOO-RE-6XX6



## Contents

Preamble .....	
CourseStructure.....	
Structure of BSc Honours(Zoology)Programme .....	
<b>SCHEME FOR CHOICE BASED CREDIT SYSTEM IN B.</b>	
Sc.Honours(Zoology) .....	
<b>CORE COURSE (HONOURS IN Zoology) .....</b>	
<b>SemesterI.....</b>	
ZOO-HC-1016:Non-chordates 1:Protista to Pseudocoelomates .....	
ZOO-HC-1026: Principles of Ecology.....	
<b>SemesterII .....</b>	
ZOO-HC-2016: Non-chordates II:Coelomates .....	
ZOO-HC-2026: Cell Biology.....	
<b>SemesterIII .....</b>	
ZOO-HC-3016:DIVERSITY OF CHORDATES.....	
ZOO-HC-3026 Physiology: Controlling and Coordinating Systems .....	
ZOO-HC-3036:FUNDAMENTALS OF BIOCHEMISTRY .....	
<b>SemesterIV.....</b>	
ZOO-HC-4016:COMPARATIVE ANATOMY OF VERTEBRATE.....	
ZOO-HC-4026:PHYSIOLOGY: LIFE SUSTAINING.....	
ZOO-HC-4036:BIOCHEMISTRY OF METABOLIC PROCESS .....	

SemesterV .....	
ZOO-HC-5016:MOLECULAR BIOLOGY.....	
ZOO-HC-5026: PRINCIPLES OF GENETICS.....	
SemesterVI.....	
ZOO-HC-6016:DEVELOPMENTAL BIOLOGY .....	
ZOO-HC-6026:EVOLUTIONARY BIOLOGY .....	
ZOOLOGY-GENERAL ELECTIVE COURSE (GE)	
SEMESTER I-----	
ZOO-HG-1016: ANIMAL DIVERSITY	
SEMESTER II-----	
ZOO-HG-2016: COMPARATIVE ANATOMY AND DEVELOPMENTAL BIOLOGY OF VERTEBRATE	
SEMESTER III-----	
ZOO-HG-3016: PHYSIOLOGY AND BIOCHEMISTRY	
SEMESTER IV-----	
ZOO-HG-4016: GENETICS AND EVOLUTIONARY BIOLOGY	
ZOOLOGY-Discipline Specific Electives(DSE) .....	
ZOO-HE-5016: COMPUTATIONAL BIOLOGY AND BIostatISTICS	
.....	
ZOO-HE-5026: ANIMAL BIOTECHNOLOGY.....	
ZOO-HE-5036: ENDOCRINOLOGY .....	
ZOO-HE-5046: PARASITOLOGY .....	
ZOO-HE-6014 :BIOLOGY OF INSECTA.....	
ZOO-HE-6026: FISH AND FISHERIES.....	

ZOO-HE-6036: REPRODUCTIVE BIOLOGY .....

ZOO-HE-6046: WILDLIFE CONSERVATION AND MANAGEMENT

ZOO-HE-6056 DISSERTATION-----  
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Skill Enhancement Courses .....

ZOO-SE-3014: ORNAMENTAL FISH AND FISHERIES.....

ZOO-SE-3024: APICULTURE .....  
ZOO-SE-4014: Non-Mulberry Sericulture.....  
ZOO-SE-4024:Wildlife Photography and Eco-tourism .....  
ZOO-SE-4034 Research methodology  
Ability Enhancement Compulsory Courses.....  
ENG-AE-1014:ENGLISHCOMMUNICATION .....  
ENV-AE-2014:ENVIRONMENTALSCIENCE.....



### **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.

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

**\*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

Seme ster	Type	Core	AECC	SEC	DSE	GEN
	Cred its	14 × 6 = 84	2 × 4 = 8	2 × 4 = 8	4 × 6 = 24	4 × 6 = 24
<b>I</b>	ZOO-HC-1 016	ENG-AE-10 14				XXX-HG- 1XX6
	ZOO-HC-1 026					
<b>II</b>	ZOO-HC-2 016	ENV-AE-20 14				XXX-HG- 2XX6
	ZOO-HC-2 026					
<b>III</b>	ZOO-HC-3 016			ZOO-SE- 3YY4†		XXX-H G- 3XX6
	ZOO-HC-3 026					
	ZOO-HC-3 036					
<b>IV</b>	ZOO-HC-4 016			ZOO-SE- 4YY4†		XXX-H G- 4XX6
	ZOO-HC-4 026					
	ZOO-HC-4 036					
<b>V</b>	ZOO-HC-5 016				ZOO-HE- 5YY6‡	
	ZOO-HC-5 026				ZOO-HE- 5YY6‡	
<b>VI</b>	ZOO-HC-6 016				ZOO-HE- 6YY6‡	
	ZOO-HC-6 016				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
<b>Total Credits in Semester I</b>			<b>22</b>
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
<b>Total Credits in Semester II</b>			<b>22</b>
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 Practical/Tutorial 3	2/1
<b>Total Credits in Semester III</b>			<b>28</b>
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
<b>Total Credits in Semester IV</b>			<b>28</b>
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		
<b>Total Credits in Semester V</b>			<b>24</b>
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

	<b>DSE-4 Lab</b>	
<b>Total Credits in Semester VI</b>		<b>24</b>
<b>Grand Total Credits</b>		<b>148</b>

**\*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:** Parasitology (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 Semester III**

**Any One from the following**

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

**SEC for Semester IV**

**Any One from the following**

3. **ZOO-SE-4014:** Non Mulberry sericulture
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**
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**CORE COURSE I  
CODE: ZOO-HC-1016**

**NON-CHORDATES I: PROTISTS TO PSEUDOCOELOMATES**

<b>THEORY</b>	<b>(Credits 4)</b>
<b>Unit 1: Protista, Parazoa and Metazoa</b>	<b>19</b>
General characteristics and Classification upto classes Study of <i>Euglena</i> , <i>Amoeba</i> and <i>Paramecium</i> Life cycle and pathogenicity of <i>Plasmodium vivax</i> and <i>Entamoeba histolytica</i> Locomotion and Reproduction in Protista Evolution of symmetry and segmentation of Metazoa	
<b>Unit 2: Porifera</b>	<b>7</b>
General characteristics and Classification upto classes Canal system and spicules in sponges	
<b>Unit 3: Cnidaria</b>	<b>12</b>
General characteristics and Classification upto classes Metagenesis in <i>Obelia</i> Polymorphism in Cnidaria Corals and coral reefs	
<b>Unit 4: Ctenophora</b>	<b>4</b>
General characteristics and Evolutionary significance	
<b>Unit 5: Platyhelminthes</b>	<b>10</b>
General characteristics and Classification up to classes Life cycle and pathogenicity of <i>Fasciola hepatica</i> and <i>Taeniasolium</i>	
<b>Unit 6: Nematelminthes</b>	<b>8</b>
General characteristics and Classification up to classes Lifecycle, and pathogenicity of <i>Ascaris lumbricoides</i> and <i>Wuchereri abancrofti</i> 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. 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*, *Pennatulula*, *Fungia*, *Meandrina*, *Madrepora*
5. One specimen/slide of any ctenophore
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*, 8<sup>th</sup> 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

**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 quadrat 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).
4. Report on a visit to National Park/Biodiversity Park/Wild life sanctuary

### **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 Press

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

<b>THEORY</b>	<b>(Credits 4)</b>
<b>Unit 1: Introduction to Coelomates</b>	<b>2</b>
Evolution of coelom and metamerism	
<b>Unit 2: Annelida</b>	<b>10</b>
General characteristics and Classification upto classes Excretion in Annelida	
<b>Unit 3: Arthropoda</b>	<b>17</b>
General characteristics and Classification upto classes Vision and Respiration in Arthropoda Metamorphosis in Insects Social life in bees and termites	
<b>Unit 4: Onychophora</b>	<b>4</b>
General characteristics and Evolutionary significance	
<b>Unit 5: Mollusca</b>	
General characteristics and Classification upto classes Respiration in Mollusca Torsion and detorsion in Gastropoda Pearl formation in bivalves Evolutionary significance of trochophore larva	
<b>Unit 6: Echinodermata</b>	<b>12</b>
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*, 8<sup>th</sup> edition, Holt Saunders International Edition”

## NON-CHORDATES II: COELOMATES

### PRACTICAL

(Credits 2)

1. Study of following specimens:  
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. Study of digestive system, septal nephridia and pharyngeal nephridia of earthworm
3. T.S. through pharynx, gizzard, and typhlosolar intestine of earthworm
4. Mount of mouth parts and dissection of digestive system and nervous system of *Periplaneta*\*
5. To submit a Project Report on any related topic to larval forms (crustacean, mollusc and echinoderm)

**Note:** Classification to be followed from “Ruppert and Barnes (2006) *Invertebrate Zoology*, 8<sup>th</sup> 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

**CORE COURSE IV**  
**CODE: ZOO-HC-2026**  
**CELL BIOLOGY**

<b>THEORY</b>	<b>(Credits4)</b>
<b>Unit 1: Over view of Cells</b>	<b>3</b>
Prokaryotic and Eukaryotic cells, Virus, Viroids, Mycoplasma, Prions	
<b>Unit 2:Plasma Membrane</b>	<b>7</b>
Various models of plasma membrane structure Transportacrossmembranes:ActiveandPassivetransport,Facilitatedtra nsport Cell junctions: Tight junctions, Desmosomes, Gapjunctions	
<b>Unit 3:Endomembrane System</b>	<b>10</b>
Structure and Functions: Endoplasmic Reticulum, Golgi Apparatus, Lysosomes	
<b>Unit 4: Mitochondria and Peroxisomes</b>	<b>8</b>
Mitochondria:Structure,Semi- autonomou nature,Endosymbiotichypothesis Mitochondrial Respiratory Chain, Chemi-osmotichypothesis Peroxisomes	
<b>Unit5:Cytoskeleton</b>	<b>8</b>
Structure and Functions: Microtubules, Microfilaments and Intermediate filaments	
<b>Unit6:Nucleus</b>	<b>12</b>
Structure of Nucleus: Nuclearenvelope, Nuclear pore complex, Nucleolus Chromatin: Euchromatin and Hetrochromatin and packaging(nucleosome)	
<b>Unit 7:Cell Division</b>	<b>8</b>
Mitosis, Meiosis, Cell cycle and its regulation	
<b>Unit 8:Cell Signaling</b>	<b>4</b>
GPCR and Role of second messenger (cAMP)	

## CELL BIOLOGY

### 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:
  - i DNA by Feulgen reaction
  - ii Mucopolysaccharides by PAS reaction
  - iii Proteins by Mercurio 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. ASM Press and Sunderland, Washington, D.C.; Sinauer Associates, MA.
- 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 Albert, Bray Dennis, Levis Julian, Raff Martin, Roberts Keith and Watson James (2008). *Molecular Biology of the Cell*, V Edition, Garland publishing Inc., New York and London.

## CORE COURSE V

### DIVERSITY OF

### CHORDATA

CODE: ZOO-HC-3016

<b>THEORY</b>	<b>(Credits 4)</b>
<b>Unit 1: Introduction to Chordates</b>	<b>2</b>
General characteristics and outline classification	
<b>Unit2:Protochordata</b>	<b>8</b>
General characteristics of Hemichordata, Urochordata and Cephalochordata; Study of larval forms in protochordates; Retrogressive metamorphosis in Urochordata	
<b>Unit 3: Origin of Chordata</b>	<b>3</b>
Dipleurula concept and the Echinoderm theory of origin of chordates Advanced features of vertebrates over Protochordata	
<b>Unit4:Agnatha</b>	<b>2</b>
General characteristics and classification of cyclostomes up to class	
<b>Unit5:Pisces</b>	<b>8</b>
General characteristics of Chondrichthyes and Osteichthyes, classification up to order Migration, Osmoregulation and Parental care in fishes	
<b>Unit6:Amphibia</b>	<b>6</b>
Origin of <i>Tetrapoda</i> (Evolution of terrestrial ectotherms); General characteristics and classification up to order; Parental care in Amphibians	
<b>Unit7:Reptilia</b>	<b>7</b>
General characteristics and classification up to order; Affinities of <i>Sphenodon</i> ; Poison apparatus and Biting mechanism in snakes	
<b>Unit8:Aves</b>	<b>8</b>
General characteristics and classification up to order <i>Archaeopteryx</i> -- a connecting link; Principles and aerodynamics of flight, Flight adaptations and Migration in birds	
<b>Unit9:Mammals</b>	<b>8</b>
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-poisonous snakes

#### 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

18

- 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 Hallgrímsson B. (2008). *Strickberger's Evolution*.  
IV Edition. Jones and Bartlett Publishers Inc.

**CORE COURSE VI**  
**ANIMAL PHYSIOLOGY: CONTROLLING AND COORDINATING**  
**SYSTEMS**  
**CODE: ZOO-HC-3026**

<b>THEORY</b>	<b>(Credits 4)</b>
<b>Unit 1: Tissues</b>	<b>6</b>
Structure, location, classification and functions of epithelial tissue, connective tissue, muscular tissue and nervous tissue	
<b>Unit 2: Bone and Cartilage</b>	<b>4</b>
Structure and types of bones and cartilages, Ossification, bone growth and resorption	
<b>Unit 3: Nervous System</b>	<b>10</b>
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.	
<b>Unit 4: Muscle</b>	<b>12</b>
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	
<b>Unit 5: Reproductive System</b>	<b>10</b>
Histology of testis and ovary; Physiology of male and female reproduction; Puberty, Methods of contraception in male and female	
<b>Unit 6: Endocrine System</b>	<b>18</b>
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 hormone action, Signal transduction pathways for steroid and non-steroidal hormones; Hypothalamus (neuroendocrine gland)- principal nuclei involved 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 jerk reflex)
2. Preparation of temporary mounts: Squamous epithelium, Striated muscle fibres and nerve cells
3. Study of permanent slides of Mammalian skin, Cartilage, Bone, Spinal cord, Nerve cell, Pituitary, Pancreas, Testis, Ovary, Adrenal, Thyroid and Parathyroid
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. Harcourt 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**

<b>THEORY</b>	<b>(CREDITS 4)</b>
<b>Unit1:Carbohydrates</b>	<b>8</b>
Structure and Biological importance: Monosaccharides, Disaccharides, Polysaccharides and Glycoconjugates	
<b>Unit2:Lipids</b>	<b>8</b>
Structure and Significance: Physiologically important saturated and unsaturated fatty acids, Tri-acylglycerols, Phospholipids, Glycolipids, Steroids	
<b>Unit3:Proteins</b>	<b>14</b>
<b>Amino acids:</b> Structure, Classification and General properties of $\alpha$ -amino acids; Physiological importance of essential and non-essential $\alpha$ -amino acids	
<b>Proteins:</b> Bonds stabilizing protein structure; Levels of organization in proteins; Denaturation; Introduction to simple and conjugate proteins	
<b>Immunoglobulins:</b> Basic Structure, Classes and Function, Antigenic Determinants	
<b>Unit 4:NucleicAcids</b>	<b>12</b>
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	
<b>Unit5:Enzymes</b>	<b>18</b>
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 $K_m$ and $V_{max}$ , 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., 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.

**CORE COURSE VIII COMPARATIVE  
ANATOMY OF VERTEBRATES**

**CODE: ZOO-HC-4016**

<b>THEORY</b>	<b>(CREDITS 4)</b>
<b>Unit 1: Integumentary System</b>	<b>8</b>
Structure, functions and derivatives of integument	
<b>Unit 2: Skeletal System</b>	<b>8</b>
Overview of axial and appendicular skeleton, Jaw suspensorium, Visceral arches	
<b>Unit 3: Digestive System</b>	<b>8</b>
Alimentary canal and associated glands, dentition	
<b>Unit 4: Respiratory System</b>	<b>8</b>
Skin, gills, lungs and air sacs; Accessory respiratory organs	
<b>Unit 5: Circulatory System</b>	<b>8</b>
General plan of circulation, evolution of heart and aortic arches	
<b>Unit 6: Urinogenital System</b>	<b>6</b>
Succession of kidney, Evolution of urinogenital ducts, Types of mammalian uteri	
<b>Unit 7: Nervous System</b>	<b>8</b>
Comparative account of brain Autonomic nervous system, Spinal cord, Cranial nerves in mammals	
<b>Unit 8: Sense Organs</b>	<b>6</b>
Classification of receptors Brief account of visual and auditory receptors in man	



## COMPARATIVE ANATOMY OF VERTEBRATES

### PRACTICAL

(CREDITS 2)

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 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

**CORE COURSE IX**  
**ANIMAL PHYSIOLOGY: LIFE SUSTAINING SYSTEMS**  
**CODE: ZOO-HC-4026**

**THEORY** **(Credits 4)**

**Unit 1: Physiology of Digestion** **14**

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

**Unit 2: Physiology of Respiration** **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

**Unit 4: Blood** **14**

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

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

Blood groups: Rh factor, ABO and MN

**Unit 5: Physiology of Heart** **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's haemoglobinometer
4. Preparation of haemin crystals
5. Recording of blood pressure using a sphygmomanometer
6. Examination of sections of mammalian oesophagus, stomach, duodenum, ileum, rectum, liver, trachea, lung, kidney

**(\*Subject to UGC guidelines)**

### **SUGGESTED READINGS**

- Guyton, A.C. & Hall, J.E. (2006). Textbook of Medical Physiology. X Edition. Harcourt 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.
- Vander A, Sherman J. and Luciano D. (2014). Vander's Human Physiology: 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**

$\beta$ -oxidation and omega-oxidation of saturated fatty acids with even and odd number of carbon atoms; Biosynthesis of palmitic acid; Ketogenesis

**Unit 4: Protein Metabolism** **10**

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

**Unit 5: Oxidative Phosphorylation** **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's method.
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) [goat liver]
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., 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.

## 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; Process of 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; Inhibitors of proteinsynthesis; 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: enhance silencer elements; Activators, repressors, rs, 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*. VIII Edition. 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**

<b>THEORY</b>	<b>(CREDITS 4)</b>
<b>Unit 1: Mendelian Genetics and its Extension</b>	<b>8</b>
Principles of inheritance, Incomplete dominance and co-dominance, Multiple alleles, Lethal alleles, Epistasis, Pleiotropy, Sex-linked, sex- influenced and sex-limited characters inheritance.	
<b>Unit 2: Linkage, Crossing Over and Chromosomal Mapping</b>	<b>12</b>
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.	
<b>Unit3:Mutations</b>	<b>10</b>
Typesofgenemutations(Classification),Typesofchromosomalaberrations (Classification, figures and with one suitable example of each), Molecular basisofmutationsinrelationtoUVlightandchemicalmutagens;Detection of mutations: CLB method, attached X method.	
<b>Unit 4:SexDetermination</b>	<b>4</b>
Chromosomal mechanisms of sex determination in Drosophila and Man	
<b>Unit 5:Extra-chromosomalInheritance</b>	<b>6</b>
Criteria for extra-chromosomal inheritance, Antibiotic resistance in <i>Chlamydomonas</i> , Mitochondrial mutations in <i>Saccharomyces</i> , Infective heredity in <i>Paramecium</i> and Maternal effects	
<b>Unit 6:PolygenicInheritance</b>	<b>3</b>
Polygenic inheritance with suitable examples; simple numericals based on it.	
<b>Unit 7: Recombination in BacteriaandViruses</b>	<b>9</b>
Conjugation, Transformation, Transduction, Complementation test in Bacteriophage	
<b>Unit 8: TransposableGeneticElements</b>	<b>8</b>
Transposons in bacteria, Ac-Ds elements <sup>33</sup> in maize and P elements in <i>Drosophila</i> , 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)**

**Unit 1: Introduction**

**4**

Historical perspective and basic concepts: Phases of development, Cell-Cell interaction, Pattern formation, Differentiation and growth, Differential gene 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: Post Embryonic Development**

**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 of Developmental Biology**

**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 (photomicrograph/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 Computer Press
- Carlson, R. F. Patten's Foundations of Embryology
- Kalthoff (2008). Analysis of Biological Development, II Edition, McGraw-Hill Publishers
- Lewis Wolpert (2002). Principles of Development, II Edition, Oxford University Press

**CORE COURSE XIV**

**EVOLUTIONARY**

**BIOLOGY**

**CODE: ZOO-HC-6026**

<b>THEORY</b>	<b>(CREDITS 4)</b>
<b>Unit1:</b> Life's Beginnings: Chemogeny, RNA world, Biogeny, Origin of photosynthesis, Evolution of eukaryotes	<b>7</b>
<b>Unit2:</b> Historical review of evolutionary concept: Lamarckism, Darwinism, Neo-Darwinism	<b>4</b>
<b>Unit3:</b> 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	<b>10</b>
<b>Unit4:</b> Sources of variations: Heritable variations and their role in evolution	<b>8</b>
<b>Unit5:</b> Population genetics: Hardy-Weinberg Law (statement and derivation of equation, application of law to human Population); Evolutionary forces upsetting H-W equilibrium; Natural selection (concept of fitness, selection coefficient, derivation of 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; Role of Migration and Mutation in changing allele frequencies	<b>13</b>
<b>Unit6:</b> 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	<b>7</b>
<b>Unit7:</b> Extinctions, Background and mass extinctions (causes and effects), detailed example of K-T extinction	<b>2</b>
<b>Unit8:</b> Origin and evolution of man, Unique hominin characteristics contrasted with primate characteristics, primate phylogeny from <i>Dryopithecus</i> leading to <i>Homo</i>	<b>6</b>

*sapiens*, molecular analysis of human origin

**Unit9:**

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

2

# EVOLUTIONARY BIOLOGY

## PRACTICALS

(CREDITS2)

1. Study of fossils from models/pictures
2. Study of homology and analogy from suitable specimens
3. Study and verification of Hardy-Weinberg Law by chi square analysis
4. Graphical representation and interpretation of data of height/weight of a sample of 100 humans in relation to their age and sex.
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 Blackwell publishing
- Hall, B.K. and Hallgrimson, B (2008). Evolution IV Edition. Jones and Barlett Publishers.
- Campbell, N.A. and Reece J.B (2011). Biology. IX Edition. Pearson, Benjamin, Cummings.
- Douglas, J. Futuyma (1997). Evolutionary Biology. Sinauer Associates.
- Snustad. S Principles of Genetics.
- 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: Biological Databases** **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 and Data Retrieval** **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)

**Unit 5: 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 of data
6. To learn graphical representations of statistical data with the help of computers (e.g. MS Excel).

### SUGGESTED READINGS

- Ghosh Z and Mallick B. (2008). *Bioinformatics: Principles and Applications*, Oxford University Press.
- Pevsner J. (2009). *Bioinformatics and Functional Genomics*, II Edition, Wiley Blackwell.
- Zvelebil, Marketa and Baum O. 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: Principles and Practice*. Tata McGraw Hill Education Private Limited, India.
- Pagana, M. and Gavreau, K. (2000). *Principles of Biostatistics*, Duxberry Press, USA

CODE: ZOO-HC-5026

### ANIMAL BIOTECHNOLOGY

### THEORY

(Credits  
4)

<b>Unit 1. Introduction</b>	<b>8</b>
Concept and scope of biotechnology	
<b>Unit 2. Molecular Techniques in Gene manipulation</b>	<b>24</b>
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	
<b>Unit 3. Genetically Modified Organisms</b>	<b>18</b>
Production of cloned and transgenic animals: Nuclear Transplantation, Retroviral Method, DNA microinjection	
Applications of transgenic animals: Production of pharmaceuticals, production of donor organs, knock out mice.	
Production of transgenic plants: <i>Agrobacterium</i> mediated transformation.	
Applications of transgenic plants: insect and herbicide resistant plants.	
<b>Unit 4. Culture Techniques and Applications</b>	<b>10</b>
Animal cell culture, Expressing cloned genes in mammalian cells, Molecular diagnosis of genetic diseases (Cystic fibrosis, Sickle cell anemia)	
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's Method)
  - e. PCR
  - f. DNA fingerprinting
7. 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.
- Watson, J.D., Myers, R.M., Caudy, A. and Witkowski, J.K. (2007). *Recombinant DNA- Genes and Genomes- A Short Course*. III Edition, Freeman and Co., N.Y., USA.
- Beauchamp, T.I. and Childress, J.F. (2008). *Principles of Biomedical 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-hypophysial Axis**

**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- Saunders Toppan
- Endocrinology: An Integrated Approach; Stephen Nussey and Saffron Whitehead.
- Oxford: BIOS Scientific Publishers; 2001.
- Hadley, M.E. and Levine J.E. 2007. Endocrinology, 6th Edition. Pearson Prentice-Hall, Pearson Education Inc., New Jersey.
- 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*, *Trypanosoma 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 *Ascaris lumbricoides*, *Ancylostoma duodenale*, *Wuchereria bancrofti* and *Trichinella spiralis*. Study of structure, life cycle and importance of *Meloidogyne* (root knot nematode), *Pratylenchus* (lesion nematode)

**Unit IV: Parasitic Arthropoda**

**10**

Biology, importance and control of ticks, mites, *Pediculus humanus* (head and body louse), *Xenopsyllacheopsis* and *Cimex lectularius*

**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*, *Schistosoma mahaematobium*, *Taenia solium* and *Hymenolepis nana* through permanent slides/microphotographs
- Study of adult and life stages of *Ascaris lumbricoides*, *Ancylostomaduodenale*, *Wuchereria bancrofti* and *Trichinella spiralis* through permanent slides/microphotographs
- Study of plant parasitic root knot nematode, *Meloidogyne* from the soil sample
- Study of *Pediculus humanus* (Head louse and Body louse), *Xenopsyllacheopsis* and *Cimex lectularius* through permanent slides/photographs
- Study of monogenea from the gills of fresh/marine fish [Gills can be procured from fish market as by product of the industry]
- 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 SUGGESTED READINGS

- Arora, D. R and Arora, B. (2001) *Medical Parasitology*. II Edition. CBS Publications and Distributors
- E.R. Noble and G.A. Noble (1982) *Parasitology: The biology of animal parasites*. V Edition, Lea & Febiger
- Ahmed, N., Dawson, M., Smith, C. and Wood, Ed. (2007) *Biology of Disease*. Taylor and Francis Group
- Parija, S. C. *Textbook of medical parasitology, protozoology & helminthology (Text and colour Atlas)*, II Edition, All India Publishers & Distributors, Medical Books Publishers, Chennai, Delhi
- Rattan Lal Chhpujani and Rajesh Bhatia. *Medical Parasitology*, III Edition, Jaypee Brothers Medical Publishers (P) Ltd., New Delhi

□ Meyer, Olsen & Schmidt's Essentials of Parasitology,  
Murray, D. Dailey, W.C. Brown Publishers

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

**CODE: ZOO-HE-6016**  
**BIOLOGY OF INSECTA**

<b>THEORY</b>	<b>(Credits 4)</b>
<b>Unit I: Introduction</b>	<b>4</b>
General Features of Insects	
Distribution and Success of Insects on the Earth	
<b>Unit II: Insect Taxonomy</b>	<b>4</b>
Basis of insect classification; Classification of insects up to orders	
<b>Unit III: General Morphology of Insects</b>	<b>8</b>
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	
<b>Unit IV: Physiology of Insects</b>	<b>28</b>
Structure and physiology of Insect body systems - Integumentary, digestive, excretory, circulatory, respiratory, endocrine, reproductive, and nervous system	
Sensory receptors	
Growth and metamorphosis	
<b>Unit IV: Insect Society</b>	<b>6</b>
Group of social insects and their social life	
Social organization and social behaviour (w.r.t. any one example)	
<b>Unit V: Insect Plant Interaction</b>	<b>4</b>
Theory of co-evolution, role of allelochemicals in host plant mediation Host-plant selection by phytophagous insects, Insects as plant pests	
<b>Unit VI: Insects as Vectors</b>	<b>6</b>
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 their venation.
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 their damages
9. Study of any three beneficial insects and their products

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

### SUGGESTED READINGS

- A general text book of entomology, Imms, A. D., Chapman & Hall, UK
- The Insects: Structure and function, Chapman, R. F., Cambridge University Press, UK
- Principles of Insect Morphology, Snodgrass, R. E., Cornell Univ. 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., Harvard Univ. Press, UK
- Host Selection by Phytophagous insects, Bernays, E. A., and Chapman, 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; Bioluminescence; 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 of fish; Pen and cage culture; Polyculture; Composite fish culture; Brood stock management; Induced breeding of fish; Management of finfish hatcheries; Preparation and maintenance of fish aquarium; Preparation of compound diets for fish; Role of water quality in aquaculture; Fish diseases: Bacterial, viral and parasitic; Preservation and processing of harvested fish, Fishery by-products

**UNIT 5: Fish in research** 53 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. Water quality criteria for Aquaculture: Assessment of pH, 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. Project Report on a visit to any fish farm/pisciculture unit/Zebra fish rearing Lab.

### SUGGESTED READINGS

- Q Bone and R Moore, Biology of Fishes, Talyor and Francis Group, CRC Press, U.K.
- D. H. Evans and J. D. Claiborne, The Physiology of Fishes, Taylor and Francis Group, CRC Press, UK von der Emde, R. J. Mogdans and B. G. Kapoor. The Senses of Fish: Adaptations for the Reception of Natural Stimuli, 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**

Gonadal hormones and mechanism of hormone action, steroids, glycoprotein hormones, and prostaglandins, hypothalamo – hypophyseal – gonadal axis, regulation of gonadotropin 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, stem 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. and Short, R. V. reproduction in Mammals. Cambridge University Press.
- Degroot, L.J. and Jameson, J.L. (eds). Endocrinology. W.B. Saunders and Company.
- Knobil, E. et al. (eds). The Physiology of Reproduction. Raven Press Ltd.
- 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 successional process; Cover construction; Preservation of general genetic diversity; Restoration of degraded habitats

**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**

Estimation of carrying capacity; Ecotourism/wildlife tourism in forests; Concept of climax persistence; Ecology of perturbation.

**Unit 7: Management of excess population**

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

**Unit 8: Protected areas**

National parks & sanctuaries, Community reserve; Important features of protected areas in India; Tiger conservation - Tiger reserves in India; Management challenges in Tiger reserve.

## 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 & rectangular plots, Parker's 2 Step and other methods for ground cover assessment, Tree canopy cover assessment, Shrub cover assessment.
6. Trail/transect monitoring for abundance and diversity estimation of mammals and bird (direct and indirect evidences)

### SUGGESTED READINGS

- ☐ Caughley, G., and Sinclair, A.R.E. (1994). *Wildlife Ecology and Management*. Blackwell Science.
- ☐ Woodroffe R., Thirgood, S. and Rabinowitz, A. (2005). *People and Wildlife, Conflict or Co-existence?* Cambridge University.
- ☐ Bookhout, T.A. (1996). *Research and Management Techniques for Wildlife and Habitats*, 5 th edition. The Wildlife Society, Allen Press.
- ☐ Sutherland, W.J. (2000). *The Conservation Handbook: Research, Management and Policy*. Blackwell Sciences
- ☐ Hunter M.L., Gibbs, J.B. and Sterling, E.J. (2008). *Problem-Solving in Conservation Biology and Wildlife Management: Exercises for Class, Field, and Laboratory*. Blackwell Publishing.

**ZOO-HE-6056**

**DISSERTATION**

Dissertation of Zoology Specific subject

□ .

**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 Nematelminthes**

**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

<b>Unit 8: Phylum Mollusca</b>	<b>4</b>
General characters and classification up to classes; Torsion in gastropods	
<b>Unit 9: Phylum Echinodermata</b>	<b>4</b>
General characters and classification up to classes; Water-vascular system in Asterozoa	
<b>Unit 10: Protochordates</b>	<b>2</b>
General features and Phylogeny of Protochordata	
<b>Unit 11: Agnatha</b>	<b>2</b>
General features of Agnatha and classification of cyclostomes up to classes	
<b>Unit 12: Pisces</b>	<b>4</b>
General features and Classification up to orders; Osmoregulation in Fishes	

<b>Unit13: Amphibia</b>	<b>4</b>
General features and Classification up to orders; Parental care	
<b>Unit14: Reptiles</b>	<b>4</b>
General features and Classification up to orders; Poisonous and non-poisonous snakes, Biting mechanism in snakes	
<b>Unit15: Aves</b>	<b>5</b>
General features and Classification up to orders; Flight adaptations in birds	
<b>Unit17: Mammals</b>	<b>5</b>
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 following specimens:

*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 this purpose.

### 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
- Young, J. Z. (2004). *The Life of Vertebrates*. III Edition. Oxford university press.
- Pough H. *Vertebrate life*, VIII Edition, Pearson International.
- Hall B.K. and Hallgrimsson B. (2008). *Strickberger's Evolution*. IV Edition. Jones and Bartlett Publishers Inc.

**COMPARATIVE ANATOMY AND DEVELOPMENTAL BIOLOGY OF  
VERTEBRATES**  
CODE: ZOO-HG-2016

<b>THEORY</b>	<b>(CREDITS 4)</b>
<b>Unit 1: Integumentary System</b>	<b>4</b>
Derivatives of integument w.r.t. glands and digital tips	
<b>Unit 2: Skeletal System</b>	<b>3</b>
Evolution of visceral arches	
<b>Unit 3: Digestive System</b>	<b>4</b>
Brief account of alimentary canal and digestive glands	
<b>Unit 4: Respiratory System</b>	<b>5</b>
Brief account of Gills, lungs, air sacs and swim bladder	
<b>Unit 5: Circulatory System</b>	<b>4</b>
Evolution of heart and aortic arches	
<b>Unit 6: Urinogenital System</b>	<b>4</b>
Succession of kidney, Evolution of urinogenital ducts	
<b>Unit 7: Nervous System</b>	<b>3</b>
Comparative account of brain	
<b>Unit 8: Sense Organs</b>	<b>3</b>
Types of receptors	
<b>Unit 9: Early Embryonic Development</b>	<b>12</b>
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.	
<b>Unit 10: Late Embryonic Development</b>	<b>10</b>
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.	
<b>Unit 11: Control of Development</b>	<b>8</b>

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)**

<b>Unit 1: Nerve and muscle</b>	<b>8</b>
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	
<b>Unit 2: Digestion</b>	<b>5</b>
Physiology of digestion in the alimentary canal; Absorption of carbohydrates, proteins, lipids	
<b>Unit 3: Respiration</b>	<b>5</b>
Pulmonary ventilation, Respiratory volumes and capacities, Transport of Oxygen and carbon dioxide in blood	
<b>Unit 4: Excretion</b>	<b>5</b>
Structure of nephron, Mechanism of Urine formation, Counter-current Mechanism	
<b>Unit 5: Cardiovascular system</b>	<b>6</b>
Composition of blood, Hemostasis, Structure of Heart, Origin and conduction of the cardiac impulse, Cardiac cycle	
<b>Unit 6: Reproduction and Endocrine Glands</b>	<b>7</b>
Physiology of male reproduction: hormonal control of spermatogenesis; Physiology of female reproduction: hormonal control of menstrual cycle Structure and function of pituitary, thyroid, Parathyroid, pancreas and adrenal	
<b>Unit 7: Carbohydrate Metabolism</b>	<b>8</b>
Glycolysis, Krebs Cycle, Pentose phosphate pathway, Gluconeogenesis, Glycogen metabolism, Review of electron transport chain	
<b>Unit 8: Lipid Metabolism</b>	<b>5</b>
Biosynthesis and $\beta$ oxidation of palmitic acid	
<b>Unit 9: Protein metabolism</b>	<b>5</b>
Transamination, Deamination and Urea Cycle	
<b>Unit 10: Enzymes</b>	<b>6</b>
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). *Textbook of Medical Physiology*, XII Edition, Harcourt Asia Pvt. Ltd/ W.B. Saunders Company
- Berg, J. M., Tymoczko, J. L. and Stryer, L. (2006). *Biochemistry*. VI Edition. W.H Freeman and Co.
- Nelson, D. L., Cox, M. M. and Lehninger, A.L. (2009). *Principles of Biochemistry*. IV Edition. W.H. Freeman and Co.
- Murray, R.K., Granner, D.K., Mayes, P.A. and Rodwell, V.W. (2009). *Harper's Illustrated Biochemistry*. XXVIII Edition. Lange Medical Books/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

### **Unit 4: 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.



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## 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

**Unit 5: Entrepreneurship in Apiculture**

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.
- Singh S., *Bee keeping in India*, Indian council of Agricultural Research, New Delhi.

CODE: ZOO-SE-4014

**SEC 2 NON-**

**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 of Sericulture, 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.

**Wildlife Photography and  
Ecotourism**

**CREDITS 4  
Credit-1**

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

- 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

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.
- Wadhwa, 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.