Solapur University, Solapur

B. Sc. Zoology Part – III
Final Syllabus

Semester V & VI

w.e.f. - 2015-16

SOLAPUR UNIVERSITY, SOLAPUR

SYLLABUS FOR B.Sc. PART III (ZOOLOGY) Semester V & VI

(w. e. f. JUNE 2015)

Eligibility:

A student, who has been declared to have passed B.Sc. Part II Zoology successfully or is declared to be A.T.K.T. at B.Sc. Zoology and has cleared B.Sc. Part I, is eligible to take admission to B.Sc. Part III.

Course structure:

- The B. Sc. Part III (Zoology) will have two semesters viz… **Sem V and Sem VI**.
- Each semester shall comprise of four theory papers.
- Each paper has the weightage of 50 marks
- The course also includes a paper on English (Compulsory) as per B.Sc. III structure of Science faculty in each semester.
- The course also includes four practical courses with annual pattern of 50 marks each.
- The university practical examination will be conducted at the end of sixth semester.

SOLAPUR UNIVERSITY, SOLAPUR

Syllabus for B.Sc. III Zoology

(w.e.f. June 2015 onwards)

Theory Course

Semester V

Paper No.	Title of Paper	Marks	Lecture/ Periods
	Compulsory English	**50**	**45**
Paper- IX	Non-chordates	50	45
Paper- X	Biostatistics, Bioinformatics, Medical Zoology and Evolutionary Genetics	50	45
Paper- XI	Comparative Anatomy of Chordates	50	45
Paper -XII	Developmental Biology	50	45

Semester VI

Paper No.	Title of Paper	Marks	Lecture/ Periods
	Compulsory English	**50**	**45**
Paper XIII	Physiology	50	45
Paper- XIV	Endocrinology, Environmental Biology and Toxicology	50	45
Paper – XV	Molecular Biology and Biotechnology	50	45
Paper – XVI	Biotechniques and Applied Zoology	50	45

Practical Course

Practical No.	Title of Practical course	Marks
I	Non-chordates, Biostatistics, Bioinformatics, Medical Zoology and Evolutionary Genetics	50
II	Comparative Anatomy of Chordates and Developmental Biology	50
III	Physiology, Endocrinology, Environmental Biology and Toxicology	50
IV	Molecular Biology and Biotechnology and Applied Zoology	50

SOLAPUR UNIVERSITY, SOLAPUR
Semester Pattern Syllabus
B.Sc. III Zoology (Semester – V)
w. e. f. June 2015
Paper- IX: Non-chordates

UNIT - I. Protozoa – (4)
1. Nutrition in Protozoa**. -**
2. Reproduction in Protozoa. -

UNIT -II. Porifera –
1. Types of Canal Systems. - (2)

UNIT -III A) Coelenterata – (4)
1. Polymorphism. -
2. Corals and Coral reef. -

B) Salient features and affinities of Ctenophora. - (2)

UNIT -IV. Annelida –Type study - Leech : - (10)
1. Systematic position, Habits and habitat.
2. Morphology, body wall, & Locomotion.
3. Food, feeding and digestive system.
4. Haemo-coelomic system.
5. Excretory system.
6. Nervous system and Sense organs.
7. Reproductive system, copulation and cocoon formation.
8. Parasitic adaptations and economic importance.

UNIT -V Arthropoda – (8)
1.Significance of Peripatus and Limulus
2. Study of Crustacean larvae. -
3. Types of Insect larvae. -
4. Insect metamorphosis & its hormonal control.

UNIT –VI Mollusca –
1. Torsion and Detorsion. - (2)

UNIT - VII Echinodermata –

A)Type study –Sea star (9)
a) Systematic position, Habit and habitat.
c) Morphology and body wall.
d) Food, feeding and digestive system.
e) Water vascular system and locomotion.
f) Reproductive system.
g) Nervous system and sense organs.
h) Haemal and perihaemal system.

B). **Echinoderm larvae -** (2)

C). Minor phyla - Salient features and affinities of- Lingula (2)

Total periods - (45)

Paper- X
Biostatistics, Bioinformatics, Medical Zoology and Evolutionary Genetics

I. Biostatistics:

UNIT -I. A) Classification and Tabulation. - (3)
B) Frequency distribution & Graphical representation. - (2)

UNIT -II A) Measures of Central Tendency - Mean, Median and Mode. (4)
B) Dispersion – Mean Deviation, Standard Deviation & Standard Error, Student-T-test - (4)

UNIT -III Correlation –
a) Scatter diagram, - (3)
b) Types of correlation & Correlation coefficient.
i) Spearman's Rank Correlation Coefficient.
ii) Karl Pearson's Correlation Coefficient.

UNIT - IV **Bioinformatics :** - (7)
1. Introduction and applications of Bioinformatics
2. Introduction to proteomics and genomics
3. Applications of search Engine: Entrez, BLAST.
.

UNIT - V **Medical Zoology**:

Study of following diseases with respect to their pathogenecity and treatment (7)

a) Polio
b) Rabies
c) Ebola
d) Tuberculosis

UNIT -VI

Study of following diseases with respect to their pathogenecity and treatment (7)

a) Malaria
b)Fasciolasis
c) Elephantiasis

UNIT –VII **Evolutionary Genetics:**
1. Hardy-Weinberg Law of genetic equilibrium. (08)
2. Destabilizing forces of Natural selection with reference to:
a) Genetic drift and
b) Migration

Total Periods- (45)

Reference Books- (for Paper IX and X)

• There are few websites providing free downloadable books.

• Website of NCBI provides more than thirty books on microbiology, molecular biology, genetics and Biotechnology
• Website named Books4Doctor gives books on histology, physiology, molecular biology and Human genetics.

The books can be searched alphabetically.

1. Invertebrate Zoology- (W.B. Saunders Co.) – Barnes R.D.
2. Treatise in Zoology Sedgwick Vol III
3. Modern Text Book of Zoology, Invertebrates – R.L.Kotpal.
4. life of Invertebrates – S.N. Prasad, Vikas publishing House, New Delhi.
5. A Life of Invertebrates- Russell & Hunter.
6. Practical Zoology, Invertebrates- S.S. Lal.
7. Info technology- S. Chand and Co.
8. Bioinformatics- Murti, Himalaya Publications.
9. Introduction to Bioinformatics Attwood Pearson Education Delhi
10. General Parasitology- Cheng, T.C. Academic Press.
11. Parasitology-Chandler, Allied Agency, Kolkata.
12. Essentials of Parasitology – Gerald D. Smidth.
13. Introduction to Biostatistics Pranab Kumar Banerjee S. Chand and Company. New Delhi
14. Wikipedia : Free encyclopedia Major topics in Population genetics and related examples can be searched.
15. Evolution : Mark Ridley Blackwell Publishing In India marketed by John Wiley and Sons.
16. Textbook of medical Parasitology: K.D.Chatterjee

Paper- XI

Comparative Anatomy of Chordates

UNIT - I. a)Integument and its derivatives - (7)
b) Endoskeleton - Appendicular skeleton. (5)

UNIT - II. Digestive system – Alimentary canal and associated glands. - (6)

UNIT - III. Respiratory system – Cutaneous respiration, Gills and lungs, Air sacs in birds. - (5)

UNIT - IV. Circulatory system – Evolution of heart and Aortic arches, Portal systems. - (7)

UNIT - V. Excretory system – Evolution of kidney and its ducts - (4)

UNIT - VI. Nervous system – Comparative anatomy of Vertebrate brain - (6)

UNIT - VII. Sense organs – Comparative anatomy of ear and eye. - (5)

Total periods - (45)

Paper- XII
Developmental Biology

UNIT - I Gametogenesis- Spermatogenesis and Oogenesis (3)

UNIT - II Process of fertilization - (3)

UNIT - III Types of eggs and cleavages - (5)

UNIT - IV Development of Amphioxus - (11)
a. Structure of Egg and Sperm
b. Fertilization and cleavage
c. Blastuala and its fate map
d. Gastrulation
e. Primary organ formation: Nerve cord, Notochord, Mesoderm , Coelom and Gut

UNIT - V Development of Chick (18)
a. Structure of Egg and Sperm
b. Fertilization and cleavage
c. Blastuala and its fate map
d. Gastrulation
e. Structure of 24 Hr. Chick embryo.
f. Development of nervous, digestive and circulatory systems in second day of incubation (Structure of 48 Hr. Chick embryo)
g. Development of nervous, digestive and circulatory systems in Third day of incubation (Structure of 72 Hr. Chick embryo)

UNIT - VI Foetal membranes (amnion ,chorion, allontois and yolk sac) & their significance in chick. (2)

UNIT - VII Placentae –Types and significance. - (3)

Total Periods- (45)

Reference Books – (for Paper XI and XII):

1. An Introduction to Embryology 2003, Balinsky B.L., Saunders College, Philadelphia.
2. Developmental Biology; Patterns/Principles/Problems, 1982, Saunders J. W. Collier MacMillan, Publishers, London.
3. Developmental Biology, 2004 , 3rd Edition, Gilbert S.F. Saunder Associates Inc. U.S.A.
4. Developmental Biology, 1992 3rd edition, Browder L.W. Erickson C.A. & Williams, R.J. Saunders College, Publications, London.
5. A Text Book of Embryology, Dr. Puranik P. G. , S. Chand & Co.
6. Developmental Biology, 1984, Browder L.W. , Saunders College Publications, U.S.A.
7. Development of Chick embryo, 1972, Lillie.
8. Outlines of comparative Anatomy,Romer & Parsons, Central Book Depot, The Vertebrate Body (Saunders).
9. Biology of Vertebrates Walter & Sayles; (McMillan).
10. Modern Textbook of Zoology, R. L. Kotpal, Rastogi Publications, Meerut.

11. The Life of Vertebrates, 3rd Edition, 1993, J. Z. Young E. L. B.S. Oxford.
12. Chordate Zoology – E.L. Jordan, S. Chand & Co., New Delhi.
13. The Phylum Chordata – 1987, H.H. Newman, Distributor Satish Book Enterprise, Agra.
14. Comparative Anatomy of the Vertebrates G. C. Kent.

SOLAPUR UNIVERSITY, SOLAPUR
New Syllabus for B.Sc. III Zoology
(Semester – VI)

Paper - XIII
Physiology

UNIT I. Nutrition And Metabolism – **(14)**

a) Digestion and absorption.
b) Vitamins- With reference to source, Physiological role and deficiency. Water soluble –B complex and C ; Fat soluble – A, D, E and K.
c) Carbohydrate metabolism -
Glycogenesis, Glycogenolysis, Glycolysis, Krebs cycle, and Gluconeogenesis.
d) Protein metabolism:
Transamination, Deamination and Ornithine cycle
c) Lipid metabolism.
β- oxidation hypothesis.

UNIT II Physiology of Respiration –
1. Transport of respiratory gases (4)
2. Chemical and nervous regulation of Respiration

UNIT III. Physiology of Circulation
1. Origin and conduction of heart beat, Cardiac cycle (7)
2. ECG, Blood pressure

UNIT IV. Excretion physiology
1. Structure of nephrons (4)
2. Physiology of urine formation.
3. Dialysis.

UNIT V Muscle physiology
1. Ultra structure striated muscle (6)
2. Molecular mechanism of muscle Contraction.

UNIT - VI Nerve physiology
1. Ultra structure of neuron (7)
2. Origin and conduction of nerve impulse
3. Synapse and synaptic transmission

UNIT - VII Stress physiology
1. Introduction to stress physiology
2. Managing stress by exercise, yoga and meditation (3)

Total Periods- (45)

Paper- XIV
Endocrinology, Environmental Biology and Toxicology

Endocrinology:

UNIT I Study of endocrine glands – (12)

:

Anatomy, histology and hormones – Nature, role, regulation and disorders with reference to the following glands :

a) Thyroid gland
b)Parathyroid gland
c)Adrenal gland
b) Islets of Langerhans.

UNIT II Prostaglandins and .Neurohormones - GnRH , CRH and TRH (4)

Environmental Biology:

UNIT III 1. Concept of Biodiversity (3)
2. Conservation of endangered species with reference to Great Indian Bustard (*Ardeotis nigriceps*) (3)

UNIT IV

1. Characteristics and faunal adaptations with reference to following habitats
Fresh water, Marine water and Terrestrial (Grassland, desert ecosystem) (7)
2. Biological indicators of pollution. (2)

UNIT V

1. Solid waste management. - (2)
2. Water Management: Rain Water harvesting (2)
3. Animal Ethics- Introduction, prevention of cruelty to animals, need of virtual dissection (2)

Toxicology –

(4)

UNIT VI 1. Classification of toxicants.
2. Toxic agents and their action – Pesticides
3. Determination of LC– 50 and LD– 50 Values

UNIT VII 1 Bioaccumulation and biomagnification.
2. Applications of Toxicology

Total Periods -(45)

Reference Books (for Paper XIII and XIV)

1. General and Comparative Physiology – Hoar (Prentice Hall).
2. Animal Physiology – Nelson (Cambridge).
3. Comparative Animal Physiology – Prosser (Satish Book Enterprise).
4. Endocrinology – Hadley Pearson Education Delhi
5. General Endocrinology – Bagnara & Turner (W.B. Saunders)
6. Ecology – Odum (Amerind)
7. Limnology – Welch (McGraw Hill)
8. Introduction to Environmental Science – Y Anjaneyulu (B.S. Publications)
9. Animal Physiology – Adaptation and Environmental – Schiemdt Nielson (Cambridge)
10. Physiology : A regulatory systems approach – Strand F.L. (McMillon Publications Co.).
11. Environmental and Metabolic Animal Physiology – Prosser C.L. (Wiley –Liss Inc.)
12. Environment Physiology- Willmet P.G., Stone & Johnsion (Blackwell Science, Oxford).
13. Physiological Animal Ecology – Loan G.N. (Longman Harlog, UK)
14. Principles and methods of Toxicology – Hayes (Edited A. Wallace, Hayes Publications, Raven Press, N.Y.)
15. Books4Doctors Website Downloadable book of Endocrinology Nussey

Paper – XV
Molecular Biology and Biotechnology

Molecular Biology:

UNIT I . **Organization of DNA** (7)

a) Evidences for DNA as a genetic material - Transformation
b) Transduction
c) Conjugation
d) . Replication of DNA -
e) DNA damage and repair mechanism. -

UNIT II Transcription - (5)

a) Process of transcription in prokaryotes and eukaryotes
b) RNA polymerases.
c) Post transcriptional modifications in RNA

UNIT III Translation – (5)

i. Activation of amino acids
ii. Binding or transfer of amino acid to t RNA.
iii. Initiation
iv. Elongation
v. Termination.

UNIT IV Genetic Code (3)

i. Properties of Genetic Code
ii. Codon assignments.
iii. Initiation codon
iv. Termination codon
v. Codon and anticodon pairing
vi. Wobble hypothesis

Biotechnology:

UNIT V 1. Recombinant DNA technology (3)
a. Mechanism and role of restriction enzymes, DNA ligase and DNA polymerase
b. Cloning vectors- Plasmid and Cosmid

UNIT VI Techniques in genetic engineering- (12)

A) Polymerase chain reaction:
a. Introduction
b. Mechanism
c. Applications

B) DNA probes:
a. Introduction
b. Mechanism of synthesis of probe
c. Application

C) Blotting (Southern, Northern, Western blotting)
a. Introduction
b. Mechanism
c. Applications

D) DNA fingerprinting:
a. Introduction
b. Mechanism
c. Applications

UNIT VII 1). Immunological techniques: (4)
a) Hybridoma & synthesis of monoclonal antibodies
b) Applications of monoclonal antibodies

2) ELISA: (4)
a) Introduction
b) Applications

3) Application of Biotechnology – Cloning and Medicine (2)

Total Periods -(45)

Paper – XVI
Biotechniques and Applied Zoology

Biotechniques:

UNIT I 1. Tools and Techniques (Basic principles and uses) (3)
P^H meter, colorimeter, spectrophotometer and ultracentrifuge

2. Separation techniques (4)

i. Chromatography- TLC and Column chromatography.
ii.Gel Electrophoresis- Polyacrylamide Gel Electrophoresis and Agarose Gel Electrophoresis

UNIT II 3. Animal Cell Culture (6)

i. Introduction and principle, Requirements and applications
ii. Stem cells and their culture
iii. Tissue and organ culture
iv. Embryo culture

4. Cryopreservation of gametes and its application (2)

Applied Zoology

UNIT III **Fisheries :** (5)

1. Marine Capture fisheries
a) Coastal fishery – Sardine, Mackerel, Bombay duck
b) Off – shore fishery – Sole, Tuna, Pomphret
c) Crustacean fishery – Lobsters Crabs, Shrimps

2. Economic importance of Fish Products and byproducts- (2)

3. Pearl Culture (1)

UNIT IV 1. Fishing Crafts and Gears- (7)
a) Crafts
i. Rafts
ii. Trawler
iii. Shampan
iv. Canoe
v. Catamaran

b) Gears.
i. Hooks and lines

ii. Cast net
iii. Gill net
iv. Trap net
v. Rampani net
vi. Trawl net

UNIT V Agricultural Pest Management- (6)

a) Agricultural pests – Pyrilla, Tribolium (Jowar grain borer), Cotton Boll worm, Grass hopper and Rat.

b) Biological control of crop pests.

c) Integrated Pest Management (IPM)

UNIT VI Rearing Technology of Silk worm (6)

a. Principle of Silkworm rearing
b. Varieties of silkworms & their rearing methods
c. Government schemes for propagation of sericulture
d. Types of rearing houses
e. Rearing , Appliances and maintenance

UNIT VII Silkworm diseases :- **(3)**

a. Protozoon diseases
b. Bacterial diseases
d. Viral diseases
e. Fungal diseases

Total Periods- (45)

Reference Books- (for Paper XV and XVI)

1. Cell and Molecular Biology, 8th Edition, De. Robertis EDP and De Robertis Jr. EMF, Lippincott Williams and Wilkins, Philadelphia,'
2. Cell Biology, C.B. Powar, Himalaya Publication House.
3. Cell and Molecular Biology, E.J. Dupraw, Academic Press, NewYork.
4. Cell Structure and Function – A. G. Loewy, P. Siekevitz, J. R. Meninger & J. A. N. Gallant, Saunder College, Philadelphia.
5. Molecular Biololgy of the Cell – 3rd Edition, Bruce Alberts, Dennis Bray, Julian Lewis, Martin Raff, Keith Roberts & James D. Watson, Garlan Publishing, New York.
6. Elements of Biotechnology – P. K. Gupta, Rastogi Publications.
7. Gene V & VI, 1994, Lewin B., Oxford University Press, Oxford.
8. Prawn and Prawn Fishery of India – Kurian.
9. Fish Culture – K. H. Alikuhni.
10. Fish Culture – Lagler.
11. Fishes of India. – Zingran
12. Manual of sericulture – Krishnaswami et. al.
13. Introduction to sericulture – Ganga and Shetty.

Practical - I
Non-chordates, Biostatistics, Bioinformatics and Medical Zoology, and Evolutionary Genetics

1) Leech: Anatomical Observations and detailed explanation of Leech with the help of CD/Model/Chart of the following systems-

1. Digestive system.
2. Nervous system.
3. Reproductive system.

Study of Nephridium, Salivary glands and jaw of Leech with the help of CD/Model/Chart /Slides.

(During regular practical and while annual examination students should be provided with unlabelled figures and are expected to **label and write** a brief account on location, structure and function of various parts and submit the labeled figure and a **viva-voce** on the same is expected for the thorough understanding of his/her knowledge).

2) Sea Star: Anatomical Observations and detailed explanation of Sea star with the help of CD/Model/Chart of the following systems

1. Digestive system.
2. Water vascular System.
3. Study of tube foot of sea star with the help of CD/Model/Chart /Slides

(During regular practical and while annual examination students should be provided with unlabelled figures and are expected to **label and write** a brief account on location, structure and function of various parts and submit the labeled figure and a **viva-voce** on the same is expected for the thorough understanding of his/her knowledge).

3) *Lingula*: Study of Lophophore and Nephridium of Lingula- with the help of CD/Model/Chart/Slides/Museum Specimens

(During regular practical and while annual examination students should be provided with unlabelled figures and are expected to **label and write** a brief account on location, structure and function of various parts and submit the labeled figure and a **viva-voce** on the same is expected for the thorough understanding of his/her knowledge).

4) Squilla: Anatomical Observations and detailed explanation of Nervous System of Squilla with the help of CD/Model/Chart

(During regular practical and while annual examination students should be provided with unlabelled figures and are expected to **label and write** a brief account on location, structure and function of various parts and submit the labeled figure and a **viva-voce** on the same is expected for the thorough understanding of his/her knowledge).

5) Study of Zooids of *Porpita* and *Obelia* colony with the help of CD/Model/Chart/Permanent Slides and Museum Specimens

6) Study of locomotion in Protozoa– Amoeba, Paramoecium and Euglena using Permanent slides/photographs / Permanent Slides and Museum Specimens

7) Study of Canal systems– T.S. and L.S of Sycon using Permanent slides/photographs / Permanent Slides and Museum Specimens

8) Study of Physalia and any four Corals using models / photographs / Museum specimens / Permanent Slides and Museum Specimens

9) Study of following using photographs / Permanent Slides or Museum Specimens

1. Crustacean larvae.
2. Insect larvae.
3. Peripatus and Limulus.
4. Echinoderm larvae

10) Examples on Biostatistics. (Any Ten Examples)

11) Preparation of Parasites from Fecal samples of the animals

12) Study of Pathogens: *Plasmodium, Fasciola hepatica, Wuchereria bancropti* using slides/photographs

13) Bioinformatics –

a) Data search by 'text and sequence based search engines': Entrez and BLAST tool

b) Examples based on bioinformatics: Searching sequences of any five genes or proteins using NCBI and submission of sequences in FASTA format.

(During regular practical students are expected to use INTERNET and access the NCBI website and study the 'home page menu of NCBI, Entrez and BLAST search engine/tool' and 'perform sequence search of any five proteins or genes using Entrez tool'. At the time of examination students are expected to perform searching of any one protein or gene using INTERNET and get target sequence and submit the print of the same **or** they may directly explain the **home page or sequence format** which they had already performed and obtained during regular practicals of any five genes or proteins. For eg. Hemoglobin, Insulin, Trypsin, Myoglobin, and Collagen or any suitable protein).

14) Graphical representation of data using MS-EXCEL (produce Bar, Line, Pie, and Histogram using suitable data).

15) Examples based on Hardy Weinberg Law (08 examples)

PRACTICAL –II
Comparative Anatomy of Chordates & Developmental Biology

1) Scoliodon: Anatomical Observations and detailed explanation of Cranial Nerves of Scoliodon with the help of CD/Model/Chart (During regular practical and while annual examination students should be provided with unlabelled figures and are expected to **label and write** a brief account on location, structure and function of various parts and submit the labeled figure and a **viva-voce** on the same is expected for the thorough understanding of his/her knowledge).

2) Scoliodon: Anatomical Observations and detailed explanation of **Membranous labyrinth of Scoliodon** with the help of CD/Model/Chart (During regular practical and while annual examination students should be provided with unlabelled figure of membranous labyrinth of scoliodon and are expected to **label and write** a brief account on location, structure and functions of various parts and submit the labeled figure and **viva-voce** on the same is expected for the thorough understanding of his/her knowledge).

3) **Scoliodon:** Anatomical Observations and detailed explanation of **Eye Muscles and nerve innervations of Scoliodon** with the help of CD/Model/Chart (During regular practical and while annual examination students should be provided with unlabelled figures and are expected to **label and write** a brief account on location, structure and function of various parts and submit the labeled figure and a **viva-voce** on the same is expected for the thorough understanding of his/her knowledge).

4) Rat: Anatomical observations and detailed explanation of Reproductive System of rat with the help of CD/Model/Chart (During regular practical and while annual examination students should be provided with unlabelled figures and are expected to **label and write** a brief account on location, structure and function of various parts and submit the labeled figure and a **viva-voce** on the same is expected for the thorough understanding of his/her knowledge).

5) Rat: Anatomical Observations and detailed explanation of **Neck Nerves of Rat** with the help of CD/Model/Chart (During regular practical and while annual examination students should be provided with unlabelled figures and are expected to **label and write** a brief account on location, structure and function of various parts and submit the labeled figure and a **viva-voce** on the same is expected for the thorough understanding of his/her knowledge).

6) **Study of Scales**– **Placoid, Cycloid and Ctenoid/Ampulla of Lorenzini ,Weberian ossicle of Labeo** with the help of CD/Model/Chart/ permanent slides (During regular practical and while annual examination students should be provided with unlabelled figures and are expected to **label and write** a brief account on location, structure and function of various parts and submit the labeled figure and a **viva-voce** on the same is expected for the thorough understanding of his/her knowledge).

7) Study of Eggs of Insects, Amphioxus, Frog and Chick with the help of CD/Chart/Model/Permanent slides and museum specimens

8) Study of Cleavage, Blastula and Gastrula Amphioxus with the help of CD/Chart/Model/Permanent slides

9) Study of Whole mounts and T.S. of 18, 24, 33, 48, and 72 hrs Chick embryos with the help of CD/Chart/Model/Permanent slides

10) Study of 'procedure to understand embryological stages of chick up to 72hrs' by non invasive method' using CD/Model/Chart

(During regular practical students are expected to learn flow chart for the whole mount of chick embryo starting from incubation of egg - location of embryo - transferring of embryo on glass slide – fixation – dehydration – staining – identification – drawing - labeling and submission. **At the time examination** students will be provided an unlabelled figure of any one developmental stage of chick embryo which they are expected to identify, label and write the procedure for making a whole mount and defend viva-voce).

11) Study of placenta of Rat/ Human using CD/Chart/Model / museum specimens

12) Study of following using CD/Chart/Permanent Slides / Museum Specimens

1. T.S. / V.S. of skin of vertebrates	2. Scales- Fishes and Reptiles.
3. Feathers	4. Gills of Fishes and Lungs of Amphibian, Reptiles, Birds and Mammals
5. Hearts of Vertebrates	6. Brains of Vertebrates.

13) Project work- Research project should be prepared in consultation with faculty either individually or in group as required. The research guide will support students in selecting and executing the entire topic and preparing the report for final submission during examination after approval of the guide in the following format

a) Research project should be based on an original research topic
b) Format of Report:

1. Title
2. Introduction
3. Review of literature
4. Objectives
5. Material and Methodology
6. Result and discussion
7. Conclusion
8. References

c) At the time of practical examination submit the final project report (hard copy) and present your research findings using powerpoint.

PRACTICAL –III
Physiology, Endocrinology, Environmental Biology and Toxicology

1) Demonstration of physiological practical with the help of CD/Virtual Dissection

a) Demonstration of preparation of gastrocnemius muscle with sciatic nerve in frog;
b) Study of Simple muscle twitch and obtaining the computer generated graph;
c) Study of normal cardiogram and obtaining the computer generated graph;
d) Study of effect of temperature, Adrenaline, Nicotine on normal heart and obtaining the computer generated graph;

(At the time of examination students are supposed to 'Analyze the given graph and provide details of principle, procedure, result, inference and viva-voce based on the given practical)

2) Estimation of hemoglobin.

3) Total count of R.B.C., W.B.C and differential count of WBC

4) Measurement of blood pressure and heart beat under normal and stress condition.

5) To perform 'Erythrocyte Sedimentation Rate (ESR)' of the given blood sample.

6) Preparation of Haemin crystals

7) To determine blood clotting time using capillary method

8) To study effect of hypotonic, hypertonic and isotonic solution on RBC

9) Estimation of protein, carbohydrate and lipid by colorimetric method

10) Endocrine glands – Anatomy and Histology using slides/photographs

Testis, Ovary, Adrenal, Thyroid, Pancreas.

11) Estimation of dissolved O2 and free CO2

12) Testing of hardness of water.

13) Quantitative analysis of soil samples to assess N, P, and K.

14) **Study of animals in relation to their habitats using charts/videos**

1. Lotic – Guppies.
2. Lentic – Anabas/ Indian major Carp
3. Pelagic – Puffer fish/Mackerel, Sardine
4. Benthic – Lobster, Prawn
5. Grass land – Stick insect/Grasshopper
6. Desert – Phrynosoma, Uromastix.

15) **Study of ecological pyramid using charts**

Presentation of given data in the form of ecological pyramids. Data for the ecological pyramids.

1. Members of Grass land ecosystem –
Grasshopper, rat snake, grass, herbs, shrubs, weeds, trees, vulture, squirrel, earthworm, centipede, scorpion , rabbit and Indian bustard.

2. Members of Pond ecosystem –
Sponge, nepa, leech, planaria, hydra, lymnea, planorbis, heron, kingfisher, Cyclops, daphnia, tortoise , diatoms Vallisneria, hydrilla, chara and spirogyra.

3. Members of Forest ecosystem-
Monkey, tree snake, hyla, python, vulture, giant squirrel, gaur, tiger, leopard, deer, loris, millipede, king cobra, shrub herb, tree, jungle fowl, moss and fern.

4. Members of Desert ecosystem-
Opuntia, Aloe, sidewinder, wild ass, camel, ground spider, scorpion, Phrynosoma, Uromastix, vitis , blackbuck, Pencil tree, nerium.

16) Study of Diversity indices (Shannon/Simpson) using quadrat/line transect method

17) Excursion Tour (Any one- of duration 8-12 days)

a) Visit to sea-shore
b) Visit to Fishery Centers
c) Visit to National Parks
d) Wildlife Sanctuaries
e) National Research Institutes
f) Central Research Institutes
g) Zoological Survey of India
h) Fresh Water Ecosystem

Note:

1. Kindly note that during field visits students shall observe only animals and make record of the observations without disturbing natural habitat nor kill the animals. Students should be told about the importance of biodiversity and conservation;

2. Students are encouraged to prepare and submit a concise report of the excursion;

3. Report on multiple excursion tours may be clubbed for preparing and submitting report at the time of final examination will be allowed.

PRACTICAL – IV
Molecular Biology, Biotechnology and Applied Zoology

1) Study of procedure to understand whole mounts of Protozoa, coelenterate colony, planktons, insect larvae, echinoderm larvae, crustacean larvae, fish scales, filoplume and down feather using CD/Chart

(During regular practical students are expected to learn protocol for whole mount starting from acquisition of material – fixation if required – dehydration as necessary – staining – mounting - identification – drawing – labeling. **At the time examination** students will be given an unlabelled figure which they need to identify, label and write the protocol for making the whole mount)

2) Study of Microtomy and its applications by using CD/Chart:

a) Principle and applications of microtome machine
b) Study of 'Types of stains'(vital, nuclear, cytoplasmic)
c) Theoretical study of flow chart of microtechnique (Introduction to autopsy and biopsy – Fixation – washing if needed – dehydration – clearing – embedding – block making – trimming – fixing of trimmed block to block holder- Demonstration of working of microtome machine – sectioned ribbon – spreading on slide)
d) Theoretical study of 'Principle, staining and application of HE method

At the time examination students will be asked to write principle, procedure and applications of microtomy along with the flowchart of the Microtomy and HE staining and defend viva-voce).

3) **Staining**: Histochemical Techniques

a) Staining of chromatin using 'Feulgen Method' in human blood smear
b) Staining of DNA and RNA using methyl green and pyronin method in human blood smear

4) Molecular Biology and Biotechnology

a) Isolation of DNA: from any suitable material
b) Estimation of DNA by Diphenyl Amine method (DPA)
c) Estimation of RNA by Orcinol method
d) Paper chromatography: separation of amino acids
e) Thin Layer Chromatography (TLC): Separation of amino-acids using Thin Layer Chromatography (TLC)
f) Electrophoresis: understanding of banding pattern of gel electrophoresis of DNA / protein and determination of molecular weight of an unknown sample within the band using photographs
g) Theoretical study of animal cell and tissue culture using CD/Model/Chart
h) Study of meiotic phases in onion bud
i) Study of human Karyotype using photographs: Normal male and female (classification of chromosomes according to size and position of centromere)

5) To find out codon sequences for known polypeptide chain of ten amino acids or to find out amino acid sequence from given codons (chart will be provided)

6) Economic importance of Leech, Prawn, Lobster, Crab, Oyster, Sepia using CD/Model/Chart

7) Economic importance of Shark, Pomphret, Oil Sardine, Mackerel, Bombay duck, Eel, Ophiocephalus, Catala, Rohu, Mrugal and Cyprinus using CD/Model/Chart

8) Study of fish products- fish meal, fish glue, fish liver oil, fish body oil, fish manure, and shagreen using CD/Model/Chart

9) Study of different Fishing Crafts and Gears using CD/Model/Chart using CD/Model/Chart

10) Study of Crop pests – Pyrilla, Jawar grain borer, Cotton ball worm, Grass hopper using CD/Model/Chart

11) Excursion visits to study Sericulture, agriculture research center, yoga & meditation center and Pearl Culture

Note:

As per the guidelines of **UGC notification number F.14-6/2014(CPP-II) dated 1st August, 2014** it is now essential to make necessary modifications to stop dissection and promote and orient students towards the knowledge component rather than skill development. However, ITC based virtual dissections are promoted. Now, the responsibility to discontinue dissections and use of animals in experiments totally rests on concerned authorities of respective colleges/Institutes. As per the notification it is important to encourage the field trips and observations without disturbing the biodiversity.

Skeleton paper for practical examination

Practical – I

	Marks
Q.1: Biostatistics example	06
Q.2: Example based on Bioinformatics	06
Q.3: Example based on Hardy-Weinberg Law	06
Q.4: Graphical representation using MS-EXCEL	05
Q.5: Identification	10
Q.6: Analysis and explanation of anatomical parts of given figure/CD/Chart/Model of Leech/Sea star/Squilla as per practical syllabus	07
Q.7: Analysis and explanation of given permanent slide/CD/Chart (Lingula lopophore, nephridium; Porpita zooids; and Obelia colony)	05
Q.8: Practical Record Book	05
	Total - 50

Practical – II:

Q.1: Analysis and explanation of anatomical parts of given figure/CD/Chart/Model of Scoliodon- cranial nerves and Rat- reproductive system as per practical syllabus -	08
Q.2: Analysis and explanation of given Model/CD/Chart (Scoliodon- Internal Ear, Eye Muscles; Rat: Neck Nerves as per practical syllabus-	06
Q.3: Identification-	10
Q.4: Study of 'procedure to understand embryological stages of chick up to 72hrs' by non invasive method' using CD/Model/Chart-	06
Q.5: Submission, PowerPoint presentation and viva-voce of Project report-	15
Q.6: Practical record book-	05
	Total - 50

Practical – III:

Q.1: Estimation of Dissolved O2 from given sample/Free CO2 from given sample/Hardness of water	06
Q.2: Hemoglobin percentage /Blood Cell counts/Blood Pressure/ESR/Haemin Crystal/Blood Clotting Time/ effect of hypotonic, hypertonic and isotonic solution on RBC	10
Q.3: Ecological pyramid/Diversity Indices/Analysis of N,P,K in soil sample	06

Q.4: Analysis of given graph of Frog- muscle twitch or cardiogram / Biochemical estimations 08
Q.5: Identification 05
Q.6: Submission of Excursion Tour report 10
Q.7: Practical record book 05
Total - 50

Practical – IV:

Q.1: Cytological preparation- Meiosis/ Feulgen technique/Methyl-green & Pyronin – 08
Q.2: Examples based on codon/Analysis of Karyotype 05
Q.3: Isolation of DNA/Estimation of DNA/RNA 06
Q.4: Chromatographic separation of amino acids/Electrophoresis 06
Q.5: Principle and applications of Microtomy/whole mount preparation 05
Q.6: Identification 10
Q.7: Excursion report 05
Q.8: Practical record book 05
Total – 50

Chairman
B O S in ZOOLOGY