

## SYLLABUS FOR B.Sc. ZOOLOGY (SEMESTER PATTERN) (With effect from the academic year 2019-20)

The semester pattern syllabus for B.Sc. Three Year Degree Course in the Subject - Zoology comprises of six semesters. Each semester is based on six theory periods and six practical periods per week. The examination of each semester shall comprise of one theory papers each of three hours duration and carries 100 marks and a practical of 4 hours duration carries 30 marks. Internal assessment for each semester based on one theory papers of 20 marks shall be conducted by departmental teaching staff. Candidates are expected to pass separately in theory and practical examination.

	<b>Semester wise Theory Papers and Practicals</b>	<b>Theory Marks</b>	<b>Internal Assessment</b>	<b>Practical Marks</b>	<b>Total Marks</b>
<b>Sem - I</b>	<b>Theory Paper - I :-</b> Life and Diversity of Animals-Nonchordates  <b>Practical - I</b> (Based on Paper I)	<b>100</b>	<b>20</b>	<b>30</b>	<b>150</b>
<b>Sem - II</b>	<b>Theory Paper - II :-</b> Life and Diversity of Animals- chordates  <b>Practical - II</b> (Based on Paper II)	<b>100</b>	<b>20</b>	<b>30</b>	<b>150</b>
<b>Sem - III</b>	<b>Theory Paper - III :-</b> Cell Biology and environmental Biology  <b>Practical - III</b> (Based on Paper III)	<b>100</b>	<b>20</b>	<b>30</b>	<b>150</b>
<b>Sem - IV</b>	<b>Theory Paper - IV :-</b> Genetics and Molecular Biology  <b>Practical - IV</b> (Based on Paper IV)	<b>100</b>	<b>20</b>	<b>30</b>	<b>150</b>
<b>Sem - V</b>	<b>Theory Paper - V :-</b> Developmental Biology  <b>Practical - V</b> (Based on Paper V)	<b>100</b>	<b>20</b>	<b>30</b>	<b>150</b>
<b>Sem - VI</b>	<b>Theory Paper - VI :-</b> Animal Physiology, Bioinformatics & Biostatistics.  <b>Practical - VI</b> (Based on Paper VI)	<b>100</b>	<b>20</b>	<b>30</b>	<b>150</b>

**Shiksha Mandal's**  
**Bajaj College of Science, Wardha**  
**(An Autonomous College)**  
**Department of Zoology**  
**Syllabus for B.Sc. Zoology (Semester Pattern)**  
**Credit Based System**  
**Academic Session 2019-20**

**B.Sc. Semester I**

**Paper I: Life and Diversity of Animals – Non Chordates**

**UNIT - I** **(12 Periods)**

- 1.1 Animal Kingdom - Classification – Flow diagram of classification upto major phylum with few characters and examples
- 1.2 Protozoa - General Characters & Locomotion
- 1.3 Paramecium - Structure
- 1.4 Malaria - Causative organism & its Life cycle

**UNIT - II** **(12 Periods)**

- 2.1 Porifera - General Characters
- 2.2 Canal system in Sponges - Brief account
- 2.3 Coelenterata - General characters, Polymorphism in Coelenterata
- 2.4 Corals & Coral reef formation, Economic importance of corals

**UNIT - III** **(12 Periods )**

- 3.1 Helminthes - General characters, Platyhelminthes & Aschelminthes
- 3.2 Taenia - Morphology, Ascaris Morphology,
- 3.3 Annelida - General characters & Metamerism
- 3.4 Leech - Morphology, Genital system

**UNIT - IV** **(12 Periods )**

- 4.1 Arthropoda - General characters and vision in Arthropoda
- 4.2 Crustacean Larvae - Nauplius, Zoea, Megalopa
- 4.3 Mollusca - General characters & Torsion in Gastropoda
- 4.4 Pearl formation in Mollusc, Molluscan Larvae

**UNIT - V** **(12 Periods )**

- 5.1 Echinodermata - General characters, Echinoderm Larvae
- 5.2 Asterias - External features, Water vascular system & Locomotion
- 5.3 Hemichordata - General characters, Phylogeny
- 5.4 *Balanoglossus* - External features, Affinities of Balanoglossus

## Unit VI

(12 Periods )

- 6.1 Parasitism - Concept, Parasite Protozoa – Entamoeba, Leshmania
- 6.2 Parasitic Helminthes Adaptation
- 6.3 Taeniasis, Life cycle, Taenia, Ascariasis, Ascaris Life cycle
- 6.4 Vector - Biological & Mechanical, Insect vector, Housefly

### PRACTICAL – I Based on Life and Diversity of Animals – Nonchordates

#### 1. Study of museum specimens (Classification of animals up to orders)

- I. Protozoa (Slides) :- *Paramecium*, *Euglena*, *Amoeba*, *Plasmodium vivax*
- II. Porifera :- *Sycon*, *Leucosolenia*, *Hyalonema*, *Euplectella*,
- III. Coelenterata :- *Obelia*, *Aurelia*, *Tubipora*, *Adamsia*
- IV. Platyhelminthes :- *Planaria*, *Fasciola*, *Taenia*
- V. Aschelminthes :- *Ascaris*, *Wuchereria*
- VI. Annelida :- *Aphrodite*, *Nereis*, *Hirudinaria*
- VII. Arthropoda :- *Peripatus*, *Daphnia*, *Limulus*, *Scolopendra*, Moth
- VIII. Mollusca :- *Chiton*, *Pila*, *Mytilus*, *Octopus*
- IX Echinodermata :- *Asterias*, *Holothuria*, *Echinus*
- X. Hemichordata :- *Balanoglossus*,

#### 2. Study of Permanent Slides

Sponge spicules, T.S. *Sycon*, Redia and Cercaria larvae of *Fasciola*, T.S. male and female *Ascaris*, Scolex of *Taenia*,

Nauplius, Zoea of Arthropoda, Glochidium larva of Mollusca, T.S. of arm of star fish, Bipinnaria larva, T.S. *Balanoglossus* through proboscis

#### 3. Anatomical observation / demonstration & detail explanation of Digestive and reproductive system of Cockroach through ICT tools / Models / Charts / Photography

#### 4. Whole mount preparation of or Study of permanent preparation of Pila Gill lamella *Obelia* colony, *Nereis* parapodia, with the help of already available permanent slides / ICT tools / Charts / Photographs

#### 5. Local Biodiversity in J.B. Campus (Invertebrates) field visit and diary or visit to National park & sanctuary & submission of tour report.

**Distribution of Marks –****Total Marks 30**

1. Identification and Comment on Spots (7 Museum specimens + 3 slides)	10
2. Anatomical observation through ICT tools (Dissection)	04
3. Permanent stained preparation (through ICT tools)	03
4. Submission of certified practical record	05
5. Submission of Slides & tour diary	04
6. Viva voce	04

**B.Sc. Semester I ( List of Recommended Books )****Life and Diversity of Animals – Non Chordates**

1. Barnes – Invertebrate Zoology (Halt-Saunders international) Philadelphia, USA
2. Barradaile L.A. & Potts F.A. – The Invertebrate
3. Nigam – Biology of Nonchordates
4. Kotpal, Agrawal & Khetrapal – Modern Text Book of Zoology - Invertebrates, Rastogi Publication, Meerut
5. Puranik P.G. & Thakur R.S. – Invertebrate Zoology
6. Majupuria T.C. – Invertebrate Zoology
7. Dhami & Dhami – Invertebrate Zoology
8. Parker & Hashwell, Textbook of Zoology Vol. I (Invertebrates) A.Z.T.B.S. Publishers & Distributors, New Delhi
9. Dr. S.S. Lal Practical Zoology Invertebrates 9<sup>th</sup> edition, Rastogi Publication Meerut
10. EJW Barrington– Invertebrate Structure and Function ELBS III Edition
11. R.L. Kotpal – Phylum Protozoa to Echinodermata (series), Rastogi and Publication, Meerut
12. Parker J. and Haswell W. – Text Book of Zoology, ELBS Edition
13. Vidyarthi – Text Book of Zoology, Agrasia Publishers, Agra
14. Invertebrate Zoology – Jorden & Varma

15. Jordan E.L. and Verma P.S. – Chordate Zoology, S. Chand and Co., New Delhi
16. Ayer E. – Manual of Zoology
17. M.D. Bhatia – The Indian Zoological Memories – Leech
18. Beni Prasad – The Indian Zoological Memories – Pila
19. P. K. Gupta – Vermicomposting for Sustainable Agriculture, Agrobios India Ltd
20. A manual of Practical Zoology Invertebrates – P. S. Verma
21. Barnes – Invertebrate Zoology (Holt-Saunders international) Philadelphia, USA
22. Barradaile L.A. & Potts F.A. – The Invertebrate
23. Nigam – Biology of Nonchordates
24. Kotpal, Agrawal & Khetrapal – Modern Text Book of Zoology - Invertebrates, Rastogi Publication, Meerut
25. Puranik P.G. & Thakur R.S. – Invertebrate Zoology
26. Majupuria T.C. – Invertebrate Zoology
27. Dhami & Dhami – Invertebrate Zoology
28. Parker & Hashwell, Textbook of Zoology Vol. I (Invertebrates) A.Z.T.B.S. Publishers & Distributors, New Delhi
29. Dr. S.S. Lal Practical Zoology Invertebrates 9<sup>th</sup> edition, Rastogi Publication Meerut
30. EJW Barrington– Invertebrate Structure and Function ELBS III Edition
31. R.L. Kotpal – Phylum Protozoa to Echinodermata (series), Rastogi and Publication, Meerut
32. Parker J. and Haswell W. – Text Book of Zoology, ELBS Edition
33. Vidyarthi – Text Book of Zoology, Agrasia Publishers, Agra
34. Jordan E.L. and Verma P.S. – Chordate Zoology, S. Chand and Co., New Delhi
35. Ayer E. – Manual of Zoology
36. M.D. Bhatia – The Indian Zoological Memories – Leech
37. Beni Prasad – The Indian Zoological Memories – Pila
38. P. K. Gupta – Vermicomposting for Sustainable Agriculture, Agrobios India Ltd
39. A manual of Practical Zoology Invertebrates – P. S. Verma

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**B.Sc. Semester II**

**Paper II: Life and Diversity of Animals – Chordates**

**UNIT - I** **(12 Periods)**

- 1.1 Chordata – Origin, Phylogenetic Tree of Evolution- animals
- 1.2 Protochordata: General Characters and Classification with examples
- 1.3 *Herdmania* : Structure, Ascidian tadpole and retrogressive metamorphosis
- 1.4 *Branchiostoma* : External Characters and Sense organs

**UNIT – II** **(12 Periods)**

- 2.1 Agnatha :- Agnatha concept and Affinities
- 2.2 General Characters of Cyclostomata : *Petromyzon* and *Myxine*
- 2.3 Class Pisces: Origin, General features of *Chondrichthyes* and *Osteichthyes*,
- 2.4 Origin of paired fins in fishes ; Migration in fishes-Types, causes, and significance

**UNIT - III** **(12 Periods)**

- 3.1 Accessory respiratory organs in fishes
- 3.2 Osmoregulation in Fishes
- 3.3 Class Amphibia : Origin, General features and Classification with examples
- 3.4 Parental care and Neotony in Amphibia.

**UNIT - IV** **(12 Periods)**

- 4.1 Class Reptilia- Origin, General features and classification
- 4.2 Classification based on temporal vacuities
- 4.3 Snakes : General Characters, Poisonous and Non-Poisonous snakes,
- 4.4 Biting mechanism in snakes, Poison apparatus, snake venom properties

## UNIT - V

(12 Periods)

- 5.1 Class Aves– Origin, General features and Classification
- 5.2 Comparison of Ratitae and Caranitae
- 5.3 Flight adaptations ; Flightless Birds : Origin and general characters with examples
- 5.4 Migration in birds

## Unit VI

(12 Periods)

- 6.1 Class Mammalia – Origin, General characters of Prototheria, Metatheria and Eutheria with type
- 6.2 Adaptive radiations in mammals
- 6.3 Comparative account of Heart in Fishes, Amphibian, Reptiles, Birds and Mammals
- 6.4 Urinogenital systems in Mammals

## PRACTICAL - II Based on Life and Diversity of Animals –Chordates

### Identification, Classification, Distinguishing Characters and Adaptive features of

Urochordata	:- Herdmania, Salpa, Doliolum
Cephalochordata	:- Amphioxus
Cyclostomata	:- Petromyzon, Myxine
Pisces	:- Pristis, Torpedo, Exocoetus, Clarius,
Amphibia	:- Ichthyophis ,Bufo, Salamander
Reptilia	:- Chameleon, Draco, Tortoise, Cobra, Russel’s Viper, Rat Snake
Birds	:- Owl, Kingfisher, Duck, Parrot
Mammals	:- Squirrel, Bat, Loris, Rabbit

### 2. Study of skeleton of Rabbit

### 3. Dissection of the locally available culturable fish -

- i. Digestive system
- ii. Brain

### 4. Study of permanent slides

Amphioxus through Gonad, V.S. of Skin of fish, V.S. of Skin of frog, V.S. of skin reptiles, V.S. skin of Bird, V.S. of skin of mammals with the help available permanent slides/ ICT tools / Charts / Photographs

### 5. Permanent stained micro preparation:

Fish scales – Placoid / cycloid / ctenoid / striated muscle with the help available permanent slides/ ICT tools / Charts / Photographs

### 6. Local Biodiversity in J.B. Campus (Chordates) field visit and diary or visit to National park & sanctuary & submission of tour report.

### **Distribution of Marks -**

**Total Marks 30**

1. Identification and comment on spots ( 5 Museum specimens, 2slides, 3 bones)	10
2. Dissection (through ICT tools)	04
3. Permanent stained Preparation	03
4. Submission of certified practical record	05
5. Submission of slides & Field diary	04
6. Viva voce	04

### **List of Recommended Books :-**

#### **Life and Diversity of Animals -Chordates**

1. T. B. of Zoology vol II – Parker & Haswell
2. T. B. of Vertebrate Zoology - S. N. Prasad
3. Chordate Zoology – E. L. Jordan and P. S. Verma
4. Vertebrate Zoology –Vishwanath
5. Zoology of Chordates – Nigam H. C.
6. Phylum: Chordata – Newman H.H.
7. Biology of Vertebrates –Walter & Sayles
8. The Vertebrate Body –Romer A. S.
9. Comparative Anatomy of the Vertebrates - Kingslay J. D.
10. The Biology of Amphibia –Noble G. K.
11. Snakes of India – Gharpura K. G.
12. Life of Mammals – Young J.Z.
13. Vertebrates – Kotpal R. L.
14. Introduction to Chordates - Majupuria T.C.
15. Vertebrate Zoology – Dhami & Dhami
16. T. B. Vertebrate Zoology – Agrawal
17. Protochordates – Chatterjee & Pandey
18. Protochordates – Bhatia
19. T. B. of Chordates – Bhamrah and Juneja
20. Chordate Anatomy - Arora M.P.
21. The Chordates – Alexander.
22. Practical Zoology Vertebrates – Dr.S. S. Lal, Rastogi Publication, Meerut

23. A manual of Practical Zoology Vertebrates –P. S. Verma

## **B.Sc. Semester – III**

### **Paper – III (Cell Biology & Environmental Biology)**

#### **UNIT – I (12 Periods)**

- 1.1 Ultrastructure of Prokaryotic and Eukaryotic Cell
- 1.2 Plasma Membrane: Structure- Fluid Mosaic Model and Functions
- 1.3 Endoplasmic Reticulum: Types, Ultrastructure and Functions
- 1.4 Golgi Complex: Ultrastructure and Functions

#### **UNIT – II (12 Periods)**

- 2.1 Ultrastructure Of Mitochondria & functions
- 2.2 Ribosome: Structure, Types, Lake's Model and Functions.
- 2.3 Lysosome: Structure, Polymorphism and Functions .
- 2.4 Nucleus: Ultrastructure of Nuclear Membrane, Structure and Functions of Nucleolus

#### **UNIT – III (12 Periods)**

- 3.1 Heterochromatin. Euchromatin
- 3.2 Chromosome: Structure and Types.
- 3.3 Giant Chromosomes: Lamp-Brush and Polytene Chromosome.
- 3.4 Structure of Nucleosome.

#### **UNIT - IV (12 Periods)**

- 4.1 Peroxisomes : Structure and Function.
- 4.2 Microtubules.
- 4.3 Microfilaments.
- 4.4 Mitosis , Meiosis (Different Phases and Significance)

#### **UNIT – V (12 Periods)**

- 5.1 Somatic Cell Division: Cell Cycle, Check points of Cell Cycle
- 5.2 Elementary Idea of Cancer
- 5.3 Types of Stem Cell
- 5.4 Introduction to Animal Cell Culture.

#### **UNIT - VI (12 Periods)**

- 6.1 Concept & Types of Ecosystem
- 6.2 Structure of Ecosystem: Abiotic factors and Biotic factors; Producer, Consumer , Decomposer.
- 6.3 Food Chain , Food web; Ecological Pyramids.
- 6.4 Concept of Biodiversity; Hot Spots of Biodiversity.

## Practical III Based on Cell Biology & Environmental Biology :-

### Section – A (Practical based on Cell Biology)

1. Principle and working of microscope.
2. Use of Ocular Micrometer and Measurement of micro objects.
3. Study of Slide of Prokaryotic Cell & Eukaryotic Cell .
4. Study of Osmosis in any Cell
5. Identification of Stages of Mitosis
6. Principles and Working of Centrifuge
7. Isolation, Separation of Cell Organelle – Nucleus Mitochondria.
8. ATC Laboratory set up.
9. Primary Cell culture.
10. Lymphocyte Separation.
11. Cell Count
12. Cell Viability

### Section B (Practical based on Environmental Biology)

1. Estimation of Dissolved oxygen in water samples.
2. Estimation of free CO<sub>2</sub> in water samples
3. Study of Pond ecosystem – Producer, Consumer and Decomposer
4. Identification of common animals in your surroundings and classification based on Trophic Level (Producer, Consumer and Decomposer) Preparation of Diary

<b>Distribution of Marks –</b>		<b>Total Marks 30</b>
1.	Identification and comment on spots ( 3 Cell Biology, 1Environmental Biology)	04
2.	Experiment on Cell Biology	06
3.	Experiment on Environmental Biology	04
4.	Experiment of Cell Viability	03
5.	Submission of certified practical record	05
6.	Submission of Field diary	04
7.	Viva voce	04

## **Reference Books on :-**

### **Cell Biology**

1. C.B. Powar, Cell Biology – Himalaya Publication, New Delhi
2. Dr. S.P. Singh, Dr. B.S. Tomar – Cell Biology 9th revised edition, Rastogi Publication, Meerut
3. Gupta P.K. – Cell and Molecular Biology, Rastogi Publication, Meerut
4. Veer BalaRastogi – Introduction to Cell Biology, Rastogi Publication, Meerut
5. Gerald Karp – Cell and Molecular Biology-Concepts and Experiments, John Wiley, 2007
6. De-Robertis – Cell Biology
7. Verma and Agrawal– Concepts of Cell Biology
8. Dowben– Cell Biology
9. Witt – Biology of Cell
10. Ambrose and Eastyr – Cell Biology
11. Cell Biology, Genetics, Molecular Biology, Evolution & Ecology – P.S.Verma&V.K.Agrawal.
12. Ecology – odum

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**B.Sc. Semester IV**

**Paper IV - Genetics and Molecular Biology**

**UNIT - I**

**(12 Periods)**

- 1.1 Mendelian Principles: Mendel and his experiments with pea plant. Law of segregation: Monohybrid cross, back cross and test cross. Dominance and Recessive, Law of Independent Assortment: Dihybrid cross in Pea plant and *Drosophila*.
- 1.2 Interaction of genes- Chromosome theory of inheritance, Epistasis-dominant and recessive, codominance, incomplete dominance.
- 1.3 Linkage and crossing over – Chromosome theory of Linkage, kinds of linkage, mechanism of Meiotic Crossing over, significance of Crossing over.
- 1.4 Cytoplasmic inheritance- *Kappa* particles in *Paramecium*, CO<sub>2</sub> sensitivity in *Drosophila*, Extra nuclear inheritance: (mitochondria).

**UNIT - II**

**(12 Periods)**

- 2.1 Chromosomal variation in Number: ( Euploidy, Aneuploidy- Monosomes, Nullisomes and Trisomes) Disorders related to chromosomal number- Turner syndrome, Klinefelter syndrome and Down syndrome.
- 2.2 Chromosomal aberrations: Deletion, Duplication, Inversion, Translocation, Position Effect, Centromeric & Non-centromeric breaks in chromosomes. (Chronic Myeloid Leukemia (CML) and Burkitt's Lymphoma.
- 2.3 Introduction and Types of Gene mutations (Spontaneous and induced mutations) - Base substitution, Frame shift mutation (insertion, deletion, missense, nonsense mutation)
- 2.4 Mutagens - Physical, chemical and biological.

**UNIT - III**

**(12 Periods)**

- 3.1 Human karyotype and its applications
- 3.2 Amniocentesis and it's applications with examples
- 3.3 Population genetics: Basic concepts in population genetics, Genetic Drift, Hardy Weinberg equilibrium and its significance
- 3.4 Ames test.

## UNIT – IV

(12 Periods)

### (Introduction to Molecular biology)

- 4.1 Chemical Basis of Heredity: DNA as genetic material, Experiments of Griffith.
- 4.2 DNA Composition & Structure
- 4.3 RNA types and structure.
- 4.4 Fine structure of the Gene: Cistron, muton and recon.

## UNIT – V

(12 Periods)

- 5.1 Meselson– Stahl Experiment ,
- 5.2 DNA Replication in prokaryotes
- 5.3 Transcription in prokaryotes.
- 5.4 Genetic code: Nirenberg and Matthaei experiment, Khurana Experiment, Wobbles Hypothesis.

## UNIT – VI

(12 Periods)

- 6.1 Translation in Prokaryotes.( activation of amino acids, transfer of activated amino acids to tRNA, Initiation, elongation and termination of polypeptide chain.)
- 6.2 Eukaryotic vs. Prokaryotic gene structure..
- 6.3 Regulation of Gene expression in prokaryote
- 6.4 Operons – Lactose and Repressible operon – Tryptophan

### Practical based on Genetics and Molecular Biology and Immunology

#### Section A : Genetics –

1. Study of Monohybrid and Dihybrid ratio
2. Study of Normal Human Karyotype ( Normal male and female)
3. Study of characters and Karyotypes of Syndrome like Down, Klinefelter & Turner
4. Field survey of Genetic traits in Human being and Submission of Diary
5. *Drosophila* culture: Media preparation and handling of flies
6. Study of *Drosophila* life cycle and its external morphology.
7. Study of *Drosophila* mutants.

#### Section B: Molecular Biology and Immunology

##### Molecular Biology :

1. Introduction to basic laboratory instruments and equipment's - Autoclave, pH meter, Electrophoresis apparatus; Molar and normal solutions calculations
2. Isolation of DNA (Genomic DNA from any available source) by phenol extraction method or any other method.
3. Quantification of Isolated DNA using Spectrophotometer.
4. Principles and Working of PCR.
5. Thin Layer Chromatography.

(Note: PCR and TLC has to be introduced as its basic technique required in research)

<b>Distribution of Marks -</b>		<b>Total Marks 30</b>
1.	Identification and comment on spots ( 2 Genetics, 2 Molecular Biology & Immunology)	04
2.	Experiment on Genetics	06
3.	Experiment on Molecular Biology & Immunology	06
4.	Submission of certified practical record	05
5.	Submission of Field diary	05
6.	Viva voce	04

### **Reference Books:**

#### **Genetics & Molecular Biology**

1. Genetics & Genetic Engineering – Joshi
2. Genetic Engineering & its applications – Joshi
3. Genetics – Gardener
4. Genetics – Winchester
5. Genetics – Gupta
6. Principles of Genetics – Sinnot Dunn, Dobzansy
7. Genetics – Ahluwalia
8. Genetics – Sarin
9. Elementary Genetics – Singleton
10. General Genetics – SRb, Owen & Edger
11. Genetics – Alenberg
12. Foundation of Genetics – Pai
13. Genetics - Strickberger
14. T. B. of Genetics- Veerbala Rastogi
15. Gene VI by Benjamin Lewis, Oxford press
16. Gene VIII by Benjamin Lewis, Oxford press
17. Genetics Vol. I and II by Pawar C. B., Himalaya publication

#### **Molecular Biology**

1. Cell and Molecular Biology by De Robertis- E. D. P., I. S. E. publication
2. Molecular Biology by Turner P. C. and McLennan , Viva Books Pvt. Ltd
3. Advanced Molecular Biology by Twyman R. M., Viva Books Pvt. Ltd
4. Molecular Biology by Freifelder D., narosa publication House
5. Molecular Biology of Gene by Watson J. D. et. al., Benjamin publication
6. Molecular Cell Biology by Darnell J. Scientific American Books USA
7. Molecular Biology of the Cell by Alberts B., Bray D. Lewis J., garland publishing Inc
8. Essentials of Molecular Biology by Freifelder D., narosa publication House
9. Molecular Cell Biology by Laodish H., Berk A., Zipursky S. L., Matsudaira P.

Baltimore D. and Darnell J., W. H. Freeman and Co.

10. The Cell: Molecular Approach by Cooper G. M.
11. Molecular Biology by Upadhyay A and Upadhyay K. Himalaya publication
12. Molecular cell Biology by Bamrath
13. Cell and Molecular Biology by P.K. Gupta

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**B.Sc. Semester V**

**Paper V:- Developmental biology**

**UNIT I :- (12 Periods)**

**Gametes to fertilization in Frog**

- 1.1 Spermatogenesis.
- 1.2 Oogenesis.
- 1.3 Sperm egg recognition and fusion
- 1.4 Post fertilization events (prevention of polyspermy, rearrangement of egg cytoplasm)

**UNIT II :- (12 Periods)**

**Early embryonic development**

- 2.1 Cleavage properties and types.
- 2.2 Blastula of frog.
- 2.3 Gastrulation of frog.
- 2.4 Germ layer formation in chick.

**UNIT III :- (12 Periods)**

**Axis specification in embryo:**

- 3.1 Embryonic organizer in frog.
- 3.2 Nieuwkoop Center.
- 3.3 Concept of morphogen gradient.
- 3.4 Basics of axis specification in Drosophila.

**UNIT IV :- (12 Periods)**

**Gene and development:**

- 4.1 Sex determination in bird and human.
- 4.2 Dosage compensation.
- 4.3 Cloning by nuclear transfer in mammals.
- 4.4 Teratogens.

**UNIT V :- (12 Periods)**

**Techniques in developmental biology:**

- 5.1 Multiple ovulation.
- 5.2 IVF, ICSI.
- 5.3 In situ hybridization.
- 5.4 Cryopreservation of gametes & embryos.

**Developmental biology in human welfare:**

- 6.1 Model organisms with examples *Drosophila* & *C. elegans*
- 6.2 Transgenic animals with examples
- 6.3 Sources & Basics of stem cells culturing with examples of application.
- 6.4 Induced Pluripotency Basics and genes involve.

**Practical based on Developmental Biology –**

1. Study of permanent slides of Frog embryology: T.S. Blastula, T.S. Gastrula, T.S. Neurula, T.S. tadpole passing through internal and external gill stage.
2. Study of permanent slides of chick embryology W.M.: 18 hrs, 24 hrs, 36 Hrs, 72hrs. 96 hrs.
3. Semen analysis: Motility and Sperm count (Source of semen: Government artificial insemination centre).
4. Sperm vitality study using suitable stains (Source of semen: Government artificial Insemination centre).
5. Hypo-osmotic swelling (HOS) for the assessment of normal semen.
6. Study of Egg Structure (Avian Egg)
7. Histology of male and female reproductive organs (Testis, Ovary, Uterus, Fallopian tube and accessory reproductive glands) With the help of already available permanent slides/ ICT tools/ charts/ photographs etc.
8. Demonstration of Barr body
9. Submission of Field report / Diary on Congenital disorders / Birth defects / Life Cycles of Animals in your surroundings

**Distribution of Marks –****Total Marks 30**

1.	Identification and Comment on spots ( 2 Slides on Frog embryology, 2 Slides on chick Embryology, 1 Slides on Reproductive Histology)	10
2.	Experiment on Sperm Count / Hypo-osmotic test for Fertility	04
3.	Experiment on Sperm Vitality / Preparation of Slides of Barr Body	04
4.	Submission of Field diary	04
5.	Submission of certified practical record	04
6.	Viva voce	04

## References Books :-

1. Developmental Biology. 2nd Edition. Leon W. Browwer Saunders College publishing.
2. Current Topics in Developmental Biology eds. R. A. Pedersen and G. P. Schatten.
3. Principles of animal developmental biology: S. C. Goel, Himalaya Publishing House.
4. Developmental Biology, S.F. Gilbert. 4th Edn. Sinauer Associates Inc. Publishers.
5. An Introduction to Developmental Biology: D. A. Ede.
6. Principles of developmental: Paul Weiss edited by Hafner publishing company New York.
7. Cells into organs. 2nd Edition. The forces that shape the Embryo. John Philip Trinkaus ed. Tom Aloisi.
8. Principles of development: Lewis Wolpert et al. 1998. Oxford University Press.
9. Foundations of Embryology. B. M. Patten & B. M. Carlson. Tata McGraw Hill Publishing Company Ltd., New Delhi.
10. An Introduction to Embryology: Balinsky (1981) 5th Ed. (CBS College Publishing).
11. Embryonic and foetal development. Cambridge University Press by Austin and Short, 1982, 1994 2nd Ed.
12. Marshall's Physiology of Reproduction Longmont, Green and Co. London Vol. 1 & 2. Lamming 1984, 2000.

## B.Sc. Semester VI

### Paper VI :- Animal Physiology, Bioinformatics and Biostatistics

#### UNIT I : (12 Periods)

- 1.1 Respiration: Structure of respiratory organs: Gills and Human Lungs
- 1.2 Transport of gases: O<sub>2</sub> and CO<sub>2</sub> Transport, Haemoglobin
- 1.3 Circulation: Blood : Definition and its constituents, functions of blood.
- 1.4 Human Heart structure, Cardiac cycle.

#### UNIT II :- (12 Periods)

- 2.1 Muscle Physiology: Types of Muscles: striated, non-striated and cardiac muscles
- 2.2 E.M. Structure and Chemical Composition of striated muscle. Mechanism of muscle contraction by Sliding filament theory.
- 2.3 Nerve Physiology: Neuron: E.M. Structure of neuron and Types : Myelinated and non-Myelinated nerve fibres, saltatory nerve conduction.
- 2.4 Synapse and synaptic transmission (with acetyl choline as an example)

#### UNIT III :- (12 Periods)

- 3.1 Nutrition and Digestion : Structure and functions of digestive system and associated Glands in Human
- 3.2 Digestion and absorption of proteins, carbohydrates and lipids.
- 3.3 Excretion : Structure of Uriniferous tubule ; Mechanism of urine formation ;
- 3.4 Concept of Ammonotelic, Ureotelic, Uricotelic animals.

#### UNIT IV :- (12 Periods)

- 4.1 Endocrine system: Hormones and its classification
- 4.2 Structure & Functions of Endocrine Glands : Pineal Gland, Hypothalamus,
- 4.3 Pituitary Gland, Thyroid Gland, Parathyroid Gland,
- 4.4 Adrenal Gland, Islets of Langerhan's

#### UNIT V :- (12 Periods)

- 5.1 Reproductive Physiology: Estrous and menstrual cycle,
- 5.2 Hormonal control of Reproduction in males and female,
- 5.3 Structure and Physiology of Human Placenta
- 5.4 Physiology of Lactation

#### UNIT VI :- Bioinformatics and Biostatistics (12 Periods)

- 6.1 Bioinformatics: Definition, Basic concepts in bioinformatics, importance and role of bioinformatics in life sciences
- 6.2 Bioinformatics databases- introduction, types of databases
- 6.3 Biostatistics – Tabulation of data, presentation of data, sampling errors,
- 6.4 Mean, Mode, Median, Standard error and Standard deviation

## Practicals :-

1. Estimation of hemoglobin percentage with the help of haemometer.
2. Preparation of Haemin crystals.
3. Measurement of blood pressure.
4. Action of salivary amylase on starch.
5. Qualitative detection of nitrogenous waste products (Ammonia, urea, uric acid) in given sample.
6. Estimation of glucose by O-toluidine method.
7. Qualitative analysis of carbohydrate, lipid and protein.
8. Field Report / Diary on disorders / Diseases observe in your surrounding (Survey Report)

**Study of histological slides of Mammal** – T.S. kidney, pituitary, thyroid, adrenal, testis, ovary; uterus, placenta, medullated and non medullated nerve fiber, smooth and striated muscle

## Section B : (Bioinformatics and Biostatistics)

1. Separation of amino acids by paper chromatography .
2. Separation of proteins by electrophoresis technique .
3. Determination of mean, mode, median, SE, SD from a given biostatistical data.
4. Graphical representation of the data using computers .
5. Retrieval of gene sequences from gene Bank.

## Distribution of Marks -

	Total Marks 30
1. Physiological Expt.	06
2. Spotting (A To D)	08
3. Analysis of given biostatistical data	04
4 Submission of Diary	04
5. Class record	04
6. Viva - voce	04

## Reference Books

1. Prosser and Brown : Comparative Animal Physiology
3. Guyton : Physiology
4. Best and Taylor : Physiological basis of Medical practice
5. C Hoar, W.S..General and comparative Physiology.Prentice Hall of India.
6. Lehninger. L.. Biochemistry. W.H. Freeman & co.
7. Nagabushnam, R. Animal physiology, S.Chand & co.
8. Martin, D.W. P.A. Mayes and W.W. Rodwell,.Harper's Review of Biochemistry lange Medical Publications.
9. Prosser, C.L. and F.A.Brown Comparative Animal physiology. W.B. Suanders.
10. Rama Rao, A.V.S.S..Biochemistry.UBSPD.
11. Stryer. L. Biochemistry Wiley International
12. Verma, P.S. and V.K. Agarwal..Animal physiology.S.Chand& co.
13. Wilson, J.A., Principles of Animal Physiology, Macmillan
14. Chatterjee, C.J; Human Physiology(Vol-I and II)

## Biotechniques, Bioinformatics and Biostatistics

1. Biophysical Chemistry – Upadhyay, Upadhyay and Nath
2. Techniques in Life Sciences – D. B. Tembhare
3. Mount W. 2004. Bioinformatics and Sequence Genome Analysis 2nd Editon CBS Pub. New Delhi.
4. Bergman, N. H. Comparative Genomics. Humana Press Inc. Part of Springer Science+Business Media, 2007.
5. Baxevanis, A. D. Ouellate, B. F. F. 2009. Bioinformatics: A Practical Guide to the Analysis of Genes and Proteins. John-Wiley and Sons Publications, New York.
6. Campbell A. M. and Heyer, L. J. 2007. Discovering Genomics, Proteomics and Bioinformatics, 2nd Edition. Benjamin Cummings.
7. Des Higgins and Willie Taylor 2000. Bioinformatics: Sequence, Structure and Databanks. Oxford University Press.
8. Rashidi H. H. and Buehler 2002. Bioinformatics Basics: Applications in Biological Science and Medicine, CRC Press, London.
9. Gibas Cynthia and Jambeck P. 2001. Developing Bioinformatics Computer Skills: Shroff Publishersand Distributors Pvt. Ltd. (O'Reilly), Mumbai.