

UNIVERSITY OF KALYANI
REVISED SYLLABUS
FOR THREE YEARS B.Sc. DEGREE COURSE
(HONOURS AND GENERAL)
IN
ZOOLOGY
According to the New Examination Pattern
Part - I, Part- II & Part- III
WITH EFFECT FROM THE SESSION
2016 – 2017

University of Kalyani
Revised Syllabus for B.Sc. (General) Course in

ZOOLOGY

(w.e.f. the session 2016 - 2017)

According to the New Examination Pattern

Part – I, Part – II & Part – III

University of Kalyani
Revised Syllabus of Zoology
General Course
(w.e.f. the session 2016-2017)
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Syllabus for Zoology (General)**Distribution of Marks****Part I****Total Marks – 100 (Theoretical – 100 Marks)****Paper I****Full Marks : 100**

Unit I : Life and diversity of Non-chordates	Marks – 25
Unit II : Life and diversity of Chordates	Marks - 25
Unit III : Cell Biology and Genetics	Marks - 25
Unit IV : Parasitology	Marks – 25

Distribution of marks

Question No.	No. of questions to be attempted	Marks Distribution	Total
1	6	1 x 6	6
2	11	2 x 11	22
3	7	6 x 7	42
4	3	10 x 3	30
Total	27		100

*Questions are to be set from all units equally

Part II**Total Marks -200 (Theoretical -100 Marks and Practical – 100 Marks)****Paper II****Full Marks : 100**

Unit I: Ecology, Biodiversity, Wild life and Environmental Biology	Marks - 25
Unit II : Zoogeography, Evolution and Taxonomy	Marks - 25
Unit III: Animal physiology and Biochemistry	Marks - 25
Unit IV: Developmental Biology	Marks – 25

Distribution of Marks : Same as paper I**Paper III (Practical)****Full Marks -100**

Distribution of Marks: Dissection, Drawing and Labelling [7+3+2=12] (one non -chordate and one chordate) 12 x 2 = 24; Mounting (one non -chordate and one chordate) 6 x 2= 12; Ecology: 10; Identification (2 specimens each from non-chordate & chordate and 2 items from osteology) 4x6 = 24 ; field report : 07; Laboratory note book and prepared slides (At least six slides): 10+3 = 13 and viva- voce: 10

Part III**Full Marks – 100 (Theoretical 60 Marks and Practical 40 marks)****Paper IV****Full marks : 100****Theoretical****Marks : 60**

Unit I : Ethology

Marks - 15

Unit II : Applied Zoology

Marks - 15

Unit III: Histology and Endocrinology

Marks - 15

Unit IV: Immunology and Biotechnology

Marks – 15

Distribution of marks

Question No.	No. of questions to be attempted	Marks Distribution	Total
1	6	1 x 6	6
2	7	2 x 7	14
3	5	6 x 5	30
4	1	10 x 1	10
Total	19		60

*Questions are to be set from all units equally

Paper V**Practical****Marks : 40****Distribution of Marks:** Physiology : 10 ; Identification : 3 x 6 = 18; Laboratory notebook : 06; Viva voce :06

Part I (General)

Paper I	Full marks: 100
Unit I : Life and diversity of Non-chordates	Marks:25
	No. of classes
1. Classification with salient features and suitable examples of subkingdom Protozoa (up to Phyla), Phylum: Porifera, Cnidaria, Platyhelminthes, Aschelminthes, Annelida, Arthropoda, Mollusca, Echinodermata (up to Subclasses)	9
2. Types study :	
a) <i>Paramecium</i> – Reproduction	1
b) <i>Sycon</i> – Canal system	1
c) <i>Obelia</i> – Structure and life history	2
d) <i>Pheretima</i> – Excretory system	1
e) <i>Periplaneta</i> – Nervous systems	1
f) <i>Pila</i> – Respiratory system	1
g) Starfish – Water vascular system	1
3. Origin of coelom, symmetry and metamerism	3
4. Corals reefs : Definition, Formation, Types and Distribution	2
5. Torsion and detorsion in Gastropoda	2
6. Affinities and phylogenetic positions of : Ctenophora and Balanoglossus	2
Unit II : Life and diversity of Chordates	Marks:25
	No. of classes
1. General characters with classification of phylum Chordata (up to classes)	1
2. Distinctive characters and suitable examples of the living forms of Chondrichthyes and Osteichthyes (up to Subclasses) Amphibia and Reptilia (up to living orders), Aves (up to Subclasses) and Mammalia (up to Infraclasses).	6
3. Types study : a) Fish – Scales and swim bladder	2
b) Snake - Poison apparatus and Biting mechanism	2
c) Pigeon – Air sacs	1
4. Comparative account of: Heart and aortic arches, Brain and Kidney in vertebrates	4
5. Retrogressive metamorphosis in <i>Ascidia</i>	1
6. Echolocation in bats	1
Unit III : Cell Biology and Genetics	Marks:25
	No. of classes
1. Cell junctions, Cell adhesion and extracellular matrix	2
2. General principles of cell signalling (Signalling molecules and their receptors)	2
3. Nucleosome model	1
4. Regulation of Cell cycle progression	2
5. Cancer - Development and Causes of Cancer, Types	3
6. Sex determination in <i>Drosophila</i> and man	2
7. Mutations and Mutagens	3
8. Genetic disorders – PKU, Albinism, Thalassemia , Sickle cell anaemia	2
9. Replication, Transcription and Translation in Prokaryotes	3
Unit IV : Parasitology	Marks:25
	No. of classes
1. Animal association : Symbiosis, Commensalism, Mutualism	2
2. Host - parasite interaction	2
3. Life history, Mode of infection, pathogenicity and control measures of the following parasites: a) <i>Plasmodium vivax</i> b) <i>Entamoeba histolytica</i> c) <i>Fasciola hepatica</i> d) <i>Ascaris lumbricoides</i>	6
4. Parasitic adaptation of <i>Fasciola</i> , <i>Taenia</i> and <i>Ascaris</i>	2
5. Vectors : Examples, structures associated with disease transmission and names of diseases transmitted by fleas, ticks and mosquitoes	4

Distribution of marks

Question No.	No. of questions to be attempted	Marks Distribution	Total
1	6	1 x 6	6
2	11	2 x 11	22
3	7	6 x 7	42
4	3	10 x 3	30
Total	27		100

*Questions are to be set from all units equally

Part II (General)**Paper II****Full marks: 100**

Unit I : Ecology, Biodiversity, Wild life and Environmental Biology	Marks : 25	No. of classes
1. Population Dynamics: Density, Natality and Mortality, Growth forms, Survivorship curves, Age ratio, Regulation of Population density		3
2. Community structure: Characteristics, Types, Stratification, Niche concept		3
3. Ecological Succession: Concept of Community change, Theories of Climax		3
4. Biodiversity: Definition, levels, values, causes of depletion; In-situ and Ex-situ conservation, Bio-diversity Hotspots and Mega diversity countries		4
5. Endangered Mammals of India		1
6. Global environment change - Greenhouse effect and global warming; climate change; Shrinking of glaciers & polar ice caps and consequent effects on river & sea levels; Ozone layer depletion; Acid rain		4
7. Solid waste and its management		1
Unit II : Zoogeography, Evolution and Taxonomy	Marks : 25	No. of classes
1. Zoo-Geographical realms with predominant fauna		2
2. Origin of Life		3
3. Biological species concept and Speciation		2
4. Geological time scale		2
5. Fossils : Definition, types and importance		2
6. Hardy-Weinberg Equilibrium and its application		2
7. Definition of taxonomy and relationship with systematics , Linnaean hierarchy		2
8. Zoological nomenclature - Binomial , Trinomial, Principle of priority, Synonym and Homonym		2
Unit III: Animal Physiology and Biochemistry	Marks : 25	No. of classes
1. pH and buffers -their role, physiological process and action		2
2. Thermoregulation in Mammals		2
3. Physiology of Vision in Mammals		2
4. Physiology of nerve impulses and synaptic transmission		2
5. Structures, Classification and functional significance of Carbohydrates, Proteins and Lipids		5
6. Carbohydrate Metabolism - Glycolysis, Citric acid cycle, Gluconeogenesis, Glycogenesis and Glycogenolysis		5
7. Protein Metabolism : Urea cycle		1
8. Enzymes : Major classes of enzymes, Allosterism, Effect of pH and Temperature on enzyme activity		2
Unit IV: Developmental Biology	Marks : 25	No. of classes
1. Gametogenesis : Process of Spermatogenesis and Oogenesis		2
2. Fertilization : Outline knowledge of Fertilization in Human		2
3. Types of egg and role of yolk in pattern of cleavage		2
4. Gastrulation in Chick		1
5. Development and functions of Extra embryonic membranes in chick		2
6. Structure and function of Human placenta		2
7. Implications of Developmental Biology - Diagnosing Infertility, IVF, Teratogenesis – teratogenic agents and effects of teratogens on embryonic development		3

Distribution of marks

Question No.	No. of questions to be attempted	Marks Distribution	Total
1	6	1 x 6	6
2	11	2 x 11	22
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4	3	10 x 3	30
Total	27		100

*Questions are to be set from all units equally

Paper III (Practical)**Full marks : 100****1. Demonstration of dissection through computer simulation:**

- a) *Pheretima*: Nervous system.
- b) *Periplaneta*: Nervous system and Female reproductive system
- c) *Pila* : Digestive system and Nervous system
- d) *Lata* : Afferent branchial system, Efferent branchial system and Origin & distribution of IXth and Xth cranial nerves
- e) *Tilapia* : Urino-genital system

2. Mounting and preparation :

- a) *Daphnia*, *Cylops*, *Cypris*, *Mysis*, Mosquito larva and head of Mosquito
- b) Placoid , Cycloid and Ctenoid scales

3. Ecology:

- a) Estimation of dissolved O₂ of water
- b) Estimation of free CO₂ in water
- c) Estimation of pH of water
- d) Quantitative counting of zooplankton

4. Identification with reasons :

- a) Non-chordates : *Paramoecium*, *Sycon*, *Obelia*, *Fasciola*, *Ascaris*, *Hirudinaria*, *Scolopendra*, Horse-shoe crab, Silverfish, *Octopus*, *Mytilus*, *Achatina*, *Asterias*, *Balanoglossus*.
- b) Chordates: *Ascidia*, *Branchiostoma*, *Petromyzon*, *Scoliodon* , *Exocoetus*, *Hippocampus*, *Hyla*, Axolotl larva, *Draco*, *Naja*, *Tryonix*, Microchiroptera.
- c) Bones: Skull of poisonous and non-poisonous snakes, pigeon and dog.
Limb and girdle bones of *Columba* and *Cavia*.

5. Field study report: Report on the visit of at least one of the following : Zoological garden, Zoological museum, Sericultural, Agricultural, Apicultural and Fisheries Institute/Research centre /Farm, Forest ecosystem, Beach ecosystem.**6. Submission of Laboratory Note Book and prepared slides from class work (at least 6 such slides to be submitted).****7. Viva Voce**

Distribution of Marks: Dissection, Drawing and Labelling [7+3+2=12] (one non -chordate and one chordate) 12 x 2 = 24; Mounting (one non -chordate and one chordate) 6 x 2= 12; Ecology: 10; Identification (2 specimens each from non chordate & chordate and 2 items from osteology) 4x6 = 24 ; field report : 07; Laboratory note book and prepared slides (At least six slides): 10+3 = 13 and viva-voce: 10

Part III (General)**Paper IV:****Full marks : 100****Theoretical****Marks : 60****Unit I : Ethology****Marks : 15****No. of classes**

- | | |
|---|---|
| 1. Basic concept of Instinct and Learning behaviour | 3 |
| 2. Communication in Honey bees (Dance language and pheromone) | 3 |
| 3. Eusociality in Termites | 2 |
| 4. Biological rhythms | 2 |
| 5. Parental care in Amphibia | 2 |

Unit II : Applied Zoology**Marks : 15****No. of classes**

- | | |
|--|---|
| 1. Apiculture : Indian honey bees, Life cycle of <i>Apis indica</i> , Langstroth's Hive, Honey and its uses | 3 |
| 2. Sericulture : Kinds of silkworm and their host plants, life history of <i>Bombyx mori</i> and rearing of silkworm, harvesting and processing of cocoons, reeling and extraction of silk, common diseases of <i>Bombyx mori</i> and their remedies | 3 |
| 3. Pisciculture : Composite fish culture and management, Knowledge of induced breeding technique in fish, Common fish diseases and their control | 4 |
| 4. Poultry : Types of breed – Fowl, Management of fowl (deep litter system), Disease and control | 1 |
| 5. Dairy : Common Indian and foreign dairy breeds of milching cows, Milk processing (pasteurization) | 1 |

Unit III : Histology and Endocrinology**Marks : 15****No. of classes**

- | | |
|---|---|
| 1. Histology of liver, kidney, thyroid, pancreas, testis and ovary in mammals | 6 |
| 2. Locations, name of hormones and functions of following endocrine glands : Pituitary, Thyroid, Pancreas, Testis and Ovary | 6 |
| 3. Menstrual cycle of human | 2 |

Unit IV: Immunology and Biotechnology**Marks : 15****No. of classes**

- | | |
|---|---|
| 1. Components of immune system – Innate and Adaptive ; Humoral and Cell mediated immunity | 3 |
| 2. Structure and classification of Immunoglobulins | 2 |
| 3. Antigen-antibody interaction | 2 |
| 4. Basic principles of vaccination | 2 |
| 5. Recombinant DNA technology, Cloning vectors | 2 |
| 6. Gene cloning and its applications | 2 |
| 7. Transgenic animals and their application | 2 |

Distribution of marks

Question No.	No. of questions to be attempted	Marks Distribution	Total
1	6	1 x 6	6
2	7	2 x 7	14
3	5	6 x 5	30
4	1	10 x 1	10
Total	19		60

*Questions are to be set from all units equally

Paper V : Practical

Marks : 40

1. Physiological experiments :

- a) Total count (TC) of human blood
- b) Differential count (DC) of human blood
- c) Determination of human blood pressure
- d) Determination of haemoglobin percentage
- e) Determination of human blood groups

2. Identification :

A. Specimens with characters and economic importance:

Bombyx mori, *Apis*, *Anomis sabulifera*, *Scirpophaga incertulus*, *Sitophilus oryzae*, *Lepisma*, Termite queen, *Macrobrachium*, *Labeo rohita*, *L. calbasu*, *Hypophthalmichthys molitrix*, *Ctenopharyngodon*, *Cyprinus carpio*, *Lates*, *Hilsa*, *Bandicota bengalensis*

B. Histological slides :

- a) T.S. of mammalian small intestine, liver, pancreas, lung, kidney, ovary and testis.
- b) Whole mount of chick embryo of 24 hours, 48 hours and 72 hours.

3. Submission of Laboratory Note Book

4. Viva voce

Distribution of Marks : Physiology : 10 ; Identification (Four from Economically important specimens and Two from Histology & Embryology) : 3 x 6 = 18; Laboratory notebook : 06; Viva voce :06

University of Kalyani

Revised Syllabus for B.Sc. (Honours) Course in

ZOOLOGY

(w.e.f. the session 2016 - 2017)

According to the New Examination Pattern

Part – I, Part – II & Part – III

University of Kalyani
Revised Syllabus of Zoology
Honours Course
(w.e.f. the session 2016-2017)

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University of Kalyani
Revised Syllabus of Zoology
Syllabus structure for B.Sc. (Hons.) Zoology
(w.e.f. the session 2016-2017)

<u>Part I</u>	<u>Full marks : 200</u>
<u>Paper I</u>	<u>Full marks : 75</u>
Unit I : Non- chordates	Marks : 25
Unit II : Chordates	Marks : 25
Unit III: Specialized features of Non-chordates and Chordates	Marks : 25
<u>Paper II</u>	<u>Full marks : 75</u>
Unit I : Cell Biology	Marks : 25
Unit II : Economic Zoology	Marks : 25
Unit III: Applied Zoology	Marks : 25
<u>Paper III : Practical</u>	<u>Full marks : 50</u>
<u>Part II</u>	<u>Full marks : 200</u>
<u>Paper IV</u>	<u>Full marks : 75</u>
Unit I : Ecology	Marks : 25
Unit II : Biodiversity and Wildlife	Marks : 25
Unit III: Environmental biology and Toxicology	Marks : 25
<u>Paper V</u>	<u>Full marks : 75</u>
Unit I : Ethology	Marks : 25
Unit II : Zoogeography, Evolution and Taxonomy	Marks : 25
Unit III: Biological Techniques	Marks : 25
<u>Paper VI : Practical</u>	<u>Full marks : 50</u>

Part III**Full marks : 400****Paper VII****Full marks : 80****Unit I : Parasitology and Immunology****Marks : 20****Unit II : Biostatistics****Marks : 20****Unit III : Bioinformatics****Marks : 20****Unit IV : Microbiology****Marks : 20****Paper VIII****Full marks : 80****Unit I : Genetics****Marks : 20****Unit II : Molecular Biology****Marks : 20****Unit III : Biotechnology****Marks : 20****Unit IV : Biochemistry****Marks : 20****Paper IX****Full marks : 80****Unit I : Histology and Histochemistry****Marks : 20****Unit II : Endocrinology****Marks : 20****Unit III : Physiology****Marks : 20****Unit IV : Developmental Biology****Marks : 20****Paper X : Practical****Full Marks : 80****Group A****Marks : 40****Group B****Marks : 40****Paper XI: Practical****Full Marks : 80****Group A****Marks : 40****Group B****Marks : 40**

THE UNIVERSITY OF KALYANI
SYLLABUS FOR THREE-YEAR DEGREE COURSE
IN ZOOLOGY HONOURS
TOTAL MARKS : 800

Distribution of Marks

	THEORITICAL PAPERS	PRACTICAL PAPERS	MARKS DISTRIBUTION		TOTAL MARKS
			THEORY	PRACTICAL	
PART I	2	1	(2 x 75) = 150	+ (1 x 50) = 50	200
PART II	2	1	(2 x 75) = 150	+ (1 x 50) = 50	200
PART III	3	2	(3 x 80) = 240	+ 2x (40+40) = 160	400
TOTAL	7	4	540	+ 260	800

PART – I (Honours)

Total Marks - 200- Theoretical 150 (2X75) and Practical 50 (1 x 50)

PAPER – I :

Full Marks : 75

UNIT – I Non-chordates

Marks- 25

UNIT – II Chordates

Marks- 25

UNIT – III Specialized features of Non-chordates and Chordates

Marks- 25

Distribution of marks

Question No.	No. of questions to be attempted	Marks Distribution	Total
1.	5	1 x 5	5
2.	6	2 x 6	12
3.	3	6 x 3	18
4.	4	10 x 4	40
Total	18		75

*Questions are to be set from all units equally

PAPER – II :

Full Marks : 75

UNIT – I Cell Biology

Marks- 25

UNIT – II Economic Zoology

Marks- 25

UNIT – III Applied Zoology

Marks- 25

Distribution of Marks : Same as Paper I

Paper III: Practical

Full Marks : 50

Distribution of marks: Non- chordate Dissection, Drawing and Labelling : 03+02 = 05 ; Chordate Dissection, Drawing and Labelling: 03+02 = 05; Mounting :03 ; Identification (2 Non-chordates & 2 Chordates) : 03x04 =12 ; Identification of meiotic stages (Any two) : 2¹/₂ x 02 = 05 ; Attendance : 05*; Laboratory note book & Slides (at least five) : 04+01 =05 ; Viva voce : 05 ; Field report :05

*

Percentage of attendance	Marks Division (out of 05)
91 – 100 %	05
81 – 90 %	04
75 – 80 %	03

PART – II (Honours)**Total Marks - 200- Theoretical 150 (2x75) and Practical 100 (1 x 50)****PAPER – IV****Full Marks : 75**

UNIT – I Ecology

Marks- 25

UNIT – II Biodiversity and Wild life

Marks- 25

UNIT – III Environmental Biology

Marks- 25

Distribution of Marks : Same as Paper I**PAPER –V****Full Marks : 75**

UNIT – I Ethology

Marks - 25

UNIT – II Zoogeography, Evolution and Taxonomy

Marks- 25

UNIT – III Biological techniques

Marks- 25

Distribution of Marks : Same as Paper I**PAPER –VI (PRACTICAL)****Full Marks : 50**

Distribution of Marks: Identification (Osteology) : $2\frac{1}{2} \times 2 = 05$; Ecological experiment :08 ; Identification (Ecological apparatus) : $1\frac{1}{2} \times 2 = 03$; Adaptive features : $1\frac{1}{2} \times 2 = 03$; Camera lucida and microscopic measurement :05 ; Seminar presentation : 08 ; Attendance : 05* ; Laboratory note book : 05; Viva voce : 05; Field report :06.

*

Percentage of attendance	Marks Division (out of 05)
91 – 100 %	05
81 – 90 %	04
75 – 80 %	03

PART – III (Honours)**Total marks : 400 : Theoretical 240 (3 x 80) and Practical 160 : 2 x (40+40)****PAPER –VII****Full Marks : 80**

UNIT – I Parasitology and Immunology

Marks- 20

UNIT – II Biostatistics

Marks- 20

UNIT – III Bioinformatics

Marks- 20

UNIT - IV Microbiology

Marks- 20

Distribution of marks

Question No.	No. of questions to be attempted	Marks Distribution	Total
1.	7	1 x 7	7
2.	6	2 x 6	12
3.	3	7 x 3	21
4.	4	10 x 4	40
Total	20		80

*Questions are to be set from all units equally

PAPER –VIII**Full Marks : 80**

UNIT – I Genetics	Marks- 20
UNIT – II Molecular biology	Marks- 20
UNIT – III Biotechnology	Marks- 20
UNIT - IV Biochemistry	Marks -20

Distribution of marks : Same as Paper VII**Paper - IX****Full Marks : 80**

UNIT – I Histology and Histochemistry	Marks- 20
UNIT – II Endocrinology	Marks- 20
UNIT – III Physiology	Marks- 20
UNIT - IV Developmental Biology	Marks - 20

Distribution of marks : Same as Paper VII**Paper –X (Practical)****Full Marks : 80****Group – A****Full Marks - 40****Distribution of Marks :** Pedigree analysis : 07 ; Chi-square / t-test + One way ANOVA :05+ 05 =10; Bioinformatics : 05;

Seminar presentation :08; Laboratory notebook : 05 ; Viva-voce : 05 .

Group – B**Full Marks – 40**

Distribution of Marks : Microtechnique [Section cutting and Stretching (2+1) , Staining of the supplied tissue section and identification with reasons (3+3), Drawing a part of the tissue and labelling (2+1)] : 12 ; Embryo [Dissection, staining and mounting (05), Identification with reasons (03)] : 08 ; Identification of Histological and Embryological slides (Two each) : $2\frac{1}{2} \times 4 = 10$; Laboratory note book : 05; Viva-voce :05.

Paper XI (Practical)**Group -A****Full Marks – 40**

Distribution of Marks: DNA Isolation / Preparation of Pituitary extract : 08; Microbiology : 05; Parasitology [Preparation and staining (05) and identification(01)]: 06 , Identification of parasites with reasons (any two): $3 \times 2 = 6$; Attendance : 05* Laboratory note book: 05 ; Viva-voce : 05.

*

Percentage of attendance	Marks Division (out of 05)
91 – 100 %	05
81 – 90 %	04
75 – 80 %	03

Group – B**Full Marks – 40****Distribution of Marks:** Xenobiotics : 10; Biochemistry : 12; Physiology : 08; Laboratory note book: 05 ; Viva voce : 05.

Part I (Honours)

Total Marks : 200 - Theoretical 150 (2 x75) and Practical 50 (1 x 50)

Paper I:

Full Marks : 75

Unit I: Non-chordates

Marks 25

No. of classes

1. Protozoa : Salient features and classification up to Subphylum, Amoeboid movement of *Amoeba*, Ciliary movement of *Paramecium* and flagellar movement of *Euglena*, Reproduction in *Paramecium* with special reference to conjugation. 5
2. Porifera: Salient features and classification up to Subclass, Cell types and spicules of *Sycon* 2
3. Cnidaria: Salient features and classification up to Subclass, Structure and Life cycle of *Obelia* 3
4. Platyhelminthes: Salient features and classification up to Subclass 1
5. Aschelminthes: Salient features and classification up to Subclass 1
6. Annelida: Salient features and classification up to Subclass , Reproductive system of *Pheretima* 2
7. Arthropoda: Salient features and classification up to Subclass , Circulatory system of *Periplaneta* 2
8. Mollusca: Salient features and classification up to Subclass , Respiration in *Pila* 2
9. Echinodermata: Salient features and classification up to Subclass. 1
10. Origin of coelom, symmetry and metamerism 3
11. Affinities and phylogenetic positions of :-*Peripatus*, *Limulus*, *Balanoglossus* 3

Unit II: Chordates

Marks : 25

No. of classes

1. Urochordata and Cephalochordata: Salient features and classification up to order, Excretion in *Branchiostoma*. 3
2. Cyclostomata : Classification up to subclasses , Affinities and phylogenetic position of *Petromyzon*. 2
3. Chondrichthyes and Osteichthyes : Classification up to subclasses, Affinities and phylogenetic position of Dipnoi. 3
4. Amphibia : Salient features and classification up to living orders, Paedomorphosis with special reference to Axolotl larva 2
5. Reptilia: Salient features and classification up to living orders, Affinities of *Sphenodon* 2
6. Aves: Salient features and classification up to subclasses, Double respiration of *Columba*, Exoskeletal structures 4
7. Mammalia: Salient features and classification up to infraclasses, Exoskeletal structures 3
8. Comparative account of : Heart and aortic arches, Brain and Kidney in vertebrates 4
9. Distinguishing features : a) Non-poisonous and poisonous snakes, b) Ratitae and Carinatae, c) Cetacea and Sirenia, d) Artiodactyla and Perissodactyla 2

Unit III: Specialized features of Non-chordates and Chordates

Marks : 25

No. of classes

1. Canal system in sponges 2
2. Polymorphism in Siphonophora 2
3. Corals and coral reefs : Definition, Formation, Types, Distribution and Conservation 3
4. Moulting and Metamorphosis in insects 2
5. Torsion and detorsion in Gastropoda 3
6. Water vascular system of *Asterias* 1
7. Retrogressive metamorphosis in *Ascidia* 1
8. Scales and Swim bladder in fishes 2
9. Poison apparatus and Biting mechanism of snakes; composition and types of venom in snake, First aid to snake bite 4
10. Principles of bird flight 2
11. Dentition in Mammals 1
12. Ruminant stomach in mammals 1
13. Echolocation in bats 1

Distribution of marks

Question No.	No. of questions to be attempted	Marks Distribution	Total
1.	5	1 x 5	5
2.	6	2 x 6	12
3.	3	6 x 3	18
4.	4	10 x 4	40
Total	18		75

*Questions are to be set from all units equally

SUGGESTED READINGS:

Non - chordates :

1. Biology – Raven, Johnson, Losos, Mason and Singer (Tata MaGraw-Hill Edition)
2. Biology of Animals. Vol. I - K.S. Sinha, S. Adhikari, & Ganguly (New Central Book Agency (p) Ltd. Kolkata)
3. Biology of the Invertebrates – J.A. Pechenik (McGraw Hill)
4. Biology of nonchordates – H.C. Nigam
5. General Zoology -Villem, Walker and Barnes
6. Invertebrates – R.C. Brusca & G.J. Brusca
7. Invertebrate structure and function – E. J. W. Barrington
8. Invertebrate Zoology - Jordon and Verma
9. Invertebrate Zoology -Meglitch and Schram
10. Invertebrate Zoology- Ruppert and Barnes
11. Modern Textbook of Zoology: Invertebrate – Kotpal (Rastogi)
12. Textbook of Zoology, Vol. I : Invertebrates - Parker and Haswell (Edited by Marshall & Williams)
13. The Invertebrates (Vol-I) – L.H. Hyman (Mc.GrawHill Book Company)

Chordates :

1. Analysis of Vertebrate Structure- Hildebrand
2. Biology of Animals. Vol. II. – K.S. Sinha, S. Adhikari, B.B. Ganguly & B.D. Goswami (New Central Book Agency (p) Ltd.)
3. Biology of Chordates - Nigam (S. Chand)
4. Biology of Vertebrates- Walter & Sayles
5. Chordate Zoology – E.L. Jordan & P.S. Verma (S. Chand & Company Ltd. New Delhi)
6. Comparative Anatomy of Vertebrates- G.C. Kent & R. Carr
7. Elements of Chordate Anatomy- Weichert
8. Introduction to General Zoology, Vol. 1. – K.K. Chaki, G. Kundu & S. Sarkar (New Central Book Agency (P) Ltd. Kolkata)
9. Life of Vertebrates - J. Z. Young
10. Modern Text Book of Zoology Vertebrates - Kotpal (Rastogi)
11. Vertebrates : Comparative anatomy, function, Evolution - K. V. Kardong (Tata MaGraw-Hill Edition)
12. Vertebrate life - Pough and McFerland
13. Text book of Zoology Vol-II Vertebrates – Parker & Haswell (Edited by Marshall & Williams)
14. The Vertebrate body- Romer & Parsons

Paper II**Full marks : 75**

Unit I : Cell Biology	Marks : 25	No. of classes
1. Cell-cell communication : Cell junctions, Cell adhesion and extracellular matrix, General principles of cell signalling (Signalling molecules and their receptors; functions of cell surface receptors; Intracellular signal transduction pathway; signalling networks.)		6
2. Intracellular transport and protein sorting		3
3. Membrane transport : Principles of membrane transport, Channel proteins, Carrier proteins, Passive and Active transport		3
4. Regulation of Cell cycle progression		3
5. Cell Death and Cell Renewal		2
6. Cancer : Development, Causes, Types, Oncogenes, Tumor Suppressor genes		5
7. Regulation of Chromatin Structure and Nucleosome Assembly		3
Unit II : Economic Zoology	Marks : 25	No. of classes
1. Basic idea of pests and insecticides, Integrated Pest Management		4
2. Life history, damage and control measures of the following; <i>Chilo infuscatellus</i> (Sugarcane); <i>Anomis sabulifera</i> (Jute), <i>Scirpophaga incertulus</i> (Paddy), <i>Leucinodes orbonalis</i> (Vegetable) and <i>Bandicota bengalensis</i> (rodent pest).		5
3. Medical and veterinary zoology : Brief account of life history, mode of infection and pathogenicity of the following pathogens with reference to prophylaxis and treatment: a) <i>Entamoeba histolytica</i> , b) <i>Plasmodium vivax</i> c) <i>Leishmania donovani</i> d) <i>Fasciola hepatica</i> e) <i>Wuchereria bancrofti</i> f) <i>Echinococcus granulosus</i> .		10
4. Vectors : Examples, structures associated with disease transmission and names of diseases transmitted by fleas, ticks and mosquitoes; management of these vectors		6
Unit III : Applied Zoology	Marks : 25	No. of classes
1. Sericulture : Silkworm species and their host plants, Life history of <i>Bombyx mori</i> ; brief idea of silkworm rearing; extraction and reeling of silk, diseases and enemies of silkworm and silk moths.		5
2. Apiculture : Species of honeybees in India, Langstroth's hive, extraction of honey and uses of honey, Problems and prospects of apiculture.		3
3. Aquaculture : A) Pisciculture : Stocking and management of rearing ponds, Induced breeding, Integrated fish farming, knowledge of fish seed transport, fishery by- products, fish diseases, their symptoms and remedies B) Prawn culture : Giant fresh water prawn and tiger prawn, Sources, seed, culture methods, problems C) Pearl culture : Pearl producing species, their distribution, pearl culture methods, composition and uses of pearl		11
4. Poultry keeping : Fowl breeds, diseases and their control, poultry management (Deep litter system)		3
5. Dairy : Common breeds of cow, artificial insemination, milk – its processing and products		3

Distribution of marks

Question No.	No. of questions to be attempted	Marks Distribution	Total
1.	5	1 x 5	5
2.	6	2 x 6	12
3.	3	6 x 3	18
4.	4	10 x 4	40
Total	18		75

*Questions are to be set from all units equally

SUGGESTED READINGS:**Cell Biology**

1. Cell Biology - C.B. Powar (Himalaya Publication, New Delhi)
2. Cell Biology - De-Robertis
3. Cell and Molecular Biology (John Wiley) – Karp
4. Cell and Molecular Biology – P.K. Gupta (Rastogi Publication, Meerut)
5. Cell Biology - Dr. S.P. Singh, Dr. B.S. Tomar (Rastogi Publication, Meerut)
6. Concepts of Cell Biology - Verma and Agrawal
7. Essential Cell Biology - Alberts *et al* (Garland)
8. Introduction to Cell Biology - Veer Bala Rastogi (Rastogi Publication, Meerut)
9. Molecular Biology of the Cell - Alberts *et al*(Garland)
10. Molecular Cell Biology - Lodish *et al* (Freeman)
11. The Cell A Molecular approach - Cooper and Hausman (Sinauer)

Economic and Applied Zoology

1. A Handbook on Economic Zoology – J. Ahsan & S.P. Sinha (S. Chand & Company Ltd.)
2. Animal Husbandary- G. C. Banerjee
3. A textbook of Applied Entomology. Vol.I & II 2nd Ed. - K. P. Srivastava (Kalyani Publishers, New Delhi)
4. Aquaculture, Fishing News Books - T. V. Pillay
5. Aquaculture Resurgence - Birth of Blue Revolution (Professor Hiralal Chaudhuri's Dynamic Contribution to South and Southeast) - A. B. Chaudhuri (Daya Publishing House)
6. Bee keeping in India- ICAR
7. Economic Zoology – G.S. Shukla & V.B. Upadhyay (Rastogi Publication)
8. Fish and Fisheries of India - V. G. Jhingran (Hindusthan Pub. Corp.)
9. General and Applied Entomology – B.V. David & T.N. Ananthkrishnan (Tata McGraw-Hill Publishing)
10. General Parasitology - T. C. Cheng (Academic Press, Inc. Orlando. U.S.A.)
11. Human Parasitology – B.J. Bogitsh, C.E. Carter, & T.N. Oltomann (Academic Press, New York)
12. Induced Breeding of Carps – H. Chaudhuri & S.B. Singh (Satish Book Enterprise)
13. Lac Culture- N. Ghorai
14. Livestock & Poultry Production- Singh and Moore
15. Parasitology, Chatterjee Medical - K.D. Chatterjee
16. Sericulture & Silk Industry- D. C. Sarkar

Paper III: Practical**Full marks : 50****Demonstration of dissection through computer simulation:**

1. **Non-chordates:**
 - a) *Pheretima* : Reproductive system and Nervous system
 - b) *Periplaneta*: Digestive, Nervous, Male and Female reproductive systems
 - c) *Pila*: Digestive system and Nervous system
2. **Chordates :**
 - a) Lata : Afferent and Efferent branchial systems; Origin and distribution of IXth and Xth cranial nerves
 - b) Tilapia : Urinogenital system
3. **Mounting:**
 - a) *Daphnia*, *Cyplops*, *Cypris*, *Mysis*, Mosquito larva and Head of mosquito
 - b) Placoid , Cycloid and Ctenoid Scales
 - c) Pecten of fowl
4. **Identification:**
 - a) **Non- chordates:** *Paramoecium*, *Sycon*, *Obelia* , *Aurelia*, Sea anemone, *Ascaris* , *Nereis*, *Hirudinaria*, *Chaetopterus*.
Peripatus, Horse-shoe crab, *Squilla*, *Eupagurus*, *Lepisma*, *Bombyx mori*, *Achatina*, *Mytilus*, *Octopus*, *Asterias*,
Echinus, *Antedon* , *Balanoglossus*
 - b) **Chordates:** *Ascidia*, *Branchiostoma*, *Petromyzon*, *Sphyrna*, *Trygon*, *Torpedo*, *Hippocampus*, *Tylototryton*, *Ichthyophis*,
Axolotl larva, *Rhacophorus*, *Trionyx* , *Phrynosoma* , *Naja*, Owl, *Passer*, *Microchiroptera*, *Bandicota*
5. Identification of meiotic stages
6. Attendance in both Theoretical and Practical classes
7. Submission of Laboratory note book and slides
8. Viva - voce
9. Field report: Visit to ZSI/ Zoo garden/ Museum/Fish farm/Sericulture station/Pond ecosystem/ Agricultural research station

Distribution of marks: Non- chordate Dissection, Drawing and Labelling : 03+02 = 05 ; Chordate Dissection, Drawing and Labelling: 03+02 = 05; Mounting :03 ; Identification (2 Non-chordates & 2 Chordates) : 03x04 =12 ; Identification of meiotic stages (Any two) : 2¹/₂x 02 = 05 ; Attendance : 05*; Laboratory note book & Slides (at least five) : 04+01 =05 ; Viva voce : 05 ; Field report :05

*

Percentage of attendance	Marks Division (out of 05)
91 – 100 %	05
81 – 90 %	04
75 – 80 %	03

Part II (Honours)**Total Marks : 200 Theoretical 150 (2 x75) and Practical 50 (1x50)****Paper IV:****Full marks:75****Unit I : Ecology****Marks : 25****No. of classes**

- | | |
|---|---|
| 1. Ecological efficiencies; Productivity | 4 |
| 2. Population Dynamics: Density, Natality and Mortality, Growth forms, survivorship curves, age ratio, Regulation of Population density, r and K strategies, Gause's Principle with laboratory and field examples | 5 |
| 3. Community structure: Characteristics, Types, dominance, diversity, species richness, abundance, stratification; Ecotone and edge effect, Niche concept, Resource partitioning. | 6 |
| 4. Ecological Succession: Concept of Community change, Theories of Climax, Models of Succession. | 6 |
| 5. Wetland ecosystem and its importance | 3 |
| 6. Soil profile | 1 |

Unit II: Biodiversity and Wild life**Marks : 25****No. of classes**

- | | |
|---|---|
| 1. Biodiversity: Definition, levels, values, causes of depletion; In-situ and Ex-situ conservation, Bio-diversity Hotspots and Mega diversity countries; Biodiversity Act; Biopiracy. | 6 |
| 2. Endangered Mammals of India; Management Strategies with special reference to Tiger, Rhinoceros and Olive Ridley turtle in India; Human-elephant conflict, Wildlife Protection Act, 1972. | 7 |
| 3. International organizations and legislations. Brief programme of CITES, WWF, MAB, IUCN, TRAFFIC, ZSI | 4 |
| 4. People's Biodiversity Register (PBR) | 1 |

Unit III: Environmental Biology and Toxicology**Marks : 25****No. of classes**

- | | |
|---|---|
| 1. GIS and Remote sensing – Basic concept | 2 |
| 2. Water – Rainwater harvesting, aquifers , groundwater recharge, watershed management | 3 |
| 3. Sustainable Development: Definition; Threats to sustainable development, Ecological footprint | 2 |
| 4. Global environment change : Greenhouse effect and global warming; climate change; Shrinking of glaciers & polar ice caps and consequent effects on river & sea levels; Ozone layer depletion and its effects on vegetation and biota | 4 |
| 5. Biosafety of GMOs. | 1 |
| 6. Environmental impact assessment | 1 |
| 7. Eutrophication; Bioremediation | 2 |
| 8. Depletion of resources; Generation of waste; types (agricultural, municipal, industrial); Management of wastes and disposal (emphasis on concepts of reduce, reuse and recycle) | 2 |
| 9. Xenobiotics – general concept, biotransformation reaction. | 3 |

Distribution of marks

Question No.	No. of questions to be attempted	Marks Distribution	Total
1.	5	1 x 5	5
2.	6	2 x 6	12
3.	3	6 x 3	18
4.	4	10 x 4	40
Total	18		75

*Questions are to be set from all units equally

SUGGESTED READINGS :

Ecology, Environmental Biology & Biodiversity and Wildlife :

1. Basic Ecology- E. P. Odum
2. Biodiversity – Principle of Conservation - Kumar and Asija
3. Biodiversity- Wilson
4. Concepts of Ecology, Pearson Education- E. J. Kormondy
5. Conservation Biology: Foundations, Concepts, Application – F. Van Dyke
6. Conservation Biology- Hunter
7. Ecology - C. J. Krebs (Benjamin Cummings)
8. Ecology: Principles and Applications- Chapman & Reiss
9. Ecology- Riclefs and Miller
10. Elements of Ecology-T. H. Smith and R. L. Smith. (Pearson)
11. Endangered animals of India- A. K. Mukherjee
12. Environmental Biology- P.D. Sharma (Rastogi Publication)
13. Environmental Biology – P.S. Verma & V.K. Agrawal (S. Chand)
14. Environmental Science- G. Tyler Miller
15. Essentials of Ecology – C. Townsend, J. L. Harper, M. Bagon
16. Fundamentals of Ecology- E. P. Odum
17. Threatened Animals of India. ZSI. – B.K. Tikadar
18. Threatend Mammals of India- G. K. Shah & S. Majumdar
19. Wildlife of India- Majupuria

Toxicology:

1. Basic Toxicology: Fundamentals, Target organs and Risk Assessment - F.C. Lu
2. Casarett & Daul's Toxicology: The Basic Science of Poisons - C.D. Klaassen (McGraw-Hill, New York)
3. Fundamental Toxicology - J.H. Duffus & H.G. J. Worth (RSC publishing)
4. Introduction to Toxicology – J. Timbrell

Paper- V**Full marks : 75****Unit I : Ethology****Marks : 25****No. of classes**

- | | |
|---|---|
| 1. Instinct and learning, Fixed Action Pattern | 5 |
| 2. Communication in Honey bees (Dance language and pheromones) | 3 |
| 3. Eusociality in Termites | 2 |
| 4. Altruism, Reciprocal Altruism, Kinship, Selfishness, Cooperation | 3 |
| 5. Biological rhythms | 3 |
| 6. Parental care in Amphibia and parent offspring conflict | 4 |
| 8. Migratory behaviour of Bird | 3 |

Unit II: Zoogeography, Evolution and Taxonomy :**Marks : 25****No. of classes**

- | | |
|--|---|
| 9. Zoo - Geographical Realm and Bathymatric (Halobiotic and Limnobiatic) Distribution of animals | 3 |
| 10. Barriers to dispersal of animals, Discontinuous distribution | 2 |
| 11. Modern synthetic theory of Evolution | 1 |
| 12. Concepts of species (Typological, Nominalistic, Biological, Evolutionary) and Speciation | 4 |
| 13. Adaptation (morphological as well as physiological) Aquatic and desert. | 3 |
| 14. Evolutionary and adaptive significance of colouration and mimicry | 2 |
| 15. Hardy-Weinberg Equilibrium and its application | 4 |
| 16. Definition of taxonomy and relationship with systematics | 1 |
| 17. Zoological nomenclature - Binominal , Trinominal, principle of priority; synonym and homonym, Type and Sub-species | 3 |
| 18. Kinds of taxonomic concepts – Morphological, Cytogenetical, Biochemical, Numerical (Phenetics and Cladistics) | 2 |

Unit III : Biological techniques**Marks : 25****No. of classes**

- | | |
|---|----|
| 1. Cell and tissue culture techniques : Culture media, Types of animal cell culture, Cell viability testing, Filtration, autoclaving, dry heat sterilization, wet sterilization and radiation | 7 |
| 2. Separation of techniques: Centrifugation (Sedimentation, density gradient); Chromatography (Elementary idea of thin layer, gel filtration and ion exchange, High-Performance Liquid Chromatography(HPLC) - Principles and application) , Agarose gel electrophoresis, SDS-PAGE | 10 |
| 3. Microscopic-Principles of Light microscopy; Phase contrast microscopy; Confocal microscopy; Electron microscopy (EM)- SEM, TEM and scanning transmission EM (STEM); Fluorescence Microscopy | 8 |

Distribution of marks

Question No.	No. of questions to be attempted	Marks Distribution	Total
1.	5	1 x 5	5
2.	6	2 x 6	12
3.	3	6 x 3	18
4.	4	10 x 4	40
Total	18		75

*Questions are to be set from all units equally

SUGGESTED READINGS :

Animal Behaviour

1. Animal Behaviour – R. Mathur (Rastogi Publication)
2. Animal Behaviour – concepts, processes and methods- Drickamer & Vessey
3. An Introduction to Animal Behaviour - Manning & Dawkins (Cambridge)
4. Animal Behaviour, Psychology, Ethology and Evolution - Mcfarland (Pitman)
5. An Introduction to Ethology – Slater (Cambridge)
6. Biology of Animal Behaviour - Goodenough *et al.* (Mosby)
7. The Foundation of Ethology - Lorenz (Springer)

Zoogeography, Evolution & Taxonomy :

1. Animal Taxonomy and Museology - Dalela & Sharma
2. Evolution- Dobzhansky, Ayala, Stebbins, Valentine
3. Evolution-Strickberger
4. Evolutionary Biology- Futuyama
5. Principles of Animal Taxonomy- Simpson
6. Principles of Systematic Zoology- Mayr & Ashlock
7. Theory and Practicals of Animal Taxonomy Kapoor
8. Understanding Evolution- Hanson
9. Zoogeography- Darlington

Biological Techniques :

1. An Introduction to Practical Biochemistry – Plummer (McGraw Hill)
2. Biological Instrumentation and Methodology- P.K. Bajpai(S. Chand & Company Ltd.)
3. Experimental Biochemistry - Wilson & Walker (Cambridge)
4. Fundamentals of Bioanalytical Techniques and Instrumentation. PHI - Ghoshal & Shrivastava
5. Modern Experimental Biochemistry – Boyer (Benjamin-Cummings)
6. Techniques in Microscopy and Cell Biology – V.K. Sharma (Tata-McGraw Hill)

Paper VI (Practical)**Full marks : 50****1. Identification:**

- a) Skull : Toad, *Chelone*, Poisonous and non-poisonous snakes, *Columba*, *Cavia*
 b) Vertebrae : *Columba*(Atlas, Axis , Synsacrum, Pygostyle) and *Cavia*((Atlas, Axis, Sacrum)
 c) Limb and Girdle bones: *Columba and Cavia*

2. Ecology:

- a) Estimation of productivity of pond ecosystem by light and dark bottle experiment using Winkler's method
 b) Estimation of percent frequency, abundance and dominance of producers and consumers in grass land by quadrat sampling method
 c) Determination of organic carbon and nitrate in soil samples
 d) Determination of dissolved O₂ , CO₂, pH (Use of pH meter)
 e) Ecological apparatus: Secchi disc, Refractometer, Berlese funnel, Planckton net, Sedgwick Rafter counter

3. Comments on Ecological adaptive features: Sucker fish, Flying fish, *Chamaeleon*, Flying lizard ; Hermit crab, Liver fluke.

4. Use of microscope, Camera lucida, Stage and Ocular micrometer for cellular studies

5. Seminar presentation on any topic selected from the Theoretical syllabus

6. Attendance in both Theoretical and Practical classes

7. Submission of Laboratory note book

8. Viva – voce

9. Submission of field report on any one of the following :

Ecosystem study of Marine beach / Forest / Mountain / National Park/ Sanctuary.

Distribution of Marks: Identification (Osteology) : $2\frac{1}{2} \times 2 = 05$; Ecological experiment : 08 ; Identification (Ecological apparatus) : $1\frac{1}{2} \times 2 = 03$; Adaptive features : $1\frac{1}{2} \times 2 = 03$; Camera lucida and microscopic measurement : 05 ; Seminar presentation : 08 ; Attendance : 05* ; Laboratory note book : 05 ; Viva voce : 05 ; Field Report: 06.

*

Percentage of attendance	Marks Division (out of 05)
91 – 100 %	05
81 – 90 %	04
75 – 80 %	03

Part III (Honours)**Total Marks : 400 – Theoretical 240 (3 × 80) and Practical 160 (2×80)****Paper VII****Full marks : 80****Unit I : Parasitology and Immunology:****Marks : 20****No. of classes**

- | | |
|--|---|
| 1. Animal association : Symbiosis, Commensalism, Mutualism, Parasitism and Zoonosis | 2 |
| 2. Evolution of Parasitism | 1 |
| 3. Host – Parasite interaction | 2 |
| 4. Components of immune system - Innate and Adaptive, Passive and Active, Humoral and Cell mediated | 3 |
| 5. Cells and organs of immune system - Types of immune cells: lymphoid and myeloid, Primary and secondary lymphoid organs and lymphatic system | 3 |
| 6. Antigen - Antigenicity and immunogenicity, Adjuvants and Haptens, influencing immunogenicity, B and T-cell epitopes. | 3 |
| 7. Immunoglobulins: Structure, types and function, Generation and diversity of antibodies, Polyclonal sera, Monoclonal antibodies | 4 |
| 8. Antigen – antibody interaction | 1 |
| 9. Primary and secondary immunodeficiency, AIDS | 2 |

Unit II: Biostatistics**Marks : 20****No. of classes**

- | | |
|--|---|
| 1. Definition and importance of Biometry in Zoology | 1 |
| 2. Methods of Sampling | 2 |
| 3. General idea of Probability | 2 |
| 4. Mean, Mode, Median, Standard Deviation and Standard Error | 3 |
| 5. Hypothesis testing (Chi-square, t-test) | 4 |
| 6. Correlation and Regression test | 3 |
| 7. One way ANOVA | 2 |

Unit III :Bioinformatics**Marks : 20****No. of classes**

- | | |
|--|---|
| 1. Bioinformatics: Definition, Branches of Bioinformatics, Aim, Scope and Research areas of Bioinformatics. | 2 |
| 2. Bioinformatics databases | |
| • National Center for Biotechnology Information (NCBI): Tools and Databases of NCBI, Database Retrieval Tool, Sequence Submission to NCBI, Basic local alignment search tool (BLAST), Nucleotide Database, Protein Database (PDB). | 4 |
| • DNA Data Bank of Japan (DDBJ): Introduction, Resources at DDBJ, Data Submission at DDBJ. | 3 |
| • Swiss-Prot: Introduction and Salient Features | 2 |
| 3. Basic concept of Structural Bioinformatics in Drug Discovery | 2 |

Unit IV: Microbiology**Marks : 20****No. of classes**

- | | |
|--|---|
| 6. Types of Microbes; Normal flora in Man and their Protective role | 2 |
| 7. Prokaryotes: General morphology of bacteria, their characters and economic importance; Gram-positive and Gram-negative bacteria. | 3 |
| 8. Eukaryotes: General morphology of Protista and economic importance. | 3 |
| 9. Viruses: structure, genome, epidemiology of infectious diseases with reference of human hosts. Bacterial (Tuberculosis), Viral (Hepatitis), Protozoan (Amoebiasis) disease. | 3 |
| 10. Microbe interactions and immune responses; Antibiotics and other chemotherapeutic agents | 2 |
| 11. Applied microbiology in the fields of food, agriculture, industry and environment. | 2 |

Distribution of marks

Question No.	No. of questions to be attempted	Marks Distribution	Total
1.	7	1 x 7	7
2.	6	2 x 6	12
3.	3	7 x 3	21
4.	4	10 x 4	40
Total	20		80

*Questions are to be set from all units equally

SUGGESTED READINGS :**Parasitology and Immunology:**

1. An Introduction to Parasitology- J. D. Smyth
2. Cellular and Molecular Immunology : Abbas *et al*(Saunders)
3. Foundation of Parasitology- Schmidt & Roberts
4. General Parasitology- Cheng
5. Immunology-A. K. Chakraborty
12. Immunology – G. Pinchuk (Tata McGraw-Hill Edition)
13. Immunology- J. Kuby
14. Parasitism- The diversity and ecology of animal parasites- A. Bush, J. Fernandez, G. Esh and J. Richard
15. Roitt's Essential Immunology : Roitt and Delvis (Blackwell)
16. The elements of Immunology- F. H. Khan (Pearson)
17. Zoonosis: Infectious diseases Transmissible from animal to human- K. W. Appel *et al*

Biostatistics:

1. Biostatistics: Principles and Practice – B. Antonisamy, S. Christopher, and P. P. Samuel (Tata McGraw-Hill Edition)
2. Biostatistical Analysis - J.H. Zar Pearson Education (India) Ltd.
3. Biostatistics: How it works? Pearson Education : S. Selvin
4. Biostatistics : An Introduction. Pearson Education – P. Mariappan
5. Introduction to Biostatistics and Research Methods – S. Rao & Richard
6. Introduction to Biostatistics: A Guide to Design, Analysis and Discovery. Academic Press – N. Forthofer & E.S. Lee
7. Statistical Methods in Biology. Cambridge University Press. N.T.J. Bailey
8. Statistics in Biology and Psychology. Academic Publishers – D. Das

Bioinformatics

1. Bioinformatics - from genomes to drugs – Thomas Lengauer
2. Bioinformatics a biologist's guide to biocomputing and the internet- Stuart M. Brown
3. Bioinformatics basics applications in biological science and medicine- Hooman Rashidi and Lukas K. Buehler
4. Bioinformatics the machine learning approach – Pierre Baldi , Soren Brunak
5. Bioinformatics sequence and genome analysis - David W. Mount
6. Statistical methods in bioinformatics an introduction - Warren J. Ewens, Gregory R. Grant
7. Introduction to bioinformatics - Arthur M. Lesk
8. Introduction to bioinformatics a theoretical and practical approach - Stephen A. Krawetz and David D. Womble

Microbiology :

1. Brock Biology of Microorganisms : Madigan and Martinko (Prentice Hall)
2. Foundations in Microbiology – K. Talaro and A. Talaro (McGraw Hill)
3. General Microbiology – H.G. Schlegel (Cambridge University Press)
4. Microbiology- An Evolving Science – J.L. Slonczewski and J.W. Foster(Norton)
5. Microbiology : an Introduction- G. J. Tortora, B. R. Funke and C. L. Case (Pearson)
6. Microbiology – M. J. Pelczar Jr., E.C.S. Chan and N.R. Krieg (Tata McGraw- Hill Edition)
7. Microbiology: Prescott, Harley and Klein (McGraw)
8. Principles of Microbiology- Dr. Geeta Sumbali and Dr. R. S. Mehrotra. (Tata McGraw-Hill Edition)

Paper VIII**Full marks :80****Unit I : Genetics****Marks : 20****No. of classes**

- | | |
|---|---|
| 1. Linkage, Crossing over, Recombination, Holliday model, Chromosome mapping | 5 |
| 2. Inheritance of sex-linked traits in <i>Drosophila</i> | 2 |
| 3. Sex determination in <i>Drosophila</i> and man | 3 |
| 4. Mutation – Types, molecular mechanism, types of mutagens , detection of sex linked and autosomal mutation in <i>Drosophila</i> | 5 |
| 5. DNA repair mechanisms | 2 |
| 6. Transposable genetic element – basic concept | 1 |
| 7. Genetic disorders – Cri-du-chat, PKU, Albinism, Thalassemia, Sickle cell anaemia | 2 |

Unit II: Molecular biology**Marks : 20****No. of classes**

- | | |
|---|---|
| 1. Replication, Transcription and Translation in Prokaryotes and Eukaryotes | 9 |
| 2. RNA Modifications : Split genes, concept of introns and exons, removal of introns, spliceosome machinery, splicing pathways, alternative splicing, exon shuffling, RNA editing, and mRNA transport | 4 |
| 3. Gene Regulation in Prokaryotes – Operon Concept, Lac and Trp operon; Epigenetic regulation | 4 |
| 4. Cistron concept | 2 |

Unit III: Biotechnology**Marks : 20****No. of classes**

- | | |
|---|---|
| 1. Gene cloning, Cloning and Expression Vectors | 3 |
| 2. cDNA library, PCR | 3 |
| 3. RFLP, RAPD, Elementary idea of VNTR and DNA Fingerprinting | 4 |
| 4. Gene Therapy and Genetic Counselling | 2 |
| 5. DNA sequencing | 3 |
| 6. Production of Transgenic animals and their applications | 2 |
| 7. Bioremediation and Biosensors | 2 |

Unit IV: Biochemistry**Marks : 20****No. of classes**

- | | |
|--|---|
| 1. Structures, Classification, Properties and functional significance of Carbohydrates, Proteins and Lipids. | 6 |
| 2. Carbohydrate Metabolism - Glycolysis, Citric acid cycle, Gluconeogenesis, Glycogenesis and Glycogenolysis | 5 |
| 3. Lipid Metabolism - β -oxidation of fatty acids | 1 |
| 4. Protein Metabolism : Transamination, Deamination and Urea cycle | 2 |
| 5. Enzymes - Major classes of enzymes, Kinetics (determination of K_m and V_{max} using Michaelis-Menten and Lineweaver-Burk plots) ; Concept of regulation of enzyme activity (inhibition, allosterism and effects of temperature and pH) | 4 |
| 6. Oxidative phosphorylation in mitochondria, Respiratory chain, ATP synthase. | 4 |

Distribution of marks

Question No.	No. of questions to be attempted	Marks Distribution	Total
1.	7	1 x 7	7
2.	6	2 x 6	12
3.	3	7 x 3	21
4.	4	10 x 4	40
Total	20		80

*Questions are to be set from all units equally

SUGGESTED READINGS :

Genetics :

1. An Introduction to Genetic Analysis - Griffith *et al* (Freeman)
2. Essential Genetics: A Genomic Perspective - Hartl & Jones (Jones & Bartlett)
3. Genetics – Russell (Benjamin Cummings)
4. Genetics : Analysis and Principles - Brooker (Addison-Wesley)
5. Genes IX – Lewin (Jones & Bartlett)
6. Principles of Genetics - Gardner *et al* (John Wiley)
7. Principles of Genetics - Snustad & Simmons (John Wiley)

Molecular Biology and Biotechnology:

1. Advanced Molecular Biology- Twyman
2. Basic Biotechnology – C. Ratledge & B. Kristiansen (Cambridge University Press)
3. Biotechnology and Genomics – P.K. Gupta (Rastogi Publications)
4. Cell and Molecular Biology: Concepts and experiments – G. Karp
5. Essentials of Molecular Biology. Jones & Bartlett. – G.M. Malacinski
6. Genes IX – B. Lewin
7. Introduction to Biotechnology- W. J. Thieman and M.A. Palladino. (Pearson)
8. Molecular Biology – D.P. Clark (Elsevier)
9. Molecular and Cell biology – W. D. Stansfield, J. S. Colome and R. J. Cano. (Tata McGraw-Hill Edition)
10. Molecular Biology and Biotechnology- R. A. Meyers
11. Molecular Biology of the Cell - B. Alberts *et al.* (Garland Publishing House)
12. Molecular Biology of the Gene – J.D. Watson, T.A. Baker & S.P. Bell (Benjamin Cummings)
13. The World of the Cell – Becker (Benjamin-Cummings)

Biochemistry :

1. Biochemistry- D. Das
2. Biochemistry- Lehninger
3. Biochemistry- Mathews
4. Biochemistry : Stryer (Freeman)
5. Harper's Biochemistry : Murray (Appleton & Lange)
6. Modern Experimental Biochemistry- R. Boyer (Pearson)
7. Principles of Biochemistry : Conn, Stump, Bruening & Doi (Wiley)

Paper IX:**Full Marks : 80**

Unit I: Histology and Histochemistry:	Marks : 20	No. of classes
1. Histological structure and function of Liver, Kidney, Pituitary, Thyroid, Adrenal and Pancreas in Mammals		6
2. Histochemical staining techniques for carbohydrates (Periodic acid Schiff), proteins (Mercury-bromophenol blue) and lipids (Sudan black-B), DNA, RNA, Enzyme histochemistry, immunohistochemistry, in situ hybridization		8
3. Fixation, dehydration, clearing, embedding & section cutting , Difficulties encountered during section cutting (causes and remedies)		3
4. Double staining with Haematoxylin and Eosin		1
Unit II: Endocrinology:	Marks : 20	No. of classes
1. Classification of hormones and mechanism and effects of hormonal actions.		2
2. General idea of Invertebrate and Vertebrate Endocrine systems (Name and Locations of Endocrine Glands, Name of hormones and their functions).		4
3. Biosynthesis of Insulin, Thyroxin and Testosterone		3
4. Brief descriptions of Major Endocrine disorders in Human (Acromegaly, Diabetes incipidus, Cretinism, Myxoedema, Goiter, and Diabetes mellitus, Cushing's disease & Addison's disease).		3
5. Estrous and menstrual cycle and their hormonal regulation		4
6. Hormone assays- bioassays and RIA & ELISA		2
Unit III: Physiology	Marks : 20	No. of classes
1. pH and buffers -their role, physiological process and action		2
2. Structure and function of Haemoglobin and its role in relation to O ₂ and CO ₂ transport		3
3. Physiology of urine formation – glomerular filtration, tubular function renal clearance and counter current mechanism		3
4. Physiology of synaptic and junctional nerve impulse transmission		3
5. Physiology of muscle contraction		2
6. Thermoregulation in Mammals		2
7. Physiology of Vision and Hearing in Mammals		4
Unit IV: Developmental Biology	Marks : 20	No. of classes
8. Gametogenesis : Process of Spermatogenesis and Oogenesis; Structure of male and female gametes		3
9. Fertilization : Definition, Physical and chemical events, Outline knowledge of Fertilization in Human		2
10. Types of egg and role of yolk in pattern of cleavage, process of cleavage in Frog and Chick		3
11. Gastrulation : Definition, Process of gastrulation in Frog and Chick, Fate map and morphogenetic movement of cells during gastrulation		3
12. Concept of Organizer, Induction and Competence		2
13. Extra embryonic membranes in chick : Definition, Development and Functions		2
14. Placenta: Definition, Types in mammals; Formation in human and functions		3
15. Embryonic stem cells and potency		1
16. Implications of Developmental Biology : Infertility –Diagnosing infertility, IVF, Teratogenesis – Teratogenic agents and effects of teratogens on embryonic development		2

Distribution of marks

Question No.	No. of questions to be attempted	Marks Distribution	Total
1.	7	1 x 7	7
2.	6	2 x 6	12
3.	3	7 x 3	21
4.	4	10 x 4	40
Total	20		80

*Questions are to be set from all units equally

SUGGESTED READINGS :

Histology and Histochemistry:

1. Histochemistry - Theoretical and applied, Volume I-III – Pearse (Churchill- Livingstones)
2. Histology- Ross and Reith
3. Histology and Histological techniques- Bankroft
4. Junqueira's Basic Histology: Text and Atlas - Anthony Mescher

Endocrinology:

1. Endocrinology- M. E. Hadley and J. E. Levine (Pearson)
2. Essential Endocrinology- Charles, Book and Marshall
3. Endocrinology (Vol. 1, 2, 3)- L. J. Degroot
4. Endocrinology and Reproductive Biology- K. V. Shastry
5. General Endocrinology- Turner & Bagnara
6. Text book of Endocrinology- Gorman & Wilson
7. Vertebrate Endocrinology- Norris

Physiology:

1. A text book of Medical Physiology: Guyton and Hall (Saunders)
2. Animal Physiology – Prosser and Brown
3. Animal Physiology- Adaptation & Environment - Schmidt & Neilson (Cambridge)
4. Comparative Animal Physiology: Prosser (Satish Book)
5. Essential of Animal Physiology- S. C. Rastogi
6. General and Comparative Physiology : Hoar (Prentice Hall)
7. Physiology of Mammals and Vertebrates : Marshall and Hughes (Cambridge)
8. Review of Medical Physiology: Ganong (Lange Medical)
9. Samson Wright's Applied Physiology: Keele & Neil (Oxford)

Developmental Biology:

1. Developmental Biology- Browder *et al.*
2. Development Biology- Gilbert
3. Introduction of Embryology- Balinsky
4. Molecular Biology of the Cell : Alberts *et al.*(Garland)
5. Pattern's foundation of Embryology- (Tata MaGraw-Hill Edition)
6. Principles of Development : Wolpert (Oxford)
7. Principles of Developmental Biology – Wilt and Hake

Paper X(Practical):**Full marks : 80****Group – A****Marks : 40**

1. Pedigree analysis
2. Chi square, t-test and One way ANOVA
3. Bioinformatics: Database handling (Protein and nucleic acid), Modeller, Spread sheet, Powerpoint presentation,
4. Seminar presentation
5. Submission of Laboratory notebook
6. Viva-voce

Distribution of Marks : Pedigree analysis : 07 ; Chi-square / t-test + One way ANOVA :05+05 =10; Bioinformatics : 05; Seminar presentation :08
Laboratory note book : 05 ; Viva-voce : 05.

Group – B**Marks : 40**

1. Micro technique- Fixation, embedding, block making, section cutting , staining of histological material.
2. Identification: T.S. of mammalian ileum, liver, pancreas, lung, kidney, thyroid, ovary and testis.
3. Developmental Biology-
 - a) Whole mount preparation and identification of chick embryo -48 hrs and 72 hrs.
 - b) Identification of cross sections passing through eye, heart, kidney regions of 72 hour chick embryo.
 - c) Identification of gastrula (early and late) in Toad.
4. Submission of Laboratory notebook
5. Viva-voce

Distribution of Marks : Microtechnique [Section cutting and Stretching (2+1) , Staining of the supplied tissue section and identification with reasons (3+3), Drawing a part of the tissue and labelling (2+1)] : 12 ; Embryo [Dissection, staining and mounting (05), Identification with reasons (03)] : 08 ; Identification of Histological and Embryological slides (Two each) : 2¹/₂ x 4= 10 ; Laboratory note book : 05 ; Viva-voce :05.

Paper XI (Practical)**Full marks : 80****Group A****Marks : 40**

1. Isolation of DNA from Goat liver
2. Preparation of Pituitary extract from Major Carp
3. Microbiology: Staining of Bacteria from curd sample by Gram staining method.
4. Parasitology:
 - a) Smear preparations and staining of the gut contents of cockroach and seminal vesicle of earthworm for Protozoan parasites
 - b) Collection of helminth, parasites from vertebrates (Goat and Fowl), their fixation, staining and identification
 - c) Identifications (systematic position and specimen characters only) and clinical importance : *Entamoeba*, *Plasmodium vivax*, *Leishmania*, *Ascaris* (male and female), *Wuchereria* and *Ancylostoma*.
5. Attendance in both Theoretical and Practical classes
6. Submission of Laboratory notebook
7. Viva-voce

Distribution of Marks: DNA Isolation / Preparation of Pituitary extract : 08; Microbiology : 05; Parasitology [Preparation and staining (05) and identification(01)]: 06 , Identification of parasites with reasons (any two): 3x2 = 6 ; Attendance : 05* Laboratory note book: 05 ; Viva voce : 05.

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Percentage of attendance	Marks Division (out of 05)
91 – 100 %	05
81 – 90 %	04
75 – 80 %	03

Group B**Marks : 40**

1. Xenobiotics :
 - a) Lethality testing (LC 50) by log probit graphical method a) Benthos, b) Plankton, c) Nekton
 - b) Estimation of COD of water
2. Biochemistry :
 - a) Quantitative estimation (Colorimetric) of glucose (Anthrone or Somogyi Nelson method)
 - b) Quantitative estimation (Colorimetric) of Protein (Folin Lowry method)
3. Physiology:
 - a) Blood : CT, BT, TC, DC, Hb % and Blood grouping (ABO & RH)
 - b) Measurement of Blood Pressure
4. Submission of Laboratory notebook
5. Viva-voce

Distribution of Marks : Xenobiotics : 10; Biochemistry : 12; Physiology : 08; Laboratory note book: 05 ; Viva voce : 05.