

**Syllabus  
ZOOLOGY  
(UG courses)  
Admitted Batch 2008 -2009**



**May 2008  
A.P. State Council of Higher Education**

## **SUBJECT COMMITTEE**

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  2. Prof.G.Gnana Mani  
Andhra University, Visakhapatnam.
  3. Prof.K.Jayantha Rao,  
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- Coordinator

**MODEL CURRICULUM*****B.Sc. Courses (Structure)******First year:***

<b>S.no.</b>	<b>Subject</b>	<b>Hrs per week</b>
1.	English language including communication skills	6
2.	Second language	4
3.	Core1-I	4
4.	Core2-I	4
5.	Core3-I	4
6.	Core1-lab I	3
7.	Core2-lab I	3
8.	Core3-lab I	3
9.	Foundation course	3
10.	Computer skills	2
	<b>Total</b>	<b>36</b>

***Second year:***

<b>S.no.</b>	<b>Subject</b>	<b>Hrs per week</b>
1.	English language including communication skills	6
2.	Second language	4
3.	Core1-II	4
4.	Core2-II	4
5.	Core3-II	4
6.	Core1-lab II	3
7.	Core2-lab II	3
8.	Core3-lab II	3
9.	Environmental studies	4
10.	Computer skills	2
	<b>Total</b>	<b>37</b>

***Third year:***

<b>S.no.</b>	<b>Subject</b>	<b>Hrs per week</b>
1.	Core1-III	3
2.	Core1-IV	3
3.	Core2-III	3
4.	Core2-IV	3
5.	Core3-III	3
6.	Core3-IV	3
7.	Core1-lab III	3
8.	Core1-lab IV	3
9.	Core2-lab III	3
10.	Core2-lab IV	3
11.	Core3-lab III	3
12.	Core3-lab IV	3
13.	Foundation course	3
	<b>Total</b>	<b>39</b>

**STRUCTURE OF MODEL CURRICULUM  
FOR ZOOLOGY IN UNDERGRADUATE DEGREE PROGRAMMES**

<b>YEAR</b>	<b>PAPER No.</b>	<b>TITLE</b>	<b>WEEKLY TEACHING Hrs.</b>	<b>TOTAL TEACHING Hrs.</b>
<b>FIRST</b>	THEORY PAPER – I	Biology of Invertebrates and Cell Biology	4	120
	PRACTICAL - I	---	3	90
<b>SECOND</b>	THEORY PAPER – II	Biology of Chordates, Embryology, Ecology and Zoogeography	4	120
	PRACTICAL - II	---	3	90
<b>THIRD</b>	THEORY PAPER - III	Animal Physiology, Genetics & Evolution	3	90
	PRACTICAL - III	---	3	90
	THEORY PAPER - IV	Applied Zoology	3	90
	PRACTICAL - IV	---	3	90

ANDHRA UNIVERSITY  
ZOOLOGY SYLLABUS : ADMITTED BATCH W.E.F. 2008-09  
THEORY PAPER – I  
BIOLOGY OF INVERTEBRATES AND CELL BIOLOGY

UNIT I

**120 hrs**  
(4 hrs/ week)

**1.0 Protozoa to Annelida**

1.1. Phylum Protozoa: General characters and outline classification up to classes.

Type study: *Paramecium*. **5 hours**

1.2. Phylum Porifera : General characters and outline classification up to classes.

Type study: *Sycon*; Canal system in Sponges. **5 hours**

1.3. Phylum Coelenterata: General characters and outline classification up to classes.

Type study: *Obelia*; Polymorphism in Coelenterates; Corals and Coral reef formation. **7 hours**

1.4. Phylum Platyhelminthes: General characters and outline classification up to classes. Type study: *Fasciola hepatica*. **5 hours**

1.5. Phylum Nematelminthes: General characters and outline classification up to classes. Type study: *Ascaris lumbricoides*. **3 hours**

1.6. Phylum Annelida: General characters and outline classification up to classes

Type study: Leech; Coelom and coelomoducts in Annelids. **5 hours**

UNIT II

**2.0. Arthropoda to Hemichordata**

2.1. Phylum Arthropoda: General characters and outline classification of up to classes

Type study: Prawn; Penouy monedon (Type Study) Crustacean larvae; *Peripatus*- Characters and Significance. **10 hours**

2.2. Phylum Mollusca: General characters and outline classification of up to classes

Type study: *Pila*; Pearl formation in Molluscs. **8 hours**

2.3. Phylum Echinodermata: General characters and outline classification of up to classes. Type study: Star fish. **7 hours**

2.4. General characters of Hemichordata : Structure and affinities of *Balanoglossus*.

5 hours

**UNIT III****3.0. Cell Biology**

- 3.1. Cell theory **1 hour**
- 3.2. Ultra structure of Animal cell **4 hours**
- 3.3. Structure of Plasma membrane - Fluid-mosaic model. Transport functions of Plasma membrane- Passive transport, active transport (Antiport, symport and uniport) and bulk transport. **5 hours**
- 3.4. Structure and functions of Endoplasmic reticulum Golgi body, Ribosomes, lysosomes and Mitochondrion. **8 hours**
- 3.5. Chromosomes - nomenclature types and structure. Giant chromosomes – Polytene and Lampbrush chromosomes. **4 hours**
- 3.6. Cell division - Cell-cycle stages ( $G_1$ , S,  $G_2$ , and M phases), Cell-cycle check points and regulation. Mitosis; Meiosis - and its significance. **8 hours**

**UNIT IV****4.0. Biomolecules of the cell**

- 4.1. Carbohydrates:
- 4.1.1. Classification of Carbohydrates **3 hours**
  - 4.1.2. Structure of Monosaccharides (Glucose and Fructose) **4 hours**
  - 4.1.3. Structure of Disaccharides (Lactose and Sucrose) **4 hours**
  - 4.1.4. Structure of Polysaccharides (Starch, Glycogen and Chitin) **4 hours**
- 4.2. Proteins:
- 4.2.1. Amino acids: General properties, nomenclature, classification and structure. **3 hours**
  - 4.2.2. Classification of proteins based on functions, chemical nature and nutrition, peptide bond and structure (Primary, secondary, tertiary and quaternary structures) **4 hours**
- 4.3. Lipids: **4 hours**
- 4.3.1. Classification. Structure of Fatty acids (Saturated and unsaturated).
  - 4.3.2. Triacylglycerols, Phospholipids (Lecithin and cephalin) and Steroids (Cholesterol).

4.4. Nucleic acids:

**4 hours**

4.4.1. Structure of purines, pyrimidines, ribose and deoxyribose sugars.

4.4.2. Watson and Crick model of DNA- Nucleoside, Nucleotide, Chargaff's rule.

Structure of RNA, Types of RNA - rRNA, tRNA and mRNA.

**PRACTICAL PAPER – I****90 hrs**  
(3 hrs/ week)**INVERTEBRATES:**

1. Observation of the following slides / specimens / models:

**Protozoa** - *Elphidium*, *Monocystis*, *Paramoecium* – binary fission and Conjugation.**Porifera** - *Spongilla*, *Euspongia*.**Coelenterata** - *Physalia*, *Verella*, *Corallium*, *Gorgonia*, *Aurelia*, *Pennatula*, *Obelia colony*, *Medusa*.**Platyhelminthes and Nemathelminthes** - *Planaria*, *Larval stages of Fasciola* *Miracidium*, *Redia*, *Cercaria*, *Echinococcus granulosus* *Schistosoma haematobium*, *Ancylostoma duodenale*.**Annelida** - *Nereis*, *Aphrodite*, *Hirudo*, *Trochophore larva*.**Arthropoda** - *Sacculina*, *Limulus*, *Julus*, *Scolopendra*, *Anopheles* mouthparts (male and female), *Peripatus*.**Mollusca** - *Chiton*, *Unio*, *Pteredo*, *Sepia*, *Octopus*, *Nautilus*, *Glochidium larva*.**Echinodermata** - *Ophiothrix*, *Echinus*, *Clypeaster*, *Cucumaria*, *Antedon*, *Bipinnaria larva*.**Hemichordata** – *Balanoglossus*, *Tornaria larva*.**2. DISSECTIONS:**

Leech: Reproductive and excretory systems, Mounting Jaws and Nephridia.

Prawn: Nervous system, mounting statocyst and appendages or as an alternatively crab/Scorpion/ locust (digestive system)

*Unio* or *Pila*: Nervous system, Digestive system instead Nervous systemMounting radula of *Pila*.**CELL BIOLOGY:**

1. Identification of stages from prepared slides showing Mitosis and Meiosis
2. Squash preparation of Onion/ Garlic root tip for Mitotic chromosomes.
3. Squash preparation of Grasshopper Testis for Meiotic chromosomes.



4. Identification of salivary gland chromosomes and polytene chromosomes (Photographs or figures).
5. Qualitative identification of Amino acids.

### REFERENCE BOOKS

#### **Biology of Invertebrates:**

1. 'The Invertebrates' by L.H. Hyman. Vol I, II and V. – M.C. Graw Hill Company Ltd .
2. 'Invertebrate Zoology' - A functional Evolutionary approach. Ruppert, Fox and Barnes., Thomas publishers. Indian Edition.
3. 'Invertebrate Zoology' by E.L. Jordan and P.S. Verma., S.Chand and Company.
4. 'Invertebrate Zoology' by R.D. Barnes : W.B. Sauwonders CO., 1986.
5. 'Invertebrate structure and Function' by Barrington. E.J.W ., ELBS.
6. 'A student text book of Zoology' by Sedgwick, A., Vol-I, II and III – Central Book Depot, Allahabad.
7. 'A text book of Zoology' by Parker, T.J. and Haswell, W.A., Mac Millan Co. London.
8. 'Textbook of Invertebrates' by Kavita Juneja and H.S. Bhamrah.

#### **Cell Biology:**

1. 'Molecular Cell Biology' by Lodish, Berk, Kaiser, Scott.– Scientific American Books.
2. 'Cell and Molecular Biology' by De Robertis & De Robertis : Saunders College.
3. 'Cell Biology, Genetic Evolution and Ecology' by P.S.Varma and V.K. Agrawal; S. Chand and Company.
4. 'Molecular Biology' by Mohan P. Arora., Himalaya Publishing House Pvt.Ltd.
5. 'Manual of Laboratory Experiments in Cell Biology' – Edward Gasque: (W.C. Brouh Publishers.
6. 'Biomolecules' by Mohan P.Arora., Himalaya Publishing House Pvt.Ltd.
7. 'Cell and Molecular Biology' –P.K.Gupta.
8. 'Concepts of Cell Biology' - P.S.Verma and V.K.Agarwal

9. Biochemistry –U. Sathyanarayana and U. Chakrapani.
10. Biology –Campbell and Reece.
11. Molecular biology of the cell-Alberts et.,al
12. ‘Cell Biology’ by S.C. Rastogi
13. ‘ Cell Biology’ by C.B. Powar, Himalayan Publications.

**ANDHRA UNIVERSITY**  
**ZOOLOGY SYLLABUS : ADMITTED BATCH W.E.F. 2009-10**  
**THEORY PAPER – II**  
**BIOLOGY OF CHORDATES, EMBRYOLOGY, ECOLOGY AND**  
**ZOOGEOGRAPHY**

**120 hrs**  
(4 hrs/ week)

**UNIT I**

**1.0. Protochordata to Amphibia**

- 1.1. Protochordates: Salient features of Urochordata and Cephalochordata  
Structure and life-history of *Herdmania*, Significance of retrogressive  
Metamorphosis. **6 hours**
- 1.2. General organization of Chordates **1 hour**
- 1.3. General characters of Cyclostomes **1 hour**
- 1.4. General characters of fishes, classification up to sub-class level with  
examples **2 hours**
  - 1.4.1. Type study - *Scoliodon* : Morphology, respiratory system, circulatory  
system, excretory system, nervous system and sense organs. **9 hours**
  - 1.4.2. Migration in fishes and types of scales
- 1.5. General characters and classification of Amphibia up to order level. **1 hour**
  - 1.5.1. Type study - *Rana* : Morphology, respiratory system,  
circulatory system and reproductive  
system. **9 hours**
  - 1.5.2. Parental care in amphibians **1 hour**

## UNIT II

### 2.0. Reptilia to Mammalia

- 2.1. General characters and classification of Reptilia up to order level. **3 hours**
- 2.1.1. Type study – *Calotes* : Morphology, digestive system, respiratory system, circulatory system, urinogenital system and nervous system. **9 hours**
- 2.2. General characters and classification of Aves up to order level with examples. **3 hours**
- 2.2.1. Type study - Pigeon (*Columbia livia*) : Exoskeleton, respiratory system, circulatory system and excretory system. **6 hours**
- 2.2.2. Significance of migration in birds **2 hours**
- 2.2.3. Flight adaptation in birds **2 hours**
- 2.3. General characters and classification of Mammalia up to order level with examples. **3 hours**
- 2.3.1. Dentition in Mammals. **2 hours**

## UNIT III

### 3.0. Embryology

- 3.1. Spermatogenesis, Oogenesis and Fertilization. **3 hours**
- 3.2. Types of eggs **3 hours**
- 3.3. Types of cleavages **4 hours**
- 3.4. Development of frog up to gastrulation and formation of primary germ layers **9 hours**
- 3.5. Foetal membranes and their significance **3 hours**
- 3.6. Placenta : types and functions **4 hours**
- 3.7. Regeneration with reference to Turbellarians and Lizards **4 hours**

## UNIT IV

### 4.0. Ecology

- 4.1. Biogeochemical cycles or nutrient cycles - Gaseous cycles of Nitrogen and Carbon; Sedimentary cycle- phosphorus. **6 hours**
- 4.2. Definition of Community- Habitat and ecological niche **12 hours**
- 4.2.1. Community interactions : Brief account on Competition, predation, mutualism, commensalism and parasitism.
- 4.2.2. Ecological succession: Primary and secondary, seral stages, climax community with examples
- 4.3. Population ecology : Density and dispersions of animal populations **12 hours**
- 4.3.1. Growth curves and growth of animal populations- r-selected and k-selected species
- 4.3.2. Population regulation mechanisms – both biotic and abiotic
- 4.3.3. Growth of human population and its control
- 4.3.4. Future of human population
- 4.4 Zoogeography (Addition)
1. Fauna of Oriental Realm 2. Fauna of Australian Realm

**PRACTICAL PAPER – II**

**90 hrs**  
(3 hrs/ week)

**CHORDATA, EMBRYOLOGY AND ECOLOGY**

Observation of the following slides / specimens / models:

1. Protochordata : *Herdmania, Amphioxus, Amphioxus* T.S through pharynx.
2. Cyclostomata : *Petromyzon and Myxine*.
3. Pisces : *Pristis, Torpedo, Channa, Pleuronectes, Hippocoampus, Exocoetus, Echeneis, Labeo, Catla, Clarius, Anguilla*. Scales of fishes.
4. Amphibia : *Ichthyophis, Amblystoma, Siren, Axolotl larva, Rana, Hyla, Alytes*.
5. Reptilia: *Draco, Chamaeleon, Uromastix, Russels viper, Naja, Krait, Enhydrina, Testudo, Trionyx, Crocodile*.
6. Aves : *Picus, Psittacula, Eudynamis, Bubo, Alcedo*.
7. Mammalia: *Ornithorhynchus, Tachyglossus, Hedgehog, pteropus, Funambulus, Manis*.

**DISSECTIONS:**

1. V, VII, IX and X cranial nerves of *Scoliodon* or locally available fish.
2. Arterial system of *Scoliodon* or *Calotes*.

**OSTEOLOGY:**

1. Appendicular skeletons of *Varanus*, Pigeon and Rabbit.

**EMBRYOLOGY:**

1. Mounting of sperms ( Grasshopper/Rat)
2. Observations of following slides / models
  - 2.1. T.S. of testis and ovary (Rat / Rabbit / Human)
3. Different stages of cleavage (2-cell, 4- cell and 8- cell), Morula.
4. Blastula and gastrula of frog.

**ECOLOGY:**

1. Determination of pH in a given sample.

2. Estimation of dissolved oxygen in the given samples at different temperatures.
3. Estimation of salinity (chloride) of water in the given samples.
4. Estimation of hardness of water in terms of Carbonates , bicarbonates in the given samples

#### REFERENCE BOOKS

1. 'Chordate Zoology' - E.L.Jordan and P.S. Verma. S. Chand Publications.
2. 'Cell biology, Genetics, Evolution and Ecology' . by P.S. Verma and V.K. Agarwal., S.Chand Publishers.
3. 'Chordata – I' by Mohan P.Arora., Himalaya Publishing House Pvt.Ltd.
4. 'Text book of Zoology – Vertebrates',. by Parker and Haswell.
5. 'Text book of Chordates' - Kavita Juneja and H.S.Bhamrah.
6. 'A text book of Embryology' - N. Arumugam.
7. 'Chordate Embryology' by P.S. Verma and V.K. Agarwal., S. Chand and Company.
8. 'Developmental Biology - Scott. F. Gilbert.
9. 'Developmental Genetics – G.S. Miglani.
10. 'Embryology' – Mohan P.Arora.
11. 'Elements of Ecology' – Odum.
12. ' Environmental Biology' by H.R.Singh., S.Chand Publications.
13. 'Ecology' - M.P.Arora
14. 'Environmental Biology' – P.D.Sharma.
15. 'Environmental Ecology' – P.R.Trivedi and Gurdeep Raj.
16. 'Ecology – Principles and Applications' – J.L Chapman and M.J.Reiss.
17. 'Biology' by Campbell & Reece.
18. 'Biology: The Science of Life' by R.A. Wallace, G.P. Sanders & R.J. Ferl.

ANDHRA UNIVERSITY  
ZOOLOGY SYLLABUS : ADMITTED BATCH W.E.F. 2010-11  
THEORY PAPER – III

ANIMAL PHYSIOLOGY, GENETICS & EVOLUTION

90 hrs  
(3 hrs/ week)

UNIT I

**1.0. Physiology of Digestion**

**7 hours**

- 1.1. Definition of digestion and types of digestion – extra and intracellular.
- 1.2. Digestion of Carbohydrates, proteins, lipids and cellulose digestion.
- 1.3. Absorption and assimilation of digested food materials.
- 1.4. Gastrointestinal hormones- control of digestion.

**2.0. Physiology of respiration**

**8 hours**

- 2.1. Types of respiration – external and internal respiration.
- 2.2. Structure of mammalian lungs and gaseous exchange.
- 2.3. Transport of oxygen – formation of oxyhaemoglobin and affinity of haemoglobin for Oxygen, Oxygen dissociation curves.
- 2.4. Transport of CO<sub>2</sub> – Chloride shift, Bohr effect.
- 2.5. Cellular respiration – Main steps of glycolysis, Krebs's cycle, electron transport, Oxidative phosphorylation and ATP production (Chemiosmotic theory).

**3.0. Physiology of Circulation**

**7 hours**

- 3.1. Open and closed circulation.
- 3.2. Structure of mammalian heart and its working mechanism- Heartbeat and cardiac cycle. Myogenic and neurogenic hearts.
- 3.3. Regulation of heart rate – Tachycardia and Bradycardia.

**4.0. Physiology of Excretion**

**8 hours**

- 4.1. Definition of excretion.
- 4.2. Forms of nitrogenous waste material and their formation; classification of animals on the basis of excretory products.
- 4.3. Gross organization of mammalian excretory system and structure of kidney.
- 4.4. Structure and function of Nephron – Counter current mechanism.



## UNIT II

- 1.0. Physiology of muscle contraction** **7 hours**
- 1.1. General structure and types of muscles.
  - 1.2. Ultra structure of skeletal muscle.
  - 1.3. Sliding filament mechanism of muscle contraction.
  - 1.4. Chemical changes during muscle contraction – role of calcium, ATP utilization and its replenishment.
- 2.0. Physiology of nerve impulse** **8 hours**
- 2.1. Structure of nerve cell.
  - 2.2. Nature of nerve impulse – resting potential and action potential.  
Properties of nerve impulse – threshold value, refractory period, all or none response.
  - 2.3. Conduction of nerve impulse along an axon – local circuit theory and saltatory conduction theory.
  - 2.4. Structure of synapse, mechanism of synaptic transmission – electrical and chemical transmissions.
- 3.0. Physiology of Endocrine system** **8 hours**
- 3.1. Relationship between hypothalamus and pituitary gland.
  - 3.2. Hormones of hypothalamus.
  - 3.3. Hormones of Adenohypophysis and Neurohypophysis.
  - 3.4. Hormones of pineal gland, thyroid gland, parathyroid, thymus, adrenal and pancreas.
  - 3.5. Endocrine control of mammalian reproduction – Male and female hormones – Hormonal control of menstrual cycle in humans.
- 4.0. Physiology of Homeostasis** **7 hours**
- 4.1. Concept of Homeostasis and its basic working mechanism.
  - 4.2. Mechanism of Homeostasis – giving three illustrations viz., Hormonal control of glucose levels, Water and ionic regulation by freshwater and marine animals and temperature regulation in man.

### UNIT III

#### 1.0. Genetics

- 1.1. Mendel's laws – Law of segregation and independent assortment; Genetic interactions – Incomplete dominance, codominance and epistasis. **3 hours**
- 1.2. Identification of DNA as the genetic material –Griffith's experiment and Hershey – Chase experiment. **4 hours**
- 1.3. Central dogma of molecular biology – Brief account of DNA replication (Semi-conservative method), Replication fork (Continuous and discontinuous synthesis); Transcription– Brief account of initiation, elongation and termination in eukaryotes; Translation; Genetic code; gene regulation as exemplified by lac operon. **8 hours**
- 1.4. Human karyotyping, barr bodies and Lyon hypothesis and Amniocentesis chromosomal disorders – Autosomal and sex chromosomes **5 hours**

#### 2.0. Organic Evolution :

- 2.1. Genetic basis of Evolution, Gene pool and gene frequencies, Hardy-Weinberg's Law, Force of destabilization, natural selection, genetic drift, Mutation, Isolation and Migration. **8 hours**
- 2.2. Speciation – Allopatry and sympatry. **2 hours**

**PRACTICAL PAPER - III**  
**ANIMAL PHYSIOLOGY, GENETICS & EVOLUTION**

**90 hrs**  
(3 hrs/ week)

**ANIMAL PHYSIOLOGY**

1. Identification of carbohydrates, proteins and lipids.
2. Unit Oxygen Consumption in an aquatic animal [fish or crab]
3. Quantitative analysis of excretory products.
4. Demonstration of salivary amylase

**GENETICS:**

5. A, B, O blood group identification.
6. Problems based on Blood grouping.
7. Karyotyping of human chromosomes [Human karyotype figure on paper should be cut in to different sets of chromosomes and students are asked to arrange them in an order and comment on the ideogram]
8. Identification of genetic syndromes given on charts.
9. Problems based on Mendelian inheritance [at least one problem for each for the laws of segregation and law of independent assortment].

**REFERENCE BOOKS**

1. 'Essentials of Animal Physiology' by S.C.Rastogi'
2. 'Animal Physiology' by H.C. Nigam.
3. 'Biology' by Campbell & Reece.
4. 'Animal Physiology' – Agarwal, R.A. Srivastava, Kaushal, Anil and Kumar.
5. 'Animal Physiology and Biochemistry' by Dr. B.Annadurai.
6. 'Principles of Animal Physiology' by Christopher D.Moyes, Patricia M Schulte.
7. 'Biology: The Science of Life' by R.A. Wallace, G.P. Sanders & R.J. Ferl.
8. 'Biology: Concepts and Applications' by Starr
9. 'Genetics' Vol-I. by C.B.Powar., Himalaya Publishing House Pvt.Ltd.
10. 'Genetics' by Strickberger.
11. 'Genetics' by P.K. Gupta.

12. 'Cell Biology, Genetics, Evolution and Ecology' by P.S.Varma and V.K. Agrawal; S. Chand and Company.
13. 'Principles of Genetics' by S.B.Basu and M.Hossain.
14. 'Principles of Genetics' by Gardner, Simmons & Smustard.
15. 'Principles of Genetics' by H. Robert & Tamasin.
16. 'Genetics' by P.S.Verma & V.K.Agarwal.
17. 'Organic Evolution' by M.P.Arora & Chandrakanta.
18. 'Organic Evolution' by N.Arumugam.
19. 'Animal nutrition' by P.Mc Donald, R.A. Edwards, J.F.D. Greenhalgh, C.A. Morgan.

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**ANDHRA UNIVERSITY**  
**ZOOLOGY SYLLABUS : ADMITTED BATCH W.E.F. 2010-11**  
**THEORY PAPER – IV**  
**APPLIED ZOOLOGY**

**90 hrs**  
**(3 hrs/ week)**

**UNIT I**

**1.0. Fisheries and Aquaculture**

- |   |                |
|---|----------------|
| 1.1. Capture fisheries – Introduction   | <b>1 hour</b>  |
| 1.2. Types of fisheries, Fishery resources from Freshwater, Brackish water and Marine habitats. | <b>2 hours</b> |
| 1.3. Freshwater, Brackish water and Mariculture.  | <b>5 hours</b> |
| 1.4. Site selection criteria.   | <b>2 hours</b> |
| 1.5. Aquaculture systems.   | <b>3 hours</b> |
| 1.6. Induced breeding.  | <b>2 hours</b> |
| 1.7. Hatchery design and Management   | <b>2 hours</b> |
| 1.8. Larval rearing – Nursery ponds, rearing and grow out ponds                                 | <b>2 hours</b> |
| 1.9 Shrimp and prawn culture  | <b>2 hours</b> |
| 1.10 Preservation and processing – Freezing, solar drying, Canning, salting, smoking.           | <b>2 hours</b> |

**UNIT II**

**2.0. Clinical Science**

- |  |                 |
|--|-----------------|
| 2.1. Hematology  | <b>8 hours</b>  |
| 2.1.1. Blood composition and functions                                     |                 |
| 2.1.2. Blood groups and transfusion problems                               |                 |
| 2.1.3. Blood diseases – Anemia, Leukemia, Leucocytosis, Leucopaenia        |                 |
| 2.1.4. Biopsy and autopsy – clinical importance                            |                 |
| 2.2. Immunology  | <b>12 hours</b> |
| 2.2.1. Types of immunity – Innate and acquired                             |                 |
| 2.2.2. Antigens – Haptenes and epitopes and their properties               |                 |
| 2.2.3. Structure and biological properties of human immunoglobulin G (IgG) |                 |

2.2.4. Hypersensitivity – immediate and delayed

2.3. Important Human Parasites **10 hours**

2.3.1. Blood Parasites (Structure and Clinical significance of *Plasmodium*).

**2 Hours**

2.3.2. Intestinal parasites – Structure and clinical significance *Entamoeba*,

2.4 Addition –

2.4.1. Cholesterol and its significance in Cardiovascular problems **3 Hours**

2.4.2. Blood Sugar levels and Diabetes **3 Hours**

### UNIT III

#### 3.0. Animal Biotechnology:

3.1. Animal Biotechnology: Scope of Biotechnology, Cloning

vectors - Characteristics of vectors, Plasmids. **8 hours**

3.2. Gene Cloning – Enzymatic cleavage of DNA, Restriction enzymes

(Endonucleases) and Ligation. **10 hours**

3.3. Transgenesis and Production of transgenic animals (Fish and

Goat). **6 hours**

3.4. Application of Stem Cell technology in cell based therapy

(Diabetes and Parkinson's diseases) **6 hours**

**PRACTICAL PAPER – IV**

**90 hrs**  
(3 hrs/ week)

**FISHERIES AND AQUACULTURE**

1.0. Identification of important Freshwater and Marine edible fishes (Minimum 10).

2.0. Identification of important edible prawns (Minimum 4).

**FIELD WORK :**

Field work is compulsory. Field trip to local fisheries / aquaculture unit is to be conducted and certified field note book should be submitted at the time of practical examination.

**CLINICAL SCIENCE :**

1.0. Identification of the following protozoan parasites.

- a). *Entamoeba histolytica*
- b). *Giardia intestinalis*
- c). *Balantidium coli*
- d). *Trypanosoma gambiense*
- e). *Plasmodium* – Any two stages

2.0. Identification of the following helminth parasites.

- a). *Taenia solium*
- b). *Ascaris* (Male and female)
- c). *Enterobius vermicularis*
- d). *Dracanculus medinensis*
- e). *Ancylostoma duodenale*

3.0. Blood cell counting – RBC and WBC

4.0. Estimation of Haemoglobin (Sahli's Method)

**ANIMAL BIOTECHNOLOGY :**

1.0. Identification of vectors (charts or photographs)

2.0. Identification of Genetic disorders (charts or photographs)

Identification of transgenic animals (charts or photographs)

## REFERENCE BOOKS

1. 'Immunology' 5<sup>th</sup> edition. 2003. - R.A. Goldsby, T.J. Kindt, B.A. Osborne and J. Kuby. W.H. Freeman and Company, New York.
2. 'Essentials of Immunology' - Ivanovski.
3. 'A text book of Immunology and Immunotechnology' by B. Annadurai, S. Chand Publications.
4. 'Principles of Immunology' N.V. Shastri., Himalaya Publishing House Pvt.Ltd.
5. 'Genetic Engineering' by Mohan P. Arora., Himalayan Publishers
6. 'Practical Immunology' - Talwar.
7. 'Introduction to basic Molecular Biology Techniques' by G.R. Naik., Himalaya Publishing House Pvt.Ltd.
8. 'Immunology' - I. Kannan.
9. 'NMS Immunology' - Richard M. Hyde.
10. 'Text book of Immunology' - C.V. Rao.
11. 'Biology' - Campbell and Reece.
12. 'Medical Zoology' - Sobti.
13. 'Parasitology' - Chandler
14. 'Elements of Biotechnology' - P.K. Gupta.
15. 'Genomics and Biotechnology' - P.K. Gupta.
16. 'Molecular Biotechnology' - Glick and Pasternak.
17. 'The Fishes of India' - Francis Day. Vol – I & II. William Dawson & Sons Ltd, 1958.
18. 'General and Applied Ichthyology' (Fish and Fisheries) S.K. Gupta and P.C. Gupta., S. Chand Publishers
19. 'Fish and fisheries of India'- V.G. Jhingran, Hindustan publishing company., 1985
20. Aquaculture productivity - V.R.P. Sinha and H.C. Siaslara Oxford IBH, 1991.
21. Advances in aquaculture - T.V.R. Pillay and M.A. Dill., Fishing news Books Ltd., 1979.