

## COURSE OUTLINE AND SYLLABUS FOR M.Sc., ZOOLOGY UNDER CBCS SCHEME

### SEMESTER-I

Sl. No	Paper	Title of the Paper	Instructi on Hrs per Week	Credits	Duration of the Exam (Hrs)	Marks		
						IA Marks	Exam Marks	Total Marks
1	CPT-1.1	Animal Systematics	4	4	3	20	80	100
2	CPT-1.2	Biology of Non-Chordates	4	4	3	20	80	100
3	CPT-1.3	Molecular Cell Biology	4	4	3	20	80	100
4	SPT-1.4A	Computer Applications & Methods in Biology	4	4	3	20	80	100
	SPT-1.4B	Aquatic Biology						
5	CPP-1.5	Animal Systematics	4	2	4	10	40	50
6	CPP-1.6	Biology of Non-Chordates	4	2	4	10	40	50
7	CPP-1.7	Molecular Cell Biology	4	2	4	10	40	50
8	SPP-1.8A	Computer Applications & Methods in Biology	4	2	4	10	40	50
	SPP-1.8B	Aquatic Biology						
<b>Total</b>				<b>24</b>				<b>600</b>

### SEMESTER-II

Sl. No	Paper	Title of the Paper	Instructi on Hrs per Week	Credits	Duration of the Exam (Hrs)	Marks		
						IA Marks	Exam Marks	Total Marks
1	CPT-2.1	Biology of Chordates	4	4	3	20	80	100
2	CPT-2.2	Developmental Biology	4	4	3	20	80	100
3	SPT-2.3A	Molecular Genetics	4	4	3	20	80	100
	SPT-2.3B	Wildlife Biology & Conservation						
4	OET-2.4	Human Physiology	4	4	3	20	80	100
5	CPP-2.5	Biology of Chordates	4	2	4	10	40	50
6	CPP-2.6	Developmental Biology	4	2	4	10	40	50
7	SPP-2.7A	Molecular Genetics	4	2	4	10	40	50
	SPP-2.7B	Wildlife Biology & Conservation						
8	OEP-2.8	Human Physiology	4	2	4	10	40	50
<b>Total</b>				<b>24</b>				<b>600</b>

## SEMESTER-III

Sl. No	Paper	Title of the Paper	Instruction Hrs per Week	Credits	Duration of the Exam (Hrs)	Marks		
						IA Marks	Exam Marks	Total Marks
1	CPT-3.1	Biology of Reproduction	4	4	3	20	80	100
2	CPT-3.2	Animal Physiology	4	4	3	20	80	100
3	SPT-3.3A	Environmental Biology	4	4	3	20	80	100
	SPT-3.3B	Biodiversity						
4	OET-3.4	Applied Zoology	4	4	3	20	80	100
5	CPP-3.5	Biology of Reproduction	4	2	4	10	40	50
6	CPP-3.6	Animal Physiology	4	2	4	10	40	50
7	SPP-3.7A	Environmental Biology	4	2	4	10	40	50
	SPP-3.7.2B	Biodiversity						
8	OEP-3.8	Applied Zoology	4	2	4	10	40	50
<b>Total</b>				<b>24</b>				<b>600</b>

## SEMESTER-IV

Sl. No	Paper	Title of the Paper	Instruction Hrs per Week	Credits	Duration of the Exam (Hrs)	Marks		
						IA Marks	Exam Marks	Total Marks
1	CPT-4.1	Evolutionary Biology	4	4	3	20	80	100
2	CPT-4.2	Animal Behaviour	4	4	3	20	80	100
3	SPT-4.3A	Endocrinology	4	4	3	20	80	100
	SPT-4.3B	Parasitology						
4	CPD-4.4	Project/ Dissertation	4	4	4	20	80	100
5	CPP-4.5	Evolutionary Biology	4	2	4	10	40	50
6	CPP-4.6	Animal Behaviour	4	2	4	10	40	50
7	SPP-4.7A	Endocrinology	4	2	4	10	40	50
	SPP-4.7B	Parasitology						
8	CPPP-4.8	CPPP – Presentation, Colloquium & Viva	4	2	4	10	40	50
<b>Total</b>				<b>24</b>				<b>600</b>

### NOTE:

- *Compulsory field visit & Study Tour of about 10 days period to be undertaken during III semester.*
- *Candidate has to submit the detailed tour report along with 3.7 Examination.*

**\* 4.4: CPD: Project Commences from the beginning of III semester and submission of Dissertation in IV semester.**

**CPT: Core Paper Theory**

**SPT: Special Paper Theory**

**OET: Open Elective Theory**

**CPD: Dissertation/ Project work**

**CPP: Core Paper Practical**

**SPP: Special Paper Practical**

**OEP: Open Elective Practical**

**CPPP: VIVA**

# I Semester

## CPT-1.1: ANIMAL SYSTEMATICS

60 hrs.

### Unit -I:

Introduction to science of taxonomy, Principles of taxonomy, History of biological classification, (6)

### Unit -II:

Theories of biological classification. Hierarchy of categories and higher taxa. (6)

### Unit -III:

(a) Taxonomic procedures: taxonomic collections, preservation, enrating, cataloging and identification. (6)

(b) Taxonomic characters; procedure of classification. (4)

(c) International Code of Zoological Nomenclature (ICZN); Interpretation of Rules of Nomenclature (in Brief). (4)

### Unit – IV:

(a) General characters and classification of invertebrate phyla (Protozoa to Echinodermata) (12)

(b) General characters and classification of Minor phyla (6)

### Unit –V

(a) General characters and classification of Protochordata (4)

(b) General characters and classification of Chordata (12)

### References:

1. Ernest Mayr. 1997. Principles of systematic Zoology. Tata-McGraw-Hill, New Delhi.428 pp.
2. Simpson, G.G.1961. Principles of animal Taxonomy. Columbia University Press, New York.247 pp.
3. Barnes, R.D.1968. Invertebrate Zoology.IIEd. Saunders, Philadelphia.
4. Barrington, E.J.W.1967. Invertebrate Structure and Function, Nelson, London.

## CPP 1.5 - ANIMAL SYSTEMATICS

1. Identification and classification up to orders with reasons of the animal species belonging from Phylum Protozoa to Class Mammalia

**Phylum Protozoa:** Ceratium, Trypanosma gambiense, Euglena, Amoeba, Entamoeba histolytica  
Paramecium, Balantidium

**Phylum Porifera:** Leucosolenia, Sycon, Euplectella, Hyalonema, Euspongia

**Phylum Coelenterata:** Hydra, Valella, Aurelia, Gorgonia, Pennatula, Astraea, Metridium, Fungia

**Phylum Platyhelminthes:** Taenia solium

**Phylum Aschelminthes:** Ascaris (Male & Female)

**Phylum Annelida:** Neries, Aphrodite, Chactopterus, Sabella, Arenicola, Earthworm, Hirudinaria

**Phylum Arthropoda:** Lepas, Balanus, Palaemon, Hermit crab, Termite, Butterfly, Honeybee, Cockroach, Mosquito, Housefly, Silkworm, Limulus, Scorpion, Peripatus

**Phylum Mollusca:** Chiton, Patella, Cypraea, Murex, Aplysia, Doris, Mytilus, Pecten, Unio, Dentalium, Loligo, Octopus, Nautilus

**Phylum Echinodermata:** Antedon, Cucomaria, Thyone, Echinus, Holothuria, Echinarachinus, Echinocardium, Astropecten, Asterias, Ophiothrix

**Phylum Chordata: Protochordata:** Balanoglossus, Amphioxus, Ascidia

**Vertebrata:**

**Pisces:** Scoliodon, Torpedo, Exocetus, Hippocampus

**Amphibia:** Ichthyopthis, Ambystoma Salamandra, Hyla

**Reptila:** Chelone, Chameleon, Varanus, Naja, Viper, Hydrophis

**Aves:** *Corvus* (Crow), *Passer domesticus* (House Sparrow), *Pavo cristatus* (Peacock), *Columba livia* (Pigeon), *Psittacula* (Parrot)

**Mammals:** Erinaceus (Hedgehog), Loris, *Elephas maximus indius*, Bat, Pangolin

2. Animal species exhibiting phylogenetic inter-relationships.

Peripatus: (Annelida-Arthropoda)

Balanoglossus: (Protochordata-chordata)

Archeopteryx: (Reptiles-Aves).

## CPT-1.2- BIOLOGY OF NON-CHORDATES

60 hrs.

### Unit-I Locomotion

(08)

Principles of hydrostatic movements, Amoeboid and flagellar movements and Locomotion in Arthropods

### Unit-II Nutrition and Digestion

(12)

Food and feeding habits of non-chordates, Filter feeding in Polychaeta, Mollusca and Echinodermata, Symbiotic nutrition

### Unit-III Respiration and Excretion

(12)

Organs of respiration: Gills, trachea and Lungs, Respiratory pigments, Mechanisms of respiration, Organs of excretion- Coelomoducts, Nephridia, malphigian tubules, Coxal Glands and mechanism of excretion

### Unit-IV Nervous system:

(8)

Primitive nervous system: Coelenterate and Echinodermata, Advanced nervous system: Annelida, Arthropod (Crustacea and Insecta)

### Unit V Reproduction

(10)

Patterns of reproduction in invertebrates, larval forms of free living, larval forms of parasites

### Unit VI Minor Phyla

(10)

General characters and affinities of Chaetognatha, Ctenophore, Phoronida and Pogonophora

### References:

1. Barrington. E J W. 1967. Invertebrate structure and function, Nelson, London.
2. Barnes, R. D 1968. Invertebrate Zoology, 2<sup>nd</sup> Ed. Saunders, Philadelphia.
3. Hyman L H. 1940-67. The Invertebrates, Vol. I-VI. McGraw-Hill, New York.
4. Russell-hunter. W D. 1968. Biology of lower invertebrates, Macmillan Company, New York.
5. Marshall, A.J and Williams, W D (Eds). 1995. Text book of Zoology-Invertebrates. VII Ed., Vol. I, A.L.T.B.S. Publishers.

## **CPP 1.6 - BIOLOGY OF NON-CHORDATES**

1. Study of locomotary organs of Amoeba/Paramecium/Ant/Spider
2. Dissect and display the Digestive / Nervous system of Cockroach.
3. Food, feeding habits and mouth parts of Mosquito/ Housefly/Honeybee/Butterfly/Bed bug.
4. Study of life cycle in Harmful and useful insects.  
Harmful insects (Termite/Housefly/Wasps)  
Useful insects (Honeybee/Silk moth/Lac insect)
5. Study of larval form of Parasites.  
Liver fluke larva-Miracidium, Redia and Cercaria larva
6. Study of larval forms of free living invertebrates.
  - a. Crustacean larva:Nauplius, Zoea and Mysis larva.
  - b. Ephyra, Glochidium, Bipinnaria, Ophiopluteus and Echinopluteus larva.

## **CPT-1.3- MOLECULAR CELL BIOLOGY**

**60 hrs.**

### **Unit-I**

(5)

Introduction to molecular cell biology: Levels of organization. Cell as a morphologic and functional unit within organisms. The central dogma of molecular biology. The scope of modern cell biology. Synthetic biology.

### **Unit-II**

(10)

Biochemistry of cell: Chemical components of the cell- (a) Water, salts, ions and their properties, (b) Proteins - primary, secondary and tertiary structures. (c) Carbohydrates - Complex polysaccharides and glycoproteins, (d) Lipids - triglycerides and compound lipids and (d) Nucleic acid - A pentose, Phosphate and four Bases. Nucleotides, double helix formation. Structure of RNA, Nucleosome.

### **Unit -III**

(8)

Bio-membranes: Molecular organization. Transport across cell membrane. Cell to cell communication and recognition. Modifications of membranes: Gap junctions and tight junctions, Membrane receptors, ion channels, gated channels.

### **Unit-IV**

(10)

Molecular organization and functions of membrane organelles: endoplasmic reticulum, golgi complex, lysosomes, peroxisomes, mitochondria and chloroplast. Molecular organization and function of cytoskeletal structures: Microfilaments, microtubules, cilia and flagella.

### **Unit –V**

(5)

Molecular anatomy of eukaryotic chromosomes, types of chromosomes, Heterochromatin, specialized chromosomes – polytene and lambrush chromosome.

- Unit-VI** (8)  
Genome organization - hierarchy in organization. Structure of Gene. Gene transcription.  
Post-transcriptional processing of RNA. Reverse transcription. Introns and exons, RNA Interference.
- Unit-VII** (4)  
Cell cycle: Molecular events during different stages of cell cycle - cyclins and cyclin dependent kinases. Regulation of CDK cyclin activity.
- Unit-VIII** (6)  
Cell aging: Biology of aging. Molecular biology of cancer cell- carcinogenesis.  
Apoptosis: mechanism and significance.
- Unit-IX** (4)  
Cellular and molecular basis of immunity: Types of immune response. Genetic control of Immune function.

**References:**

1. Alberts,B., Bray Dennis, Lewis Julian, Raff Martin, Roberts.K and Watson, J.D. Molecular Biology of the Cell. Garland Publishing Inc. New York, 1994.
2. Bruce Alberts, Essential Cell Biology.
3. Cellis, J.E. Cell Biology: a Laboratory Handbook Vol. I and II. Academic Press, 1998.
4. Lodish, H., Berk,A., Zipuosky, L.S., Matsudaira, P., Baltimore,D & Darnell, J. Molecular Cell Biology IV Ed. W.H. Freeman & Co. 2001.
5. Malacinski, G.M & Freifelder, D. Essentials of Molecular Biology III Ed. Jones & Bartlett Publishers, 1998.

**CPP 1.7 - MOLECULAR CELL BIOLOGY**

1. Study of Simple, Compound and Binocular Microscope.
2. Preparation of stains and fixatives.
3. Study of prokaryotic cell and its characteristics.
4. Study of Mitosis in onion root tips.
5. Study of Giant chromosomes in salivary gland of *Drosophila* larva.
6. Study of Meiosis in Grasshopper testis.
7. Observation of *Lacto bacillus* from curds sample
10. Histology.
  - a. Squamous epithelium/ Columnar epithelium/ Ciliated epithelium/ Epithelial tissue/ Nervous tissue/Connective tissue
11. Study of Eukaryotic cell from rectal parasite of frog
12. Microtomy method for histological slide preparation
13. Study of Eukaryotic cell organelles
14. Comparison of Light and Electron microscope

## SPT-1.4A-COMPUTER APPLICATIONS AND METHODS IN BIOLOGY

60 hrs.

### Unit-I

(5)

Computer hardware and softwares. General maintenance of computer systems. Operating systems. Programming languages. Bioinformatics.

### Unit-II

(6)

Computers assisted teaching (CAT) and labs: Integrations ICT in teaching learning, virtual learning resources. Molecular modeling, Image analysis. Computer interfacing with equipments, microscopes. Scanning and micrometric analysis. Biotelemetry.

### Unit-III

(4)

Data processing and plotting, Excel, presentations and drawings. Power point and word processors. Corel Draw.

### Unit-IV

(6)

Networking. Access to Internet: dialup, leased line, cable and *wifi* connections. Internet browsers, search engines and information retrieval. Cloud computing.

### Unit-V

(12)

Microscopy: Light, phase contrast, dark - field fluorescence. Electron microscopy -transmission and scanning. Histological and histochemical staining techniques.

### Unit-VI

(4)

Cell and tissue culture: types of culture, cell lines and culture media. Contact inhibition of Growth. Immuno-fluorescence and vital stains.

### Unit-VII

(8)

Separation techniques and instrumentation: Chromatography and gel filtration. Electrophoresis and electro-focusing. Cell fractionation, gradient centrifugation and sub-cellular fractions. Spectroscopy-UV and visible, Flow cytofluorimetry- Cell sorting.

### Unit-VIII

(6)

Radioisotopes and tracer techniques: Definition, properties of radioisotopes. Units of measurement of radioactivity. Autoradiography and its utility. Radioimmunoassay, radiometric enzyme assays. Liquid scintillation counters.

### Unit-IX

(5)

Care and handling of laboratory animals. Committee for the purpose of control and supervision of experiments on animals (CPCSEA). Alternatives for use of animals for laboratory experiments to prevent vivisection.

### Unit-X

(4)

Writing of science report/paper. Bibliography. Citations index and impact factors. Microphotography, micrometry and field photography. Biostatistics: Mean, standard deviation/error, t-test, analysis of variance (ANOVA) and significance value.

### References:

1. Young, S. S. Computerized data acquisition & Analysis for life Sciences: A Hands-on guide. Cambridge University Press, 2001.

2. Snedecor ,G.W and Cochran, W.G. Statistical Methods. Ed VI. Oxford and IBH Publishing co, New Delhi, 1967.
3. Higgins, D & Taylor, W (Eds). Bioinformatics Sequence, Structure. Chapman & Hall, 1995.
4. Bailey, N.T.J. Statistical Methods in Biology-III Ed. Cambridge University Press, 1995.
5. John, R.W.M. Ed. Animal Cell Culture- A practical approach. IRL Press.
6. Robert Brown. Introduction to instrumental analysis. McGraw Hill International Editions.
7. Wilson, K & Goulding, K.H. A Biologists Guide to Principles and Techniques of Practical Biochemistry. ELBS Ed.

## **CPP 1.8A - COMPUTER APPLICATION & METHODS IN BIOLOGY**

Study of different parts of Computers and associated devices

Computer Hardware: CPU, Mother Board, Hard disc, Floppy disc, Compact disc, USB, Pen drive, Scanner

Input devices: Keyboard, Mouse, Joy stick, Touch screen monitor

Output devices: Monitor, Printer

Microsoft Office: MS word, MS Excel and MS Power Point

Access to internet and Computer interfacing with Equipments

### **Methods in Biology**

1. Caring and Handling of Laboratory animals
2. Committee for the purpose of Control and Supervision of Experiment on animals (CPCSEA)
3. Phase contrast microscope
4. Centrifugation
5. Spectroscopy
6. Chromatography
  - a. Column chromatography
  - b. Thin layer chromatography
7. Electrophoresis –Gel Electrophoresis
8. Cytophotometry-Flow Cytophotometry
9. Micrometry
10. Biostatistics
 

Calculation of Mean, Standard deviation and Standard error.

## SPT-1.4B- AQUATIC BIOLOGY

Maximum: 60 hrs.

<b>Unit-I:</b> Introduction to Aquatic Biology and Concepts	4 h
<b>Unit-II:</b> Physical Characteristics of Water: light, temperature, Electrical Conductivity, turbidity, density, pressure	4 h
<b>Unit-III:</b> Chemical properties of water: Hydrogen-ion-concentration Dissolved oxygen, free carbon dioxide, total alkalinity, total hardness, chloride, sulphate, nitrate-nitrite, phosphate-phosphorus, BOD, COD.	10 h
<b>Unit-IV:</b> Rivers and Lakes: origins and morphometry, thermal stratification	6 h
<b>Unit-V:</b> Biological communities of lakes and rivers: Phytoplankton, periphyton, Zooplankton, benthos, microphytes, insects, mollusca, amphibians, fish and birds	10 h
<b>Unit-VI:</b> The Dynamics of ecosystem: The components, abiotic substances, producers, consumers, decomposers, transformers, productions rates, energy flow structure and ecological pyramids.	10 h
<b>Unit-VII:</b> Aquatic pollution monitoring and control.	4 h
<b>Unit-VIII:</b> Benthic communities and Detritus: Organic carbon cycling and Ecosystem metabolism.	4 h
<b>Unit-IX:</b> Lowland rivers, flood plains and wetlands	4 h
<b>Unit-X:</b> Conservation and management of aquatic ecosystem	4 h
<b>References:</b>	

1. Tonapi, G.T. (1980): Freshwater animals of India. Oxford and IBH Publishing Company, New Delhi, India.
2. Blakey, D.R. and Hrusa, D.C. (1989): Inland Aquaculture development handbook. Fishing News Books Great Britain.
3. Jhingran, V.G. (1985): Fish and Fisheries of Indian Hindustan Publishing Co, New Delhi.
4. Pillay, T.V.R. (1990): Aquaculture Principles and Practices, Fishing News Books, Oxford

## SPP-1.8B-AQUATIC BIOLOGY

1. Estimation of physical and chemical characteristics of water (pH, Density, EC, DO, Co<sub>2</sub>, PO<sub>4</sub>, Nitrates, BOD, COD)
2. Identification of phytoplankton, zooplankton in the water samples
3. Morphometric features of fishes
4. Study of Molluscs, benthos, microphytes, aquatic insects, mollusca, amphibians, fish and birds
5. Visit to aquatic ecosystems.

## II SEMESTER

### CPT-2.1-BIOLOGY OF CHORDATES

	<b>60 hrs.</b>
<b>Unit-I: Origin and systematic position</b>	(12)
Origin of chordate in the light of recent theories, Protochordata: Life cycles of Salpa, Doliolum and Amphioxus, Significance of retrogressive metamorphosis	
<b>Unit-II: Origin and evolution of vertebrate groups</b>	(10)
Agnatha, Placoderms and Chondrichthyes, Osteichthyes: Lateral line system, Migration in fishes	
<b>Unit III: Amphibia</b>	(10)
Origin and evolution, Breeding behaviour and parental care of living Amphibia, Neoteny Adaptive radiation	
<b>Unit IV: Reptilia</b>	(10)
Origin and Evolution of temporal arcades and fossae, Extinct reptiles, Adaptive radiation in living reptiles, Poisonous and non-poisonous snakes in India.	
<b>Unit V: Aves</b>	(8)
Aerial adaptations and mechanism of flight, Courtship and breeding behaviour, migration., Aquatic Birds.	
<b>Unit VI: Mammalia</b>	(10)
Origin and evolution of mammals. Adaptive radiation in Marsupials. Aquatic mammals. Origin and evolution of mammalian ear ossicles.	

#### References:

1. Marshall, A.J and Williams. W.D (Ed). Textbook of Zoology: Vertebrates-VII Ed. Vol. II. AITBS Publishers and distributors, 1995.
2. Young, J.Z. The Life of Vertebrates, III rd Ed Clarendon Press Oxford, 1981.
3. William N McFarland, F and Harvey Pough Tom.J.C and Heiser, J.B. Vertebrate Life. Collier-Macmillan Publishers, London, 1979.
4. Romer, W.B. The Vertebrate Body. Saunders, Philadelphia, 1956.

## CPP 2.5 -BIOLOGY OF CHORDATES

### I. MIGRATION IN FISHES

1. Acipenser, and
2. Anguilla

### II. CULTURABLE FRESHWATER FISHES

1. *Catla catla*,
2. *Labeo rohita*,
3. *Cirrhina mrigala*,
4. *Barbus sarana* and
5. Eel

### III. POISONOUS AND NONPOISONOUS SNAKES IN INDIA

**POISONOUS SNAKES:** *Viper russelli*, *Naja naja*, *Crotalus durissus* (Rattle snake) and Hydrophis

**NON-POISONOUS SNAKES:** *Python molurus*, *Natrix natrix* and Rat Snake

### IV. EXTINCT REPTILES

1. Ichthyosaurus,
2. Iguanodon,
3. Dimetrodon,
4. Tyrannosaurus,
5. Diplodocus
6. Rhamphorhynchus,
7. Tyrannosaurus and
8. Pteranodon

### V. FLIGHT MECHANISM

1. Gliding (eg. Swift),
2. Soaring (eg. Albatros),
3. Hovering (eg. Humming Bird) and
4. Flapping (eg. Duck)

### VI. MIGRATORY BIRDS

1. Black crowned Night Heron,
2. Ruff,
3. *Eurasian wigeon*,
4. Flamingo,
5. Combduck,
6. Siberian crane,
7. Black winged stilt,
8. Wood Sand Pecker,
9. Bar headed goose,
10. Eurasian Golden Oriole and
11. Blue throat

### VII. AQUATIC BIRDS

1. Penguin,
2. Ruficollis,
3. *Phalacrocorax niger* (Little cormorant),
4. Pelicans,
5. Sula (Gannet)
6. *Plataelia leucoroidea* (Spoon bill),
7. Flamingo,
8. *Ciconia ciconia* (Stork),
9. *Ardea cinerea* (Grey Heron),
10. *Bubulcus ibis* (cattle egret),
11. *Anser indicus* (Bar headed goose),
12. *Sarkidiornis melanoto* (Comb duck),
13. *Cygnus* (Swan),
14. *Anas* (Duck),
15. *Brachypterus* (Wood pecker)
16. *Larus riolibundus* (Black headed gull)

### VIII AQUATIC MAMMALS

1. Polar bear,
2. Sea otters,
3. Seal,
4. Sea lion,
5. Walruses,
6. Monk seals,
7. Sea cows
8. Dugongs,
9. Baleen whale,
10. Blue whale,
11. Toothed whale,
12. Dolphins
13. Porpoise

## CPT-2.2- DEVELOPMENTAL BIOLOGY

60 hrs.

- Unit-I** (4)  
Introduction: Overview of animal development. The issues of Developmental Biology. Anatomical approach to Developmental Biology. Experimental approach to Developmental biology.
- Unit-II** (12)  
Genes and Development: Embryological origin of gene theory. Evidence for genomic equivalence. Nucleo-cytoplasmic interactions in *Acetabularia* and in frog during early development. Nuclear-transplantation experiments in frog. Cloning in mammals and the Stem cell research and regenerative medicine.
- Unit-III** (12)  
Early embryonic development: Fertilization- structure of gametes, cellular and biochemical processes during early fertilization. Strategies for monospermy and conservation of species specificity. Acrosome reaction and egg activation. Cleavage and blastulation in *Drosophila*, *Amphoxius*, frog, chick and mouse (till blastocyst).  
Gastrulation in frog, chick. Presumptive areas and fate maps, morphogenetic determinants.
- Unit-IV** (12)  
a. Early development in *Drosophila*: Larva. Origin of anterior & posterior polarity, maternal effects of genes. Segmental genes, homeotic selector genes. Generation of dorso-ventral polarity.  
b. Early development in sea urchin egg: Experimental analysis of early development, biochemical and physiological gradients.
- Unit-V** (10)  
a. Axis formation in Amphibians: The progressive determination of amphibian axis, primary embryonic induction. Regional specificity of induction.  
b. Organogenesis: Development of somites and differential cell proliferation in shaping organ primordia. Differentiation of neural tube - anterior posterior axis, dorsoventral axis, Differentiation of vertebrate lens.
- Unit-VI** (10)  
Post-embryonic and abnormal development: Regeneration in animals with reference to Hydra, Planeria and Salamander limb. Metamorphosis in Amphibia- morphological, biochemical changes and hormonal control of metamorphosis. Teratology-causation of abnormal development, teratogens. Ageing-consequences and causes of ageing. Control of ageing by genes.

### References:

1. Gilbert, S.F. Developmental Biology IV ED. Sinauer Associates Inc. Publishers, Massachusetts, 2000.
2. Kalthoff, K. Analysis of Biological Development. McGraw Hill Inc. New York, 1996.
3. Rao, K. V. Developmental Biology: A Modern Synthesis. Oxford & IBH Publishing co. Pvt. Ltd, 1993.
4. Subramanian, T. Developmental Biology, Narosa Publishing House, 2002.
5. Twyman, R .M. Instant Notes. Developmental Biology. Bios Scientific Publishers Ltd, 2001.
6. Wolpert, L., Beddington, R., Brocks, J., Jessel, T., Lawrence, P and Meyerwitz, E. Principles of Development. Oxford University Press, 1998.

## **CPP-2.6 - DEVELOPMENTAL BIOLOGY**

### **I. TYPES OF EGGS**

Eggs of Insect, Frog, Fish, Chick, Snake and Mammalian egg (Graafian follicle)

### **II. HISTOLOGICAL OBSERVATION**

1. T.S of Rat ovary and testis
2. T.S of Frog ovary and testis

### **III. DEVELOPMENT OF FROG**

1. Early and late cleavage in Frog
2. Blastula and Gastrula in Frog
3. Tadpole larva of frog

### **IV. METAMORPHOSIS OF FROG**

### **V. PREPARATION OF WHOLE MOUNT OF CHICK EMBRYO**

### **VI. OBSERVATION OF PERMANENT SLIDES OF CHICK EMBRYO BASED ON HOURS OF INCUBATION.**

1. 18, 24, 33, 48 and 72 hours

### **VII. STUDY OF EMBRYOS**

1. Embryo of Snake, Rat, Pig, Sheep and Human

### **VIII. DEVELOPMENT OF INSECT**

1. Life cycle of honey bee and Silk moth

### **IX. MICROTOMY**

## SPT-2.3A - MOLECULAR GENETICS

60 hrs.

### Unit-I (4)

History and scope of molecular genetics. Identification of DNA as genetic material. Properties, storage and transmission of genetic information. Overview of Mendalism and deviations.

### Unit-II (8)

DNA Replication: Semi conservation of double stranded DNA. DNA polymerases and ligases. Events in replication fork. Discontinuous replication. Leading strand. Circular DNA and its replication.

### Unit-III (8)

Transcription: Prokaryotic transcription. RNA polymerases. Transcription signals. Classes of RNA molecules-messenger, ribosomal and transfer. Transcription in Eukaryotes. Means of studying intracellular RNA- 5-cap formation, 3-end processing, polyadenylation, splicing, editing.

### Unit-IV (10)

Translation: The genetic code. Transfer RNA and aminoacyl synthetase. Initiation. Elongation and transfer factors. The Wobble hypothesis. Polycistronic mRNA. Overlapping genes. Ribosomes.

### Unit-V (8)

Gene Regulation: Prokaryotic and Eukaryotic gene regulation. *E. coli* lactose system and Operon model. Tryptophan Operon. Auto regulation and feedback initiation.

### Unit-VI (6)

Mutation: Types of mutations. Biochemical bases of mutations. Mutagenesis-base analogue mutation, ultraviolet irradiation, intercalating substances and transposable elements.

### Unit-VII (6)

Bacteriophages: Stages in the lytic cycles of typical phage. Specific phages. T<sub>4</sub>, T<sub>7</sub>. Lytic and lysogenic cycle.

### Unit-VIII (10)

DNA recombination and repair: Alteration of DNA molecules. Repair of incorrect bases. Repair of thymine dimers. Recombination repair. Isolation. Characterization and joining of DNA molecules. Genetic disorders and Gene therapy.

### References:

1. Atherly.A.G., Girten,J.R and Mcdonald, J.F. The Science of Genetics. Saunders college, 1999.
2. Gardner, E.J., Simmons, M.J and Snustad, D.P. Genetics IIIEd. John Willy & Sons, New York, 1990.
3. Stickberger, N.W. Genetics. MacMillan Publishing Co. New York, 1985.
4. Watson, J.D et al., Recombinant DNA. W.H.Freeman & Co, 1992.
5. Trevor,B.B and Julian Burke. Gene structure and transcription. Oxford Univ Press, 1998.
6. Benjamin Lewin. Genes Vols I-IV. Oxford Univ Press, 1995.

## SPP 2.7A - MOLECULAR GENETICS

### I. Genetic problems:

**A: Mendel's law:** Monohybrid and Di-hybrid crosses, Law of segregation and Law of independent assortment

### B) Deviation from Mendel's law- Interaction of genes:

**1. Epistasis:** Dominant and Recessive epistasis

**2. Complementary Genes**

**3. Duplicate genes**

**4. Co-dominance**

**C) a. Lethal and Sub lethal genes**

### D) Sex linked inheritance:

a. Inheritance of colour blindness in man

b. Sex linked inheritance of haemophilia in man

### E) Multiple alleles

### II. Karyotyping:

Case 1. Normal male, Case 2. Normal female, Case 3. Cri-du-chat syndrome

Case 4. D.G, Unbalanced, Case 5. G.G, unbalanced, Case 6. Turner's syndrome

Case 7. Down syndrome, Case 8. Cline filter syndrome, Case 9. X, Y Y syndrome  
and Case 10. X X X

### III. Mutational disorders:

Progeria, Uner-tan syndrome, Hypertrichosis, Epidermo dysplasia verruciformis, Lesch-nyhan syndrome, Ectrodactyly, Marfan syndrome, Proteus syndrome, Severe Combined Immune Deficiency Syndrome(SCID)

## SPT-2.3B- WILDLIFE BIOLOGY AND CONSERVATION

60 hrs.

### Unit-I (6)

- i) Introduction to study of wildlife; Definition; Historical accounts.
- ii) Importance of wildlife; Ecological, Scientific, Ethical, Aesthetic, Game and Commercial values of wildlife.
- iii) Forest and wildlife as natural resources.

### Unit-II (6)

- i). Biogeographic regions of India; Distribution of wildlife: Global scenario, Indian scenario- Himalayan ranges, Western Ghats, Andaman and Nicobar Islands.
- ii). Wildlife habitats and their protection.

### Unit-III (6)

Biology of Indian wildlife: An introduction to mammals, birds, reptiles and amphibians, fishes, insects and other invertebrates of the wild-their zoogeography, adaptations, special aspects in brief.

### Unit-IV (6)

Wildlife study : ( a) Traditional Methods-Capturing, Marking, Tagging (b) Modern methods: Photography, Recording of calls, Use of Radio-location, Telemetry, Remote sensing.

### Unit-V (4)

Causes for depletion of wildlife with special reference to India.  
Endangered fauna of India-Invertebrates and vertebrate

### Unit-VI (14)

Wildlife conservation and management:

- i). General importance; History of wildlife management and current status; protected area network in India.
- ii). Special conservation projects in India-Project Tiger, Project Gir Lion, Project hangul, musk deer project, Manipur Deer project, Project Elephant, Crocodile Breeding Project, Great Indian Bustard project.
- iii). Zoo, wildlife sanctuaries, National parks, Biosphere reserves and their role in conservation of wildlife.

### Unit-VII (10)

- i). Wildlife legislations-need and perspectives
- ii). Trade in wildlife; CITES
- iii) Wildlife (Protection) Act, 1972.

iv) Wildlife (protection) Act,1972-Schedules-Schedule I [ part-I,II, II A, III, IV, IV A, IV B, IV C], Schedule-II,III, IV,V, & VI

**Unit-VIII**

**(6)**

Wildlife crimes-Introduction; Pouching, Smuggling; Prevention of wildlife crimes-Agencies and their role.

**Unit-IX**

**(4)**

- i). Organizations connected with wildlife management and conservations: WWF-India; BNHS; IBCN.
- ii). Awareness about wildlife - role of Government and Non-government organizations.

**Reference Books:**

1. Dasmann F Raymond.Wildlife Biology. Wiley eastern Ltd.India .1982
2. Burnie,D.(Ed).Animal : The Definitive Visual Guide to the World Wildlife. D.K Publications.2001
3. Anderson,S Managing Wildlife Resources. Prentice-Hall ,Englwood Cliffs,New Jersey.1991
4. Gee,E.p The Wildlife of India. E.P.Dutton Co.N.Y.1964.
5. Nair, S.M.Endangered animal of India and their Conservation. National Book Trust, India 1992.
6. Khoshoo,T.N Environmental Concerns and Strategy. Ashish publishing House,New Dehli.1985.
7. Rao,R.R.Endangered species: Problems of assessment and conservation.Zoo Print,12:1-4.1994.
8. Thapar,V.Land of Land of the Tiger : A natural history of the Subcontinent.BBC Books London.1997.
9. The wildlife Protection Act (1972). Allahabad Law Publishers (India) Pvt.Ltd 1995.
10. Prater,S.H The Book of Indian Animals.BNHS Mumbai .oxford University Press.1998.

**SPP 2.7B- WILDLIFE BIOLOGY AND CONSERVATION**

1. Study of Threatened, Endangered, Endemic, Extinct animals in India
2. Study of wetland fauna
3. Field technics in wildlife studies: Transect, Camera trapping, pug marks, scat analysis, Census techniques, sampling, GPS coordinates.
4. Visit to wildlife sanctuaries, museums, zoo, and national parks

## OET-2.4 - HUMAN PHYSIOLOGY

60 hrs.

### Unit-I.

(4)

Introduction to physiology: Cell and general physiology. Functional organization of human body. Internal environment and homeostasis. Cell and its function.

### Unit-II

(10)

Membrane physiology: Molecular organization of membrane transport across membrane. Anatomy and physiology of skeletal and smooth muscles. Anatomy and physiology of cardiac muscles. Cardiac arrhythmias, ECG myocardial infarction and cardiac arrest.

### Unit-III

(8)

Blood circulation: Arteries, veins and capillaries. Blood flow and blood pressure. Regulation of blood circulation. Composition of blood, blood groups, blood transfusion and artificial blood.

### Unit-IV

(8)

Functional morphology of the gastrointestinal tract. Physiology of digestion and absorption. Nutrition and balanced diet and vitamins. Malnutrition, over-nutrition and obesity. Hyperacidity, amoebiasis, worms and gastroenteritis.

### Unit-V

(6)

Respiratory organs and physiology of respiration. Transport of gases. Energetics. High altitude and diving physiology. Regulation of respiration. Respiratory distress and asthma. Breathing exercises and meditation.

### Unit-VI

(4)

The kidneys: Physiology of excretion. Urine formation. Micturition and diuretics. Renal failure and dialysis.

### Unit-VII

(12)

a) General organization of the nervous system: peripheral and central nervous system. Sensory and motor systems. Structure of neuron and conduction of nerve impulse. Functional differentiation of brain. Mind and memory. Deviated mental functions, mania, depression and schizophrenia. Stress and its management.

### Unit-VIII

(8)

Hormones and their physiological actions. Physiology of reproduction. Spermatogenesis and oogenesis, Pregnancy and parturition. Infertility and assisted reproductive technologies. Prenatal identification of sex and gender bias.

### References:

1. Text book of medical physiology: Guyton AC and Hall JE, Xth edition Saunders, Philadelphia, 2004.
2. Concise medical physiology: Chaudhuri SK, 4<sup>th</sup> edition, Central Book Agency, 2002, Kolkata.
3. Biological sciences: Taylor DJ, Green, NPO and Stout GW edited by Soper R, Cambridge University Press, 3<sup>rd</sup> edition 1997, Cambridge UK.
4. Animal physiology: Schmidt-Nielson K, 5<sup>th</sup> edition, Cambridge University Press, Cambridge UK.
5. Human physiology: Wiki books contributors. [http://en.wikibooks.org/wiki/Human\\_Physiology](http://en.wikibooks.org/wiki/Human_Physiology).
6. Human Physiology: An Integrated Approach with Interactive Physiology: Dee Unglaub Silverthorn DU, 3<sup>rd</sup> edition, Prentice Hall.

## **OEP -2.8 HUMAN PHYSIOLOGY**

- 1. Study of ultra-structure of Animal cell.**
- 2. Study of Compound and binocular Microscope.**
- 3. Overview of organ systems and its accessory parts**
  - a) Human digestive system and salivary glands
  - b) Human liver and pancreas
  - c) Human respiratory and Excretory system
  - d) Human heart, kidney and brain.
- 4. Study of Histological tissues.**
  - a) Epithelial tissue- Squamous, Columnar, Ciliated, Cuboidal.
  - b) Muscular tissue-Smooth, Skeletal, Cardiac.
  - c) Connective tissue- 1) Areolar, 2) Bone and 3) Fluid Connective tissue-Blood.
  - d) Study of human sperm.
  - e) Study of human Graffian follicle.
- 5. Differential staining of blood smear.**
- 6. Biochemical test: Carbohydrates and Proteins.**
- 7. Study of instruments used in human physiology.**
  - a) Accu-chek blood glucose meters and the corresponding strips.
  - b) HCG-Human Chorionic Gonadotropic-kit
  - c) PTA-Pure Tone Audiometry.
  - d) EOG-Electro Oculography for eyes. (Tracking movement of eyes)
  - e) EEG-Human Electro Encephalography-Brain.
  - f) Sphygmomanometer
  - g) ECG-Electro Cardio Gram.
  - h) Stethoscope.
  - i) Endoscopy-GI (Gastro Intestinal Endoscopy)
  - j) MRI Scanning
  - k) CT Scanning
  - l) Dialysis.

### III SEMESTER

#### CPT-3.1- BIOLOGY OF REPRODUCTION

60 hrs.

- Unit I:** (2)  
Reproduction-An overview
- Unit II:** (4)  
Sex differentiation and development of gonads and gonadal ducts. Genetic basis of sex determination. Differentiation of gonads and gonadal ducts.
- Unit III:** (6)  
Reproductive cycles (Testicular and ovarian) in non-mammalian Indian vertebrates.
- Unit IV:** (6)  
Anatomy of male reproductive system: Histoarchitecture of the testis, Spermatogonia-stem cells, spermatogenesis, somniferous epithelial cycle- wave and cycle. Stem cell renewal.  
Hormonal control of spermatogenesis. Physiological role(s) of androgens.
- Unit V:** (8)  
Functional morphology and hormonal regulation of male reproductive organs: Epidydimus, Vas deferens, Prostate gland, Seminal vesicle, Coagulatory- gland, Cowper's gland. Biochemistry of semen and biology of spermatozoa.
- Unit VI:** (10)  
Anatomy of female reproductive system: Histoarchitecture of ovary, Folliculogenesis, Follicular atresia. Mechanism of ovulation, Luteogenesis, Lutinization, Luteolysis and Lutealfunction. Physiological role of estrogens. Estrous cycle in mammals and its hormonal regulation. Menstrual cycle and its hormonal regulation.
- Unit VII:** (10)  
Implantation- Types of implantation, sequence of events during implantation, decidual cell reaction, delayed implantation, cell adhesion molecules, growth factors, hormonal regulation. Placenta: Types, physiology, histophysiology, Endocrine functions of placenta. Placental hormones. Foetoplacental unit.  
Pregnancy: Corpus luteum, luteotrophic complex in different animals, endocrine control of pregnancy in rat. Metabolic activity during pregnancy
- Unit VIII:** (8)  
Parturition: Activation and stimulus of uterus. Parturition in animal models, factors involved in parturition- prostaglandin, oxytocin. Corticosteroids and other factors. Lactation: Morphological and functional development of mammary glands. Effects of hormones. Milk ejection
- Unit IX:** (6)  
Reproductive technologies: In vitro fertilization. Gamete intra fallopian transfer. Surrogate pregnancy, gestational carrier. Fertility control in male and female.

#### References:

1. Bentely, P.J. *Comparative Vertebrate Endocrinology-U1* Ed, Cambridge University Press, 1998.
2. Degroot, L.J. & Neill, J.D. (Eds). *Endocrinology Vol I-III* W.B. Saunders Co, 2001.
3. Hadley, Mac. E. *Endocrinology*. Prentice Hall International Inc, 1992.
4. Knobil, E and Neill, J.D. (Eds). *Encyclopedia of Reproduction*. Vol. I-IV. Academic Press, 1998.
5. Knobil, E and Neill, J.D. (Eds). *The Physiology of Reproduction II. Vol I and II*. Raven Press Ltd, 1994.
6. Mandal, A. *Handbook of Neuroendocrinology*. EMKAY Publications, 1994.
7. Nelson, R.J. *An Introduction to Behavioural Endocrinology*. Sinauer Associates Inc, 1995.
8. Turner, CD and Bagnara, J.T. *General and Comparative Endocrinology*, 1998.

## CPP-3.5 -BIOLOGY OF REPRODUCTION

- I. (a) Comparative study of Male Reproductive System  
Fish, Frog, Calotes, Pigeon and Rat
- (b) Female Reproductive System-Fish, Frog, Calotes, Pigeon and Rat
- II. Care and handling of laboratory animals.
- III. Study of Estrous cycle in albino rat
- IV. Operations  
Orchidectomy, Ovaryectomy and Hysectomy in albino rat
- V. Observation of permanent slides
  1. T.S of fish ovary and testis
  2. T.S of frog ovary and testis
  3. T.S of calotes ovary and testis
  4. T.S of rat epididymus, testis, seminal vesicle, vas deference and endometrium
  5. T.S of human testis and ovary
- VI. Study of pregnancy test using velocity kit.
- VII. Types of birth control (Contraceptive methods)
  - a. Hormonal method, Birth control pill, Mini pill, Birth control shot, Ring, Patch, Implant
  - b. Intrauterine devices (IUDs)
  - c. Barrier method: Male condom and Female condom

## CPT-3.2- ANIMAL PHYSIOLOGY

60 hrs.

### Unit I

Food and Energy:

Feeding, digestion, nutrition, specific nutritional needs, vitamins, chemical defense. (6)

Energy Metabolism: Metabolic rate, energy storage (fat and glycogen), effect of oxygen concentration, problems of diving, metabolic rate and body size, size and problems of scaling.

(4)

### Unit II

Transport of gases:

(6)

Respiration: The atmosphere, solubility of gases, respiration in water, respiratory organs, mammalian lungs, air breathing in fish, bird respiration, respiration in eggs, insect respiration.

Blood: Oxygen transport in blood, Oxygen dissociation curves, facilitated diffusion, carbon dioxide transport in blood, Acid base balance regulation. (6)

Circulation: General Principles, vertebrate circulation, the physics involved in tubes, invertebrate circulation, Homeostasis. (6)

### **Unit III**

Temperature: (6)  
Temperature effects: effects of temperature change, extreme temperatures-limits to life, tolerance to high temperature, tolerance to cold and freezing temperature adaptation.  
Temperature regulation: Body temperature of birds and mammals heat transfer, heat balance, torpor and hibernation, Body temperature in 'cold blooded' animals.

### **Unit IV**

Water: (8)  
Water and osmotic regulation; the aquatic environment, aquatic invertebrates and vertebrates, terrestrial environment, moist skinned animals, arthropods terrestrial vertebrates, marine air-breathing vertebrates. Hormones and osmoregulation  
Excretion: Nitrogen Excretion-Patterns.

### **Unit V**

Enzyme catalysis: (10)  
Enzymes as catalysts, enzyme kinetics, regulation of enzyme activity, active sites, coenzymes, activators, inhibitors, isoenzymes, allosteric enzymes, ribozymes.

### **Unit VI**

Movement: Muscle and movement, skeletons, Locomotion: neurotransmitters, transmission of nerves impulses in nerves and across synapses (excitation, inhibition and computation). Information and Senses: General principles, chemical senses, vibration, pressure and sound, Light and vision, transmission and sorting of sensory information. (8)

### **References:**

1. Neilsen, K.S. Animal Physiology: Adaptation & Environment. IV Ed. Cambridge University Press, 1995.
2. Prakash, M & Arora, C.K. Encyclopedia of Animal Physiology. Anmol Publications, New Delhi, 1998.
3. Pestonjee, D.M. Stress and Coping. Sage Publications, London, 1999.
4. Poole, M.C., Pilkey Grant and Johnson.E.C. Biology in Action. Harcourt Brace, Canada, 1995.
5. Hoar, W.S. General and Comparative Animal Physiology. Prentice Hall Inc, New Delhi, 1983.
6. Guyton C. Arthur and Hall J.E. Textbook of Medical Physiology. W.B.Saunders C. London, 1996.
7. Randall David., Burggren. W and French, K. Animal Physiology. W.H. Freeman and Co.New York, 1997.
8. Physiology by Best & Taylor.

## CPP- 3.6 ANIMAL PHYSIOLOGY

I) Qualitative analysis of carbohydrates and protein.

Qualitative analysis of Carbohydrates: Benedicts test, Mollich's test, Fehling's test, Iodine test  
Qualitative analysis of Proteins: Biuret test, Xanthoprotein test, Millon's test, Ninhydrin test

II) Determination of normal and abnormal constituents of urine.

**Normal** constituents of urine: Test for Ammonia, urea and uric acid

**Abnormal** constituents of urine: Test for protein, carbohydrates and ketone bodies

III) Analysis of Blood:

a) Demonstration and enumeration of RBC and WBC in given blood sample.

b) Estimation of haemoglobin content in the given blood sample.

c) Observation of bleeding time and clotting time in human blood sample.

IV. Observation of Respiration in Egg.

V. Spotters: L.S of Mammalian kidney, T.S of cardiac tissue, adipose tissue and skin

a) Structure of Nose, Ear, Neuron, and lungs

b) Equipment's-Thermometer, Haemocytometer.

## SPT-3.3A- ENVIRONMENTAL BIOLOGY

**60 hrs.**

### Unit -I

(2)

Our Environment: Atmosphere, Hydrosphere, Lithosphere; Biogeographical realms.

### Unit -II

(10)

a) Development and evolution of ecosystem; Components of ecosystem; Types of ecosystem including habitats.

b) Energy flow in ecosystem: Food chain, food web; Trophic structure and energy pyramids; ecological energetics.

c) Hydrologic cycle; biogeochemical cycles (N, C, P cycles).

### Unit -III

(13)

Natural resources; Renewable and Non –renewable resources.

a) Forest resources; use and overexploitation; deforestation; conservation and sustainable Management.

b) Water resource; use and overutilization of surface and ground water; Floods; Drought; Conflicts over Water usage; Dams -benefits and problems; conservation and sustainable management.

c) Food resources: World food scenario; Effects of modern agriculture; Fertilizer –pesticide problems

- d) Land resource: Land classification and use; Land degradation induced landslides, soil erosion, desertification.
- e) Mineral resources (Metallic and Nonmetallic): Distribution, utilization, conservation and management.

**Unit – IV** (12)

- a) Environmental pollution: definition, causes, effects and control measures of:-
  - i) Air Pollution, ii) Water Pollution, iii) Soil pollution, iv) Noise pollution) Thermal Pollution vi) Nuclear hazards
- b) Solid waste management; Causes, Effects and control measures.
- c) Biomedical waste management: Causes, effects and control measure

**Unit – V** (8)

- a) Toxic Pollutants and their impact on non-target flora, fauna and humans.
- b) Biodegradation, biotransformation, bio-magnification and bioaccumulation of toxicants.
- c) Monitoring environmental pollutants: Physical and chemical methods; Biological indicators and monitoring.

**Unit – VI** (4)

- a) Disaster management: Floods, Earthquake, Cyclone and Landslides.
- b) Climate change – global warming, Ozone layer depletion, acid rain

**Unit – VII** (3)

- a) Human ecology: values and ethics of human environment; Population growth and related issues;
- b) Environment and human health; Human rights.

**Unit – VIII** (8)

- a) Environment and Social issues:
  - i) Resettlement and rehabilitation of people
  - ii) Wasteland reclamation
  - iii) Environmental ethics.
- b) Environmental awareness; environmental education - role of educational institutes and Other agencies.
- c) Environmental Protection Act and related Acts.

**Reference Books:**

1. Willmer, P., Stone.G and Johnston, I. Environmental Physiology of animals. Blackwell Science Ltd.
2. Mckinney, M.L and Schoch, R.M. Environmental Science: Systems and Solutions. Jones & Bartlett Publishers, 1998.
3. Cunningham, W.P. Environmental Science-V Ed. WCB McGraw Hill, 1999.
4. Clesceri, L.S., Greenberg, A.E and Eaton.A.D. Standard Methods for the Examination of Water & Waste Water-XX Ed. American Public Health Association, 1998.
5. Arora, R.K. Air Pollution. Causes & Effective control. Mangal Deep Publications, Jaipur, 1999.

6. Chakraborti, N.K. Environmental Protection and Law. 1994.
7. Chitkara, M.G. Encyclopedia of Ecology, Environment and Pollution. Vol. I-XIII, 1997.
8. Chapman, J.L and Reiss, M.J. Ecology: Principles and Applications. Cambridge University Press, 1999.
9. Eldon, D Enger and Bradly F. Smith. Environmental Sciences, 1995.

### **SPP-3.7A - ENVIRONMENTAL BIOLOGY**

1. Collection of water samples and study of physico-chemical parameter.
2. Estimation of amount of dissolved oxygen, chlorine, phosphate, alkalinity, BOD, COD, organic matter, silicates, total hardness, calcium and free carbon dioxide in Pond, tap and distilled water samples.
3. Survey of human population analysis.
4. Field visit to sewage treatment plant

**Spotters (Images of the following):** Flood, Earthquake, Cyclone, Landslide, Food chain, Food web, Energy pyramid, Global warming, Ozone layer depletion, Acid rain, Pond ecosystem, Mechanism of ozone hole formation, Coral bleaching, Ground water pollution, Deforestation, Risk assessment matrix, Age structure, Effect of air pollution on humans, Eutrophication, Indoor pollution, The greenhouse effect, Teratogenesis, Carcinogenesis, Human carrying capacity, Climate change and The 7 core concept

### **SPT-3.3B- BIODIVERSITY**

**60 hrs.**

**Unit – I:** (6)

- a) Biodiversity: Concepts, Definition.
- b) Values of biodiversity: Consumptive use and Productive use; Social, Ethical, Aesthetic, Option & Environment service values.

**Unit – II:** (12)

- a) Genetic diversity: Nature and origin of genetic variations; Measurement of genetic diversity.
- b) Species diversity: History and origin of species diversity; Species diversity indices; Measures of diversity – Alpha, Beta & Gamma diversity.
- c) Ecosystem diversity: Classification and nature of ecosystems (in brief); Ecosystem diversity of India (in brief)

**Unit – III:** (10)

- a) Biodiversity at global, national and local levels.
- b) Hot spots of biodiversity; India as a mega diversity nation.
- c) Endemism and endemic species.

**Unit – IV:** (10)

- a) Threats to biodiversity: Deforestation & habitat destruction, Hunting & Overexploitation; Introduction of exotic species, Pollution.
- b) Endangered, Vulnerable, Rare and Threatened species.
- c) Conservation of Biodiversity: Objectives and action plans; Strategies – In-situ and Ex- situ conservation; Peoples movement, Role of educational Institutions and NGO's, Biodiversity Awareness programmes.

**Unit – V:** (8)

- a) Biodiversity legislation: Legal aspects with special reference to India; CITES; Trade-related Intellectual Property Rights.
- b) Biodiversity conventions: Earth Summit and other conventions; Convention on Biological Diversity.

**Unit – VI:** (6)

- Biodiversity and Biotechnology: Role of Biotechnology in
- a) Assessment of biodiversity and bioresources;
  - b) Biodiversity conservation;

**Unit – VII:** (8)

- a) Biodiversity Management: Organizations associated with biodiversity management – IUCN, UNEP, UNESCO, WWF, FAD, WCMC –their role and contributions.
- b) Bioprospecting; Bio piracy; Biosafety.
- c) Future strategies for Biodiversity Conservation in India.

**Books:**

1. Dasmann. F Raymond. Wildlife Biology. Wiley Eastern Ltd. India. 1982.
2. Encyclopedia of Nature and Science. Vols 1-18. Bay Books Pvt.Ltd. Sydney, 1974.
3. Burnie. D. (Ed). Animal: the Definitive Visual Guide to the Worlds Wildlife. D.K.Publications, 2001.

## SPP-3.7B- BIODIVERSITY

Study of biodiversity indices: Shannon index and Simpson index.

Study of Alpha, beta and delta diversity.

Study on the impact of sewage and industrial pollution biodiversity.

Visit to National parks and protected areas.

## OET-3.4- APPLIED ZOOLOGY

60 hrs.

### Unit 1 (8)

*Sericulture*: Modern rearing methods for chawki and lateage silkworm, procurement and incubation of eggs, synchronization of hatching, brushing and feeding lea quality and its preservation. Rearing from brushing to mounting for seed production and silk production.

### Unit II (7)

*Apiculture*: Importance, history and development of bee keeping. Different species of honeybees and their distribution. Management of bees, product and by product of apiculture and their use.

### Unit III (7)

*Vermiculture*: Introduction and importance of vermiculture, Uses of earthworms for biodegradation of organic waste materials, Earthworms as protein source, Vermiculture technique.

### Unit IV Aquaculture: (10)

- a) Fin-fish Culture: Freshwater, brackish-water and marine fish culture in India.
- b) Shell-fish Culture: Prawn edible bivalve and Pearl culture.

### Unit-V Dairy: History, Importance and scope of Dairy (12)

- a) Dairy breeds and Management: Cattle breeds: Milk breeds, Draught breeds, Exotic breeds Buffalo breeds: Swamp buffaloes and Riverine Buffaloes
- b) Principles and methods of breeding: Inbreeding, out breeding and cross breeding. Fertility and breeding efficiency, artificial insemination
- c) Dairy products: Physico-chemical properties of cow and buffalo milk, Processing, preservation and marketing of milk and milk products.

### Unit-VI Poultry: History and Importance and Scope of poultry. (10)

- a) Poultry Breeds
- b) Principles and techniques and methods of breeding

c) **Poultry products:** Egg, Meat, feather, excreta, nutritive value of egg and meat.

d) **Poultry pathology:** Viral, Bacterial, fungal and protozoan diseases and their control, vaccines and for infections.

**Unit-VII Lac culture:** Lac insect (Scientific name), composition of Lac, strains of Lac insect, cultivation of Lac host plants (in brief) processing of Lac and uses of Lac  
(6)

### **OEP-3.8- APPLIED ZOOLOGY**

#### **UNIT: I: SERICULTURE**

1. Study of Life Cycle of Silkworm *Bombyx mori*.
2. Dissection of Silk Gland of *Bombyx mori*  
Identification of Male & Female pupa of *Bombyx mori*, Male & Female Moth of *Bombyx mori*, Chandrike, Silkworm Rearing House
3. Different Between Bi-Voltine and Multi-Voltine Cocoon & Larva

#### **UNIT: II: APICULTURE**

1. Identification of Different Species of Honeybees-*Apis dorsata*/ *Apis indica*/ *Apis florea*/ *Apis mellifera*
2. Identification of Honey Comb, Honey, Bee Hive, Drone Bee, Queen Bee, Worker Bee and Honey Bee Wax

#### **UNIT: III: AQUACULTURE**

1. Fresh Water Fish: *Catla catla*, *Labeo rohita*
2. Marine Water Fish: Scoliodon (Shark), Solmon
3. Brackish Water Fish: Golden Fish, Tiger Guppy Fish

#### **UNIT: IV: DAIRY**

1. Different Types of Cattle Breeds: Milk Breeds, Draught Breeds, Exotic Breeds, Buffalo Breeds (Any One Swap Buffalo/ Riverine Buffalo)
2. Dairy and its By-Products: Milk, Cheese, Curd, Ghee

#### **UNIT: V: POULTRY**

1. Poultry Breeds: Giriraja and Indian Chicken Breeds
2. Poultry Products: Egg, Feather

Visit to a Poultry Farm, Animal Breeding Centre, Sericulture Granage, Apiculture Training Institute and Vermiculture Unit.

## IV SEMESTER

### CPT – 4.1 – EVOLUTIONARY BIOLOGY

60 hrs.

**Unit I** (4)

Introduction: An overview of landmarks in Evolutionary Biology

**Unit II** (10)

Concept of organic evolution: Origin of life. Evolution through ages - Geological time scales.

Evidences of organic evolution. Evolution of man through ages.

**Unit III** (12)

Darwinism: Contributions of Charles Darwin, Alfred Russell Wallace and Thomas Malthus.

Postulates of Darwinism - objectives and evidences, limitation of Darwinism, Neodarwinism – Hardyweinberg – genetic equilibrium and destabilizing forces. Recent developments on Lamarkian concepts.

**Unit IV** (10)

Speciation: Biological and phylogenetic concepts of species. Pattern and mechanisms of reproductive isolation. Models of speciation - Allopatric, Sympatric and Strasipatric.

**Unit V** (4)

Origin of higher categories: Phyletic gradualism and punctuated equilibrium. Micro and macro evolution.

**Unit VI** (8)

The evolution of life histories: Basic questions in the evolution of life history. Evolutionary age and size at maturation. Life history trade-offs - optimality arguments and trade off surfaces. Evolutionary life span and ageing.

**Unit VII** (8)

Evolution of sex: The problem with sex. Sex and recombination. Hypothesis and advantage of sex and recombination. Sex ratio, sex allocation and sex determination. Evolution of inbreeding and heterosis.

**Unit VIII** (4)

Impact of evolutionary biology on medicine.

#### Reference Books:

1. Futuyama, D.J. Evolutionary Biology- III Ed. Sinauer Associates Inc. Massachusetts, 1998.
2. Gerhart, J and Kirchner, M. Cell, Embryos & Evolution. Blackwell Science Publishers, 1997.
3. Keynes, R. Charles Darwin's Zoology Notes & Specimen List from H.M.S Beagle. Cambridge University Press, 2000.
4. Price, P.W. Biological Evolution. Saunders College Publishing, 1995.
5. Smith, J.M. Evolutionary Genetics. Oxford University Press, 19

## CPP -4.5 EVOLUTIONARY BIOLOGY

### 8. Study of Evolution of Man

### 9. Study of Vertebrate Fossils

- a) Fish Fossil –
  - i) Mooneye
  - ii) Aipichthys
- b) Amphibian Fossil –
  - i) Palaeobatrachus gigas
  - ii) Karaurus sharovi
- c) Reptilian Fossil –
  - i) Tyranosaurus
  - ii) Tetrapodophis
- d) Avian Fossil –
  - i) Archaeopteryx
  - ii) Eozygodactylus americanus
- a) Mammalian Fossil –
  - i) Mammoth
  - ii) Juramaia sinensis

### 10. Study of Fossil evidences – Homology, Analogy and Vestigial structures.

### 11. Study of Evolution of vertebrate skull.

### 12. Study of Evolution of vertebrate heart chambers.

### 13. Study of Phylogeny of horse related to limbs and teeth.

### 14. Study of Darwin's finches related to beaks of different species.

### 15. Construction of Cladogram based on morphological characteristics and construction of character table

- a) Vertebrate Cladogram
- b) Primate Cladogram

### 16. Study and verification of Hardy-Weinberg law by chi-square analysis.

### 17. Study of Phylogenetic trees.

### 18. Visit to Natural History Museum.

## CPT-4.2- ANIMAL BEHAVIOUR

60 hrs.

### Unit I

(3)

Introduction: The science of animal behaviour-brief history. Diversity and unity in the study of behaviour and complex behaviour.

- Unit II** (6)  
Development of behaviour: Accommodative and Associate learning. Hormones and early development. Genetic basis of behaviour. Neural control of behaviour.
- Unit III** (4)  
Stereotyped behaviour: Kinesis, taxis, orientation and reflexes.
- Unit-IV** (8)  
Motivation and conflict behaviour:, models of motivation, territorial conflicts, threat display, displacement activities and fighting as conflict behaviour.
- Unit-V** (6)  
Stimuli and communication: Diverse sensory capacities, sign stimuli, stimulus filtering. Communication.
- Unit-VI** (7)  
Ecological aspects of behaviour: Habitat selection, food selection, optimal foraging theory, anti-predator defenses. Aggression, homing, territoriality, dispersal.
- Unit-VII** (6)  
Courtship and ritual behaviour: Mate selection, male-male selection, female choice and maternal behaviour.
- Unit-VIII** (6)  
Social organizations in insects and primates.
- Unit-IX** (6)  
Biological rhythms: Circadian and circannual rhythms.
- Unit 1X** (8)  
Hormones and behaviour: Pheromones and their biological actions in vertebrates and invertebrates. Chemical communication, body coloration, social life in insects (Termites and honey bees). Hormone in insect & crustacean metamorphosis.

**Books:**

1. Aubrey Manning and Marian. S. Dawkins. *An Introduction to Animal Behaviour*. Cambridge University Press, 1995.
2. McFarland. D. *The Oxford Companion to Animal Behaviour*.
3. McFarland.D. *Animal Behaviour Psychology, Ethology and Evolution*. Pitman Publications, 1985.
4. Slater.P.J.B. *Essentials of Animal Behaviour*. Cambridge University Press, 1999.
5. Krebs J.R and Davies, N.B. *An Introduction to behavioural Ecology-III* (Ed). Blackwell Science Ltd, 1993.

## **CPP -4.6 ANIMAL BEHAVIOR**

- 1. Insight Learning**
  - a) Chimpanzee Banana Catching and Tool Operating
  - b) Cheetah Cub Learning to hunt
- 2. Associate Learning**
  - a) Pavlov's Experiment

3. **Study of Learning in Rat through T-maze Technique.**
4. **Stereotype Behaviour**
  - a) Graylag Goose egg rolling Behavior
  - b) Male stickle back Behavior
5. **Cultural Learning**
  - b) Cultural/Social Learning in Primates
    1. Grooming and Courtship Behavior in Chimpanzee
  - c) Cultural/Social Learning in Birds (Ex: Sparrow)
  - d) Cultural/Social Learning in Dolphins (Ex: Bottlenose dolphins)
  - e) Cultural/Social Learning in Fishes
6. **Behaviour of Protozoans:** Response to Sodium Chloride Solution, Response to Acetic acid, Response to Sugar Solution.
7. **Behaviour of Earthworms:** Extension of body, Bridging the gap, Response to earthworm to light, Response to various surfaces, Food preference, Response to water.
8. **Courtship Behaviour**
  - a) Peacock dance and Scorpion dance
9. **Nesting Behaviour**
  - a) Bower bird and Baya bird
10. **Stimuli and Communication**
  - a) Honey bee dance
11. **Brood Parasitism**
  - a) European Cuckoo
12. **Taxis**
  - a) Positive and Negative Photo Taxis

### **SPT-4.3A- ENDOCRINOLOGY**

60 hrs

#### **Unit I**

(6)

Evolution of endocrine function. Hormones as biological signals. Classification of hormones. The concept of neuroendocrine system. Methods in endocrine research.

#### **Unit II**

(8)

Nature of hormone action: Hormone receptors- Membrane, cytosolic and nuclear receptors. Mechanism of signal transduction - role of G-proteins. Cyclic AMP and the second messenger concept. Prostaglandins and Calmodulin in hormone action.

#### **Unit III**

(8)

Structure of hypothalamohypophysial complex in vertebrates. Hypothalamic regulation of pituitary function-comparative account. The hormonal feedback systems. The caudal neurosecretory system in fish.

#### **Unit IV**

(8)

The pineal gland: Comparative morphology in vertebrates. Biosynthesis and metabolism of melatonin. Pineal function in different vertebrates. The frontal and parietal organs. Pineal and biological rhythms. Evolution of melatonin.

#### **Unit V**

(10)

The pituitary gland; Comparative morphology, chemistry and biological actions of anterior and posterior pituitary hormones.

#### **Unit VI**

(8)

Thyroid and parathyroid glands: Evolution of thyroid function in vertebrates. Biosynthesis and biological actions of thyroid hormones. Parathyroid hormones and calcium homeostasis: parathormone, calcitonin, vitamin D and their interaction.

#### **Unit VII**

(6)

Adrenal glands: Comparative morphology. Biosynthesis and biological actions of corticosteroid hormones. The adrenal catecholamines their biosynthesis, physiological actions and metabolism.

#### **Unit VIII**

(4)

Hormones of the GI tract and pancreas, chemistry and physiological actions of GI hormones, insulin and glucagons. Glucose homeostatis.

#### **Unit IX**

(2)

Hormones and metabolism: Regulation of carbohydrate, lipid and protein metabolism.

#### **Books:**

1. Bentely, P.J. Comparative Vertebrate Endocrinology-III Ed. Cambridge University Press, 1998.
2. Degroot, L.J. & Neill, J.D. (Eds). Endocrinology Vol. I-III. W.B. Saunders Co, 2001.
3. Hadley. Mac.E. Endocrinology. Prentice Hall International Inc, 1992.
4. Knobil, E and Neill, J.D. (Eds). Encyclopedia of Reproduction. Vol I-IV. Academic Press, 1998.
5. Knobil, E and Neill, J.D. (Eds). The Physiology of Reproduction II. Vol. I and II. Raven Press Ltd, 1994.
6. Mandal, A. Handbook of Neuroendocrinology. EMKAY Publications, 1994.
7. Nelson, R.J. An introduction to Behavioural Endocrinology. Sinauer Associates Inc, 1995.
8. Turner, C.D and Bagnara,J.T. General and Comaparative Endocrinology, 1998.
9. Williams, R.H. Textbook of Endocrinology. W.B. Saunders.
10. Martin.C.R. Endocrine Physiology. Oxford University Press.

## SPP -4.7A ENDOCRINOLOGY

### 1. Anatomical features of Endocrine glands in Rat

- a) Pituitary gland, Thyroid gland, Pineal gland, Pancreas, Adrenal gland
- b) Male and Female Reproductive system

### 2. Research Methodologies used in Endocrinology studies

- a) ELISA, RIA-Radio immunology assay and Histochemical Techniques

### 3. Adrenalactomy in albino Rats

4. Study of the effect of Adrenalactomy on glycogen content in liver
5. Estimation the amount of glycogen in liver tissue
6. Microtomy method for Histological slide preparation

### 7. Observation of Permanent slides.

- a) T.S of Fish Pituitary, Testis and Ovary
- b) T.S of Frog Pituitary, Pancreas, Testis and Ovary
- c) T.S of Reptilian Testis and Ovary
- d) T.S of Pituitary of Mammals
- e) V.L.S of anterior Pituitary gland of Mammals
- f) V.S of Thyroid gland of Mammals
- g) T.S of Adrenal gland, Pancreas and Hypothalamus of Mammals
- h) T.S of Testis and Ovary of Mammals

### 8. Endocrine Disorders

Dwarfism, Acromegaly, Galactorrhea, Ricket Syndrome, Hypothyroidism, Goitre, Grave's Syndrome, Hashimoto Syndrome, Osteoporosis, Diabetes, Addisons syndrome, Cushing Syndrome, Hypogonadism, Kelinefelters Syndrome, Turner syndrome, POCD-Polycystic Ovarian Syndrome

## SPT-4.3B- PARASITOLOGY

60 hrs.

### Unit-I

(6)

Origin and evolution of parasitism. Kinds of hosts and parasites.

### Unit-II

(12)

Pathogenic microorganisms: Brief outline classification of microorganisms. Bacterial cell structure. Food and water-borne bacterial diseases. Sexually transmitted bacterial diseases. Skin and wound bacterial diseases.

**Unit-III**

(12)

Pathogenic Protozoa: Amoebiasis and differentiation of different amoebae. Giardiasis. Trypanosomiasis of man and domestic animals. Haemosporidians of man and domestic animals. Coccidiosis of poultry. Myxosporians of fishes. *Nossema* and other pathogenic protozoa of insects.

**Unit-VI**

(6)

Pathogenic Nematodes: etiology, epidemiology, pathogenesis, diagnosis, prevention and control of diseases due to *Wuchereria sp*, *Trichinella spiralis* and Hookworms.

**Unit V**

(6)

Pathogenic trematodes: Etiology, epidemiology pathogenesis, diagnosis, prevention and control of diseases due to *Fasciola hepatica*, *Fasciolopsis buski* and *Systosoma sp*.

**Unit-VI**

(6)

Pathogenic Cestodes: Etiology, epidemiology pathogenesis, diagnosis, prevention and control of diseases due to *Echinococcus*, *Hymenolepis* and *Diphyllobothrium*.

**Unit -VII**

(12)

Arthropods as parasites and vectors: Kinds of vectors.

Blood sucking dipterans: Biology of mosquito. Role of blood sucking dipterans in transmission of diseases.

Soft and hard ticks: Biology of ticks. Role of ticks in transmission of diseases.

Crustacean parasites of fishes

**Reference Books:**

1. Hoare C. A (1950) Handbook of Medical Protozoology, London: Baltimore, Tindall & Cox.
2. Levine. N.D. (1973) Protozoan Parasites of Domestic Animals and of Man. 2<sup>nd</sup> Ed. Minncapolis: Burgess.
3. Levine.N.D (1978) Textbook of Veterinary Parasitology. Minneapolis: Burgess.
4. Noble.E.R. And Noble. G.A. (1961) Parasitology. The Biology OF Animal Parasites. London: Kimpton.
5. Richards, W. and Devis, R.G. (1971) Imm's General Texbook OF Entomology. 10<sup>TH</sup> Ed. London: Chapman & Hall.
6. Smith.K.G.V. (1973) Insects and other Arthropods of Medical Importance. London: British Museum of Natural History.
7. Smyth, J.D. (1976) Introduction to Animal Parasitology. London: Hodder and Stoughton.
8. Soulsby, E.J.L (1965) Textbook of veterinary Clinical Parasitology. Vol. I Helminths. Oxford:Blcakwell Scientific.
9. Soulsby, E.J.L. (1966) Biology of Parasites. New York: Academic Press.

**Paper: SPT-4.7B-PARASITOLOGY**

Study of biological vectors (Mosquitos).

Study of Mechanical vectors (horse fly, house fly and flea).

Study of ticks and mites and their diseases in humans.

Study of Lices (Head louses, body louse and pubic louses)

Study of mouth parts of vectors

Study of endoparasites (Round worm, Tape worm)

# THEORY QUESTION PAPER FORMAT

M.Sc., Course (CBCS) in Zoology

Time: 3 Hours

Max. Marks: 80

**Instructions:** Answer all questions and illustrate wherever necessary.

1. Answer the following in brief (Short answers)

(2 X 8= 16)

- a)
- b)
- c)
- d)
- e)
- f)
- g)
- h)

2. (a)

(1x16=16)

or

(b)

3.(a)

(1x16=16)

or

(b)

4. Answer any **TWO** of the following

(8x2=16)

- a)
- b)
- c)

5. Write short note on any **FOUR** of the following

4x4=16

- a)
- b)
- c)
- d)
- e)
- f)

**Note:** Equal weightage to be given to each unit while preparing question paper

## **PRACTICAL QUESTION PAPER PATTERN**

**Max marks: 40 marks**

1. Determine/Examine/Dissect/ Classify/ Identify/Comment/ /Preparation of temporary slides/Solve the problems/Write the procedure and principle of the following. **30 Marks**
2. Practical Record **05 Marks**
3. Viva-voce **05 Marks**