Unified Syllabus of Zoology for U.P.State Universities
(B.Sc. I, II, & III year)

Following Major title of papers of B.Sc. I, II, and III were finalized with their contents:

Theory Paper's duration is of Three hours and duration of practicals is Four hours

B.Sc. I		
Papers	**Title of paper**	**Max. Marks**
Paper I	Lower Non Chordata *(Protozoa- Helminths)*	50
Paper II	Higher Non Chordata *(Annelida-Echinodermata)*	50
Paper III	Cell Biology and Genetics	50
Practical	Practical Syllabus based on theory papers	50

B.Sc. II		
Papers	**Title of paper**	**Max. Marks**
Paper I	Chordata	50
Paper II	Animal distribution, Evolution and Developmental Biology	50
Paper III	Physiology and Biochemistry	50
Practical	Practical Syllabus based on theory papers	50

B.Sc. III		
Papers	**Title of paper**	**Max. Marks**
Paper I	Applied and Economic Zoology	75
Paper II	Biotechnology, Immunology, Biological Tools & Techniques and Biostatistics	75
Paper III	Ecology, Microbiology, Animal Behavior, Pollution and Toxicology	75
Practical	Practical Syllabus based on theory papers	75

Unified Syllabus of Zoology for U.P.State Universities
Subject- Zoology
B.Sc. - First Year
Practical

1-	Dissection (Major)	12 Marks
2-	Dissection (Minor)	05 Marks
3-	One Temporary Mount	03 Marks
4-	One Permanent Mount	05 Marks
5-	Cytology & Genetics Preparation/Prepared slides	05 Marks
5-	Identify and Comment upon spots (1-10)	10 Marks
6-	*Viva-Voce*	05 Marks
7-	Practical class record	05 Marks
	Total	**50**
	Marks	

Unified Syllabus of Zoology for U.P.State Universities

Subject- Zoology
B.Sc. -Second Year
Practical

1-	Dissection (Major)	10 Marks
2-	Permanent Mount	05 Marks
3-	Comment upon Physiology Apparatus	05 Marks
4-	(i) Suitable preparation of Hemin crystals from the blood (ii) Detect the Sugar /albumin / acetone from urine sample	05 Marks
5-	Stained Preparation of (i) Striped or Unstriped muscles (ii) Cartilage (hand cut Section) (iii) Blood film/Aereolar tissue	05 Marks
5-	Identify and Comment upon spots (1-10)	10 Marks
6-	*Viva-Voce*	05 Marks
7-	Practical class record	05 Marks
	Total	**50**
	Marks	

Unified Syllabus of Zoology for U.P.State Universities

Subject- Zoology
B.Sc. - Third Year
Practical

1-	Dissection (Major)	12 Marks
2-	Permanent Mounting	06 Marks
3-	Temporary Mounting	05 Marks
4-	Identify and Comment upon Spots (1-8)	16 Marks
5-	Economic Zoology *(Comments on a suitable Specimen/ life cycle of Silk worm, Honey bee, Lac insect & Food Fishes)* (02)	06 Marks
6-	Biological Tools and Techniques *(Comment)*	06 Marks
7-	Biostat / Microbiology / Immunology / Behavior	06 Marks
8-	Ecology/ Pollution/ Toxicology (Exercise or Comment	06 Marks
9-	*Viva-voce*	06 Marks
10-	Practical Class record / Project / Collection	06 Marks

Total **75**

Marks

Unified Syllabus of Zoology for U.P. State Universities
B.Sc. Part I, II & III

There will be three written papers and one practical examination.

Question No. 1 in each class will be compulsory & comprehensive based on units I to IV and of short Answer type. This will carry 40% of total marks *(i.e. 20 marks in I & II year and 30 marks in III year).* There will be two questions from each unit carrying 60% of the marks, of which one question from each unit has to be attempted.

B.Sc. Part I

Paper I- Lower Non Chordata (*Protozoa to Helminths*)

The habits, morphology, physiology, reproduction, development (in outline) and classification of the following groups of animals including a detailed study of the types given in each:

Unit-I

Protozoa - *Euglena*, *Monocystis* and *Paramecium.*

Unit-II

Porifera - *Sycon*

Unit-III

Coelenterata - *Obelia* and *Aurelia*
Ctenophora - Salient features

Unit-IV

Platyhelminthes - *Fasciola* (liver fluke) and *Taenia* (tape worm)
Nematehelminthes - *Ancylostoma* (hook worm)

Paper II- Higher Non Chordata (*Annelida to Echinodermata*)

The habits, morphology, physiology, reproduction, development (in outline) and classification of the following groups of animals including a detailed study of the types given in each:

Unit-I

Annelida - *Nereis*

Unit-II

Arthropoda - *Palaemon* (prawn)

Unit-III

Mollusca -*Pila* (apple-snail)

Unit-IV

Echinodermata -*Pentaceros* (excluding development)

Paper III- Cell Biology & Genetics

Unit-I

Cell Biology I: Structure and function of cell, Ultra structure of Plasma membrane

Unit-II

Cell Biology II: Structure and function of cell organelles with special emphasis on mitochondria, golgi bodies, nucleus, ribosome and endoplasmic reticulum.

Unit-III

Genetics-I: Structure of Chromosomes, Watson & Crick Model of DNA, Differences between DNA & RNA, Cell Division: Mitosis and Meiosis. Mendel's principles of heredity on chromosomal basis, Monohybrid cross, test cross, dihybrid cross, back cross incomplete dominance, Multiple Alleles, Blood group inheritance. Linkage and crossing over, interaction of genes. The role of DNA in heredity.

Unit-IV

Genetics II: Sex determination, sex differentiation, prenatal detection of genetic diseases (amniocentesis), Sex-linked characters, Genetic diseases and abnormalities, chromosomal aberrations, Eugenics.

B.Sc. Part I
ZOOLOGY PRACTICAL SYLLABUS

PROTOZOA

(a) **Amoeba :** Examination of culture. Prepared Slide *Amoeba proteus* and *A. verrucosa*.

(b) **Euglena :** Culture examination for *Euglena.* Prepared slides.

(c) **Monocystis** : Examination of contents of seminal vesicles of *Pheretima* or *Eutyphoeus* for different life- history stages and permanent preparation. Prepared slides.

(d) **Plasmodium :** Preparation of blood film (Leishmen's stain). Prepared slides showing the parasites.

(e) **Paramecium**
Culture examination.

(f) Demonstration of ciliary movements in *Paramecium.*
Addition to mucilage to restrain active movement. Treatment with Methyl green for staining. Feeding experiment with Congo Red and Yeast. Trichocysts (discharged), Prepared slides for structure, binary division and conjugation.

(g) Examination of pond water for different kinds of protozoa with special reference to *Arcella* and *Vorticella.*

(h) Study of prepared slides **:**
Polystomella, Gregarina, Trypanosoma and Noctiluca.

(i) Examination of rectal protozoans *Opalina, Balantidium* and *Nyctotherus.*

PORIFERA

(a) **Sycon**

General characters

Spicules glycerine preparation.

Transverse and longitudinal sections-prepared slides.

(b) Gemmule of *Spongilla* permanent preparation.

(c) Different kinds of spnge spicules and sponging fibres of *Euspongia*-prepared slides.

(d) *Euplectella* (Venus,s flower-basket) *Spongilla* (fresh-water sponge), *Euspongia* (bath sponge).

COELENTERATA

(a) **Hydra**
Live specimens.
Prepared slides of entire specimens.
Longitudinal and transverse sections-prepared slides.

(b) Obelia
Clolony-prepared slide.
Medusa-prepared slide.

(c) Aurelia
General morphology.
Tentaculocyst-prepared slide.
Prepared slides and models of life-history stages.

(d) ***Physalia*** (Portguese man of war), *Corallium* (red coral), *Fungia* (Mushroom coral), *Madrepora* (staghom coral), *Pennatula* (sea pen), *Sagartia* of *Metridium* (sea anaemone)

PLATHYHELMINTHES :

(a) Fasciola
Specimens *in situ* and prepared slides.
Transverse sections and prepared slides.
Larval forms-prepared slides.

(b) ***Taenia*** **:** Prepared slides of scolex, mature and gravid proglottids and transverse section of mature proglottid.

(c) *Planaria, Polystomum, Paramphistomum, Schistosma, Echinococcus* and *Dipylidium* Cysticercus (Bladder worm) and Cysticercoid.

(d) Examination of type worms of pigeon of fowl *in situ*

(e) Permanent preparation of mature and gravid proglottids of *Cotugnia* and *Raellietina.* **:**

NEMATHELMINTHES

(a) ***Ascaris***

External characters.
Dissected specimens of male of female.
Transverse section of male and female-prepared slides.

(b) *Ascaris lumbricoides* (from man) specimens *Enterobius vermicularisi* (from man).
Ancylostoma duodenale *(from man)* prepared slides.

ANNELIDA

(a) ***Nereis***

External characters.
Dissected specimens.
Parapodium-permanent preparation.
Transverse sections-prepared slides.

(b) ***Pheretima***

External characters.
Dissection.
Glycerine preparations of setae *in situ* and brain.
Permanent preparations of ovary and septal nephridia.
Prepared slides of transverse section through various regions.

(c) *Heteronereis, Arenicola, Aphrodite, Eutypoeus, Dero, Branchellion, Haemadipsa, Bonellia* (female).

ARTHROPODA

(a) ***Palaemon***

External characters; Examination of appendages.
Dissections.
Glycerine preparation of hastate plate.
Permanent and glycerine preparations of statocysts.

(b) ***Periplaneta***

External characters. Differences between nmale and female.
Dissections.
Cirulation of blood in the wing of cockroach.
Glycerine preparation of mouth appendages, salivary glands and trachea.
Permanent preparations of salivary glands, Malpighian tubules, ovaries and testes.

(c) ***Anopheles* and *Cules***

Glycerine preparation of mouth parts of male and female. Wings-prepared slides.
Life history-prepared slides.
Difference between *Anopheles* and *Culex*

(d) ***Musca***

External characters.
Glycerine preparation of proboscis

(e) *Daphnia, Cyclops, Balanus, Eupagurus* (hermit crab) *Scylla* (crab), *Sacculina* (on crab). Larval forms Nauplius, Zoaea), *Lepisma* (Silver fish), *Schistocerca* (locust), O*dontotermes*
(white ant), Cimex (bed bug), Pediculus (louse), *Papilio* (butterfly), *Bombyx* (Silk moth), *Apis* (honey- bee), Polistes (wasp), *Camponotus* (Black ant), *Xenopsylla* (rat flea), or *Ctenocephalus* (dog flea), *Thyroglutus* (millipede), *Scolopendra* (centipede). Lycosa (wolf-spider), *Lxodes* (trick), *Limulus* (King carb).

MOLLUSCA

(a) ***Lamellidens***

External characters
Dissection
Permanent preparations of gill lamella.
Transverse section through middle region of body-prepared slides.
Glochidium (larva) prepared slides.

(b) ***Pila***

External characters.
Dissection.
Permanent preparations of gill lamella and osphradium.

(c) Chiton, *Teredo, Turbinellai* (Shankh), *Laevicaulis* (slug), *Doris, Aplysia, Dentalium Nautilus, Sepia* and *Margaritifera* (Pearl Oyster).

ECHINODERMATA

(a) ***Pentaceros:***

External characters
Dissected specimens.
Pedicellaria-prepared slides.
Transverse section of arm-prepared slide.

(b) ***Echinus*** (Sea urchin), *Ophiothrix* (brittle star), *Holothuria* (sea cucumber) and *Antedon* (feather star).

CYTOLOGY

(a) Cell-Structure – Prepared slides

(b) Cell Division – Prepared slides

(c) Preparation of giant chromosomes

(d) Preparation of onion root tip for the stages of mitosis

B.Sc. Part II (THEORY) Zoology

There will be three written papers and one practical examination. The following courses are prescribed.

Paper I: Chordata

Unit- I

Hemichordata: Classification and detailed study (habit, morphology, anatomy, physiology and development) of *Balanoglossus*

Cephalochordata: Classification and detailed study (habit, morphology, anatomy and physiology) of *Branchiostoma* (*Amphioxus).*

Unit -II

Urochordata: Classification and detailed study (habit, morphology, anatomy, physiology and post embryonic development) of *Herdmania*

Unit-III

Classification of different classes of vertebrates (**Pisces, Amphibia, Reptilia**,) up to order with characters and examples. Poisonous and non poisonous snakes and biting mechanism. Neoteny

Unit-IV

Classification of different classes of vertebrates (**Aves and Mammalian**) up to order with characters and examples. Dentition in mammals.

Paper II: Animal distribution, Evolution and Developmental Biology

Unit-I

Animal distribution: Geological and geographical distribution with their characteristic fauna; fossils.

Unit-II

Origin of Life, concept of species (classical & modern concept)

Evolution: Evidences (including physiological and serological); Theories of evolution (including Neo-Lamarckism, Darwin-Wallace theory of natural selection, Neo-Darwinism, Modern synthetic theory). Evolution of Man. Mutation

Unit-III

Developmental Biology I:Aims and scope of Developmental Biology.
Gametogenesis, Fertilization, Egg: structure and types.
Types & patterns of cleavage

Unit-IV

Developmental Biology II: Process of Blastulation & Gastrulation. Fate Map.
Development of Chick up to formation of Primitive streak and mammal (*in out line*)
Extra embryonic membranes of chick.
Placentation and types of Placenta.

Paper III: Physiology and Biochemistry

General physiology (in outline) with special reference to mammals

Unit-I

Physiology of digestion, respiration, and blood and circulation

Unit-II

Physiology of excretion and osmoregulation, neural transmission, muscles

Unit-III

Physiology of endocrine system, thermoregulation

Unit-IV

General chemistry and classification of carbohydrates, lipids and proteins; Enzymes

B.Sc. Part II

ZOOLOGY PRACTICAL SYLLABUS

Urochordata

(a) Herdmania

(i) External characters
(ii) Dissection
(iii) (a) Permanent preparation of branchial wall
(b) Section of test and glycerine prepration of spicules.
Glycerine and permanent prepration on neural gland complex (neural gland, nerve ganglion and dorsal tubrcele).
(iv) Larva and metamorphosis- prepared slides.

(b) (i) Thaliacea : *Pyrosoma, Doliolum*
(ii) Larvacea : *Oikopleura* .

Cephalochordata

Branchistoma *(Amphioxus)*

(i) General features
(ii) (a) Permanent prepration of the pharyngeal wall
(b) Oral hood and velum- prepared slides
(c) Transverse section through the body – prepared slides.
(d) Models illustrating development

Cyclostomata

Petromyzon (Lamprey) - External characters

Chondrichthyes

(a) Fish

(i) External characters
(ii) Exo-skeleton Glycerine and permanent preparation of placoid scales
(iii) Myotomes
(iv) Endoskeleton

(1) Axial skeleton
(a) skull
(b) Visceral Skeleton
(c) Vertebral column

(2) Appendicular skeleton
(a) Pectoral girdle and fins
(b) Pelvic girdle, fins and claspers
(c) Median fins
(v) Dissection
(a) Digestive system
Examination of the folds of stomach and " scroll valve"
(b) Vascular system

Heart, ventral aorta, dorsal aorta, arterial arches (afferent and efferent)

(c) Gills
(d) Urinogenital system
(e) Nervous system : Cranial nerves
(f) Internal ear
(g) Eye muscles
(h) Permanent preparation of ampullae of Lorenzini
(i) Section through various regions of the body of adult and embryo
(j) Embryo with yolk-sac placenta

(b) *Pritis* (Saw fish), *Astrape* (Indian electric ray) *Chimaera* (rabbit fish) Slide showing development of placoid scales.

Osteichthyles

(a) *Labeo rohita* (rohu)- General morphology and dissected specimen.
(b) *Acipenser* (sturgeon), *Lepiodosteous* (gar-pike), *Hippocampus* (sea hourse) *Antennarius* (Indian angler), *Angulla* (eel), *Pleuronectes* (sole), *Exocoetus* (flying fish), *Clarius* (cat fish), *Anabas* (climbing perch) and *Neoceratodus* (lungfish).
(c) Different kinds of scales- prepared slides

Amphibia

(a) *Rana tigrina* (The Indian bull-frog)
Development of frog from modles
(b) Urodela :
Necturus, Ambystoma and Axolotal larva
(c) Anura :
Bufo, Rhacophorus (tree frog), *Alytes* (midwife toad).
(d) Gymnophiona : *Ichthyopnis*

Reptillia

(a) *Varanus*
(i) External characters
(ii) Skeleton

(1) Axial Skeleton
(a) Skull
(b) Vertebral column
(c) Ribs and sternum

(2) Appendicular Skeleton
(a) Pectoral girdle and fore-limb.
(b) Pelvic girdle and hind-limb.

(b) ***Lacertilla***
Varanus (Indian monitor), *Holoderma* (poisonous lizard) *Hemidactylus* (wall lizard),*Chamaeleon* (garden lizard) *Draco* (flying lizard).

(c) ***Ophidia***
Difference between poisonous and non-poisonous snakes, *Naja* (cobara), *Vipera* (viper), *Typhlops* (burrowing snake) and *Python*. Biting mechanism of a poisonous snake (model).

(d) Chelonia : Derman armature
(e) Crocodilia : Difference between Alligator, Crocodile and Gavialis.
(f) Extinct reptiles, Models (five)

Dimetrodon, Diplodocus, Pteranodon, Tyrannosaurus* and *lchthyosaurus

Aves

(A) *Columba livia intennedia* (pigeon)

(i) Esternal Characters. Structure of Feather. Varieties of feathers. Developments of feather-prepared slide.

(ii) Skeleton of fowl Axial skeleton:

(a) Skull
(b) Vertebral column
(c) Ribs and sternum

(2) Appendicular skeleton.

(a) Pectoral girdle and fore-limb
(b) Pelivic girdle and hind-limb.

(B) (i) Archaeornithes-Archaeopteryx (cast)

(ii) Neornithes:

(a) Palaeognathae: ***Struthio*** (ostrich);
(b) Neognathae: ***Gallus*** (fowl), ***Anser*** duck, ***Corvus*** (crow) , ***Psuttacuka*** (parrot) and ***Pavo*** (peacock).

Perching mechanism: Model
Skulls and Beaks of Birds.
Feet of birds: Models

(C) Embryonic membrances-whole mount of 72 hour's chick embryo

Mammalia

(A) (i) Prototheria: *Ornithorhynchus* (Platypus)

(ii) Metatheria *: Macropus* (Kangaroo).

(iii) Eutheria :

(a) Edentata: *Dasypus* (Armadillo)
(b) Pholidota: *Manis* (Scaly ant-eater).
(c) Cetacea: *Platanista* (Ganges dolphin).
(d) Perissodactyla: *Equus cabalus* (horse), *Equus vulgaris* (ass), *Equus zebra* (zebra), *Rhinoceros unicornis* (rhinoceros).
(e) Artictyla: *Camelus dromedaries* (A rabian camel), *Giraffa camelopardalis* (giraffe) Box (ox), *Ovis* (sheep), *Capra* (goat), *Cervus* (deer), *Sus* (dog).
(f) Proboscidea: *Elephas indicus* (elephant).
(g) Carnivora: *Felis domesticus* (Cat), *Panthera leo* (lion), *Acinonyx tigris* (Cheetah), C*anis familiari* (dog), *Ursus* (bear) *Hyaena* (hyanea), *Phoca* (seal)
(h) Rodentia: *Mus* (domestic rat), *Hystrix* (Porcupine)
(i) Lagomorpha: *Lepus* and *Oryctolagus* (hare and rabbit)
(j) Insectivora: *Erinaceu*s (hedge-hog), *Crocidura* (chhachhundar)
(k) Chiroptera: *Pteropus* (Flying-fox).
(l) Primates: *Macaca* (rhesus monkey), *Hylobates* (gibbon), *Simia* (Orang-utan), *Anthropo pithecus* (chimpanzee), *Gorilla, Homo sapiens* (man).

Histology

(i) Tissues: Preparation of the following
(a) Epithelia:
(i) Squamous (ii) Ciliated and (iii) Stratified
(b) Muscular:
(i) Striped muscles (ii) Unstriped muscles.
(c) Connective
(i) Areolar tissue (ii) Tendon the leg muscles of frog (tease and examine in glycerine)
(ii) Adipose tissue from insect and frog (iv) cartilage (free hand sections of frogs hyoid and suprascapula, train with haematoxyline and (v) Bone (Decalcified).
(d) Blood; Preparation of Vertebrate blood film, stain with Leishmann's stain.
(e) Nervous: Neurons
(f) Histology of various organs-prepared slides.

Physiology

(i) Experiments to be performed by candidates: Test for amylase. Osmolarity of blood, Hemin crystals and test for sugar and acetone in urine Determination of haemoglobin % in blood sample (s).
(ii) Detection of amino acids in blood of an animal by paper chromatography.

General :
Candidates will be required, to show knowledge of the method of microscopic techniques and to examine, describe or dissect the types prescribed. Candidates will also be required to submit their notebooks containing a complete record of laboratory work initiated and dated by the teacher for the determination of result of examination.

B. Sc. Part III (THEORY) Zoology

There will be three written papers and one practical examination. The following courses are prescribed.

PAPER-I Applied and Economic Zoology

Unit-I

Parasitology:

(a) Structure, life cycle, pathogenicity, including diseases, causes, symptoms and control of the following parasites of domestic animals and humans: *Trypanosoma, Giardia and Wuchereria,*

Unit-II

Vectors and pests: Life cycle and their control of following pests:
Gundhi bug, Sugarcane leafhopper, Rodents.
Termites and Mosquitoes and their control

Unit-III

Animal breeding and culture: Aquaculture, Pisciculture, Poultry, Sericulture, Apiculture, Lac-culture.

Unit-IV

Wild Life of India: Endangered species. Important sanctuaries; national parks of India; Different projects launched for the preservation of animal species; *in-situ* and *ex-situ* conservation of wild life.

PAPER-II Biotechnology, Immunology, Biological Tools and Techniques and Biostatistics

Unit-I

Biotechnology: Genetic Engineering (concept and recombinant DNA technology) and its application in agriculture & medical areas and energy production. Biotechnology of food-processing, pharmaceuticals (e.g. use of microbes in insulin production) and fermentation.

Unit-II

Immunology. Concepts of immunity, types of immunity, Antigen and Antibodies, vaccines of different diseases and immunological reactions.

Unit-III

Biological Tools and Techniques: Principles and uses of instruments: pH Meter, Calorimeter, Microtome, Spectrophotometer & Centrifuge.
Microscopy (light, transmission and scanning electron microscopy)
Chromatography and Electrophoresis.

Unit-IV

Biostatistics: Sampling, Measures of central tendency (mean, median and Mode) and dispersion (variance, standard deviation and standard error); Correlation and Regression

PAPER-III Ecology, Microbiology Animal Behavior and Pollution and Toxicology.

Unit- I

Ecology: Ecosystem: Concept, components, fundamental operations, energy flow, food-chain, foodwebs and trophic levels, ecological niche, abiotic and biotic factors. Population: Characteristics and regulation. Ecological succession. Adaptation: Aquatic, terrestrial, aerial and arboreal.

Unit-II

Microbiology: Morphology, physiology and infection (outline) of bacteria and viruses. Bacterial and viral diseases.

Unit-III

Animal Behavior: Introduction to Ethology, Patterns of behavior (taxes, reflexes, instinct and motivation); biorhythms; learning and memory, Migration of fishes & birds.

Unit-IV

Pollution and Toxicology: Concept, sources, types (air, water, soil, noise & radiation), and control of environmental pollution. Exposure of toxicants (routes of exposure, and duration and frequency of exposure); dose -response relationship categories of toxic effects.

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B.Sc. Part III
ZOOLOGY PRACTICAL SYLLABUS

- Permanent Preparation of: *Euglena*, *Paramecium* and rectal protozoans from frog.
- Stool examination for different intestinal parasites.
- Study of prepared slides/ specimens of *Entamoeba, Giardia, Leishmania, Trypanosoma, Plasmodium, Fasciola, Cotugnia, Taenia, Rallietina, Polystoma Paramphistomum, Schistosoma, Echinococcus, Dipylidium, Enterobius, Ascaris and Ancylostoma*;
- Permanent Preparation of *Cimex* (bed bug)/ *Pediculus* (Louse), *Haematopinus* (cattle louse), fresh water annelids, arthropods; and soil arthropods.
- Larval stages of helminths and arthropods.
- Permanent mount of wings, mouth parts and developmental stages of mosquito and house fly. Permanent preparation of ticks/ mites, abdominal gills of aquatid insects viz. Chironomus larva, dragonfly and mayfly nymphs, preparation of antenna of housefly.
- Collection and identification of pests.
- Life history of silkworm, honeybee and lac insect.
- Different types of important edible fishes of India.
- Prepared slides of plant nematodes.
- Demonstration of counting of cells (blood and protozoan) by haemocytometer, haemoglobinometer, pH meter, Colorimeter
- Microbiological Techniques: Media Preparation and sterilization, inoculation and Monitoring.
- Study of an aquatic ecosystem, its biotic components and food chain.
- Preparation of chromosomes, Test for carbohydrate Photochemical demonstration of proteins and lipids, using hand sections using hand sections, endocrine glands (Neurosecretory cells) of cockroach.
- Demonstration of developmental stages of chick.
- Project Report/ model chart making.
- **Dissections** :
- **Cockroach** : Central nervous system
- ***Wallago*** : Afferent and efferent branchial vessels, Cranial nerves, Weberian ossicles.
- Practical exercises based on Biostatistics, Microbiology, Immunology, Biotechnology, Animal Behavior, Pollution & Toxicology.

Proceedings of the meeting of the Combined Board of Studies in Zoology held on 26.10.2013 at 11.30 am in the Department of Zoology, C.C.S. University, Meerut.

In reference to the University letter no. Committee Cell (BOS-Zoology)/850 dated 17.10.2013, a meeting of the Combined Board of Studies in subject of Zoology held on 26.10.2013 at 11.30 am in the Department of Zoology, C.C.S. University, Meerut. The following members have attended the meeting :-

1. Prof. H.S. Singh, Dean, Faculty of Science, C.C.S. University, Meerut (Chairman)
2. Dr. Sanjay Kumar Bhardwaj, Head, Department of Zoology, C.C.S. University, Meerut (Convener-I)
3. Dr. A. Jalil, Deptt. Of Zoology, M.S. College, Saharanpur (Convener –II)
4. Dr. Pankaj Kumar Manglik, Principal & Head, Deptt. Of Zoology, I.P. College, Bulandshahr.
5. Prof. Vinod Kumar, Deptt. Of Zoology, Delhi University, Delhi.
6. Prof. S.M. Singh, Deptt. Of Zoology, M.J.P. Rohilkhand University, Bareilly.
7. Dr. M.P. Tyagi, Principal, Ch. Shiv Nath Singh Sandilya (PG) College, Machhra (Meerut).
8. Dr. A.K. Pandey, Principal Scientist, N.B.F.G.R., Lucknow.

The committee members persued the syllabus of B.Sc./M.Sc./Pre-Ph.D. Course work in the subject of Zoology prepared by the committee members earlier and discussed the same syllabus thoroughly. After perusal and discussion, the committee has decided approved as under:

i. The committee has approved the Theory and Practical syllabus of B.Sc. (Zoology) III year to be effective from academic session 2013-14. Further, the committee has authorized the conveners for changes, if needed.

ii. Convener-I proposed the course of chronobiology and regulation of behaviour to be opened in M.Sc. IV Semester Specialization from 2013-14 at the C.C.S. University Campus. After discussion it was modified and approved to be forwarded for further approval.

iii. Further, the committee discussed the syllabus of M.Sc. (Zoology) I, II, III and IVth Semester Theory + Practical Courses including the special courses as well and approved the same with slight modification in applied entomology Special Courses Code No. H-4080 & H-4081.

iv. The committee members discussed the syllabus of Pre-Ph.D. Course in Zoology and suggested the modification to be made and finalized by Convener-I & II in consultation with Chairman.

v. The Conveners are authorised to submit the panel of examiners of BSc and MSc

The committee ended with a vote of thanks to the chairman.

(A. Jalil) 26/10/13 (P. K. Manglik) (Vinod Kumar)

(S.M. Singh) 26.X.13 (M.P. Tyagi) (A.K. Pandey) 26/10/13

(H.S. Singh) (S.K. Bhardwaj)

B.Sc. III Zoology (Practical Syllabus)

Duration : 4 hrs **MM: 75**

1. Dissection Major - 12 Marks
   - Cockroach
     - Central Nervous System
     - Alimentary Canal with Salivary glands
   - Wallago or any other suitable fish
     - Cranial Nerves
2. Major Dissection & Permanent Mounting – 06 Marks
   - Halter, wing and Antenna of Housefly
   - Mouth parts of Mosquito, Housefly
3. Temporary Mounting 05 Marks
   - From Dissecting animals or material provided
4. Identify and comment upon spots (1 – 8) 16 Marks
   - Entamoeba, Englena, Paramecium, Opalina, Balantidium, Nyctotherus, Trypanosoma, Fasciola, Taenia, Polystomella, Schistosoma, Ascaris, Ancylostoma, Edible fishes, Cimex, Pediculus, Larval stages of helminths, arthropods, Pest – Sugarcane leaf hopper, Gundhi Bug, Termite, Rodents etc.
5. Economic Zoology Spot (One) 06 Marks
   - Life cycle of Silkworm, Honeybee, Lac insect
6. Biological Tool Techniques/Spot (One) 06 Marks
   - As per Theory Syllabus
7. Biostat Numerical/Microbiology/Immunology Behaviour (One) 06 Marks
   - As per Theory Syllabus
8. Ecology/Pollution/Toxicology (One) 06 Marks
   - As per Theory Syllabus
9. Viva Voce 06 Marks
10. Record/Project/Collection 06 Marks

26/10/13
(Convener)

26.10.13

26/10/13

Proceedings of the meeting of the Combined Board of Studies in Zoology held on 26.10.2013 at 11.30 am in the Department of Zoology, C.C.S. University, Meerut.

In reference to the University letter no. Committee Cell (BOS-Zoology)/850 dated 17.10.2013, a meeting of the Combined Board of Studies in subject of Zoology held on 26.10.2013 at 11.30 am in the Department of Zoology, C.C.S. University, Meerut. The following members have attended the meeting :-

1. Prof. H.S. Singh, Dean, Faculty of Science, C.C.S. University, Meerut (Chairman)
2. Dr. Sanjay Kumar Bhardwaj, Head, Department of Zoology, C.C.S. University, Meerut (Convener-I)
3. Dr. A. Jalil, Deptt. Of Zoology, M.S. College, Saharanpur (Convener –II)
4. Dr. Pankaj Kumar Manglik, Principal & Head, Deptt. Of Zoology, I.P. College, Bulandshahr.
5. Prof. Vinod Kumar, Deptt. Of Zoology, Delhi University, Delhi.
6. Prof. S.M. Singh, Deptt. Of Zoology, M.J.P. Rohilkhand University, Bareilly.
7. Dr. M.P. Tyagi, Principal, Ch. Shiv Nath Singh Sandilya (PG) College, Machhra (Meerut).
8. Dr. A.K. Pandey, Principal Scientist, N.B.F.G.R., Lucknow.

The committee members persued the syllabus of B.Sc./M.Sc./Pre-Ph.D. Course work in the subject of Zoology prepared by the committee members earlier and discussed the same syllabus thoroughly. After perusal and discussion, the committee has decided approved as under:

i. The committee has approved the Theory and Practical syllabus of B.Sc. (Zoology) III year to be effective from academic session 2013-14. Further, the committee has authorized the conveners for changes, if needed.

ii. Convener-I proposed the course of chronobiology and regulation of behaviour to be opened in M.Sc. IV Semester Specialization from 2013-14 at the C.C.S. University Campus. After discussion it was modified and approved to be forwarded for further approval.

iii. Further, the committee discussed the syllabus of M.Sc. (Zoology) I, II, III and IVth Semester Theory + Practical Courses including the special courses as well and approved the same with slight modification in applied entomology Special Courses Code No. H-4080 & H-4081.

iv. The committee members discussed the syllabus of Pre-Ph.D. Course in Zoology and suggested the modification to be made and finalized by Convener-I & II in consultation with Chairman.

v. The Conveners are authorised to submit the panel of examiners of BSc and MSc

The committee ended with a vote of thanks to the chairman.

(A. Jalil) 26/10/13 (P. K. Manglik) (Vinod Kumar)

(S.M. Singh) 26.X.13 (M.P. Tyagi) (A.K. Pandey) 26/10/13

(H.S. Singh) (S.K. Bhardwaj)

Paper 1: Chronobiology
Paper 2: Photoperiodism and Seasonal Breeding
Paper 3: Neuroendocrine control of behavior
Paper 4: Applied Chronobiology

PAPER 1: Chronobiology

Unit 1: Introduction to biological clocks: Temporal organization. Evolution and adaptive significance; Types of Rhythms - Ultradian, Tidal/ Lunar, Circadian and Circannual rhythms. Chronobiology in the 21st century.

Unit 2: Geophysical environment–Organisms in the cyclic environment; Proximate and Ultimate factors. Role of proximate factor in regulation of physiology and behavior.

Unit 3: Formal properties of biological clocks: Characteristics, Phase shift, phase angle difference, Phase response curve (PRC). Masking and concept of zeitgeber. Entrainment-parametric and non-parametric entrainment.

Unit 4: Clock system in prokaryotes/invertebrates: Clock in bacteria with example *Cyanobacteria*. Circadian pacemaker system in invertebrates with *Drosophila* as example.

Unit 5: Vertebrate Clock System: Suprachiasmatic nucleus (SCN), Molecular biology of the circadian pacemaker system with examples from birds and mammals.

Suggested Readings:

1. Chronobiology Biological Timekeeping: Jay. C. Dunlap, Jennifer. J. Loros, Patricia J. DeCoursey (ed). 2004, Sinauer Associates, Inc. Publishers, Sunderland, MA, USA
2. Insect Clocks. D.S. Saunders, C.G.H. Steel, X., afopoulou *(ed.)*R.D. Lewis. (3rd Ed). 2002, Barens and Noble Inc. New York, USA

PAPER 2: Photoperiodism and Seasonal Breeding

Unit 1: Photoreception: The eye as organ of photoreception. Extra-retinal photoreception. Pineal as photoreceptive structure in non-mammalian vertebrates.

Unit 2: Seasonality: Concept of seasonality, Role of photic and non-photic cues in regulation of seasonality; Cues- principal and supplementary cues, Seasonal migration in fishes and birds. Hibernation.

Unit 3: Circannual rhythms: Circannual rhythm in regulation of seasonally breeding animals with examples from subtropical birds. Circannual rhythms in sheep. Frequency demultiplication hypothesis.

Unit 4: Photoperiodic time measurement in vertebrates: Hourglass mechanism, internal and external coincidence models. Lighting protocols to test the photoperiodic time measurement- night break, T-cycle, and resonance cycles.

Unit 5: Hormonal control of seasonal reproduction: Regulation of testicular functions. Regulation of reproductive cycle in male & females. Mechanism of action of reproductive hormones. Melatonin and seasonal reproduction.

Suggested Readings:

1. The Physiology of Reproduction, Vol 1 and 2, Ernst Knobil and Jimmy D. Neil, (ed), Raven Press.
2. Biological Rhythms: Vinod Kumar (ed 2002) Narosa Publishing House, Delhi/ Springer-Verlag, Germany.

PAPER 3: Neuroendocrine control of behavior

Unit 1: Basic neurobiology: Structure and properties of neurons; Propagation of nerve impulses; Different types of synapse and synaptic transmission. Neurotransmitter and its release.

Unit 2: Hypothalamus and Pituitary gland: The hypothalamus and hypothalamic hormones: an overview of releasing and release inhibiting hormones. Structure and development of pituitary gland.

Unit 3: The hypothalamo-hypophyseal control of hormone secretion: Hypothalamo-hypophyseal axis. Regulation of thyroid, adrenal and gonadal secretion. Regulation of oxytocin and vasopressin. Concepts of feed-back in regulation of hormone secretion.

Unit 4: Neuroendocrine regulation of behaviors: Regulation of motivational system. Control of feeding and drinking. Hormonal influence of activity behaviour.

Unit 5: Principles and application of techniques in Neuro endocrinology: Electrophysiology, immunocytochemistry, *in situ* hybridization, autoradiography.

Suggested Readings:

1. An Introduction to Neuroendocrinology, Brown R., (1994), Cambridge University Press, Cambridge, UK
2. Psychoneuroimmunology, Ader R, Felten D.L. and edited by Nicholas C. (4th Ed., 2007), Academic Press, UK

PAPER 4: Applied Chronobiology

Unit 1: Methods for the study of rhythms in humans: Measurement of rhythms in physiology and metabolism (e.g. heartbeat), blood pressure, body temperature, liver metabolism.

Unit 2: Circadian clock in humans: Organization of clock system in humans. Central and peripheral clock.

Unit 3: Clocks and metabolism: Clock regulation of metabolism. Disruption of clocks and diseases viz. Diabetes, Cardiovascular diseases. Ageing and sleep disorders.

Unit 4: Melatonin and human physiology : Bio-synthesis and regulation of melatonin, role of melatonin in regulation of diseases. Sleep and diseases in human.

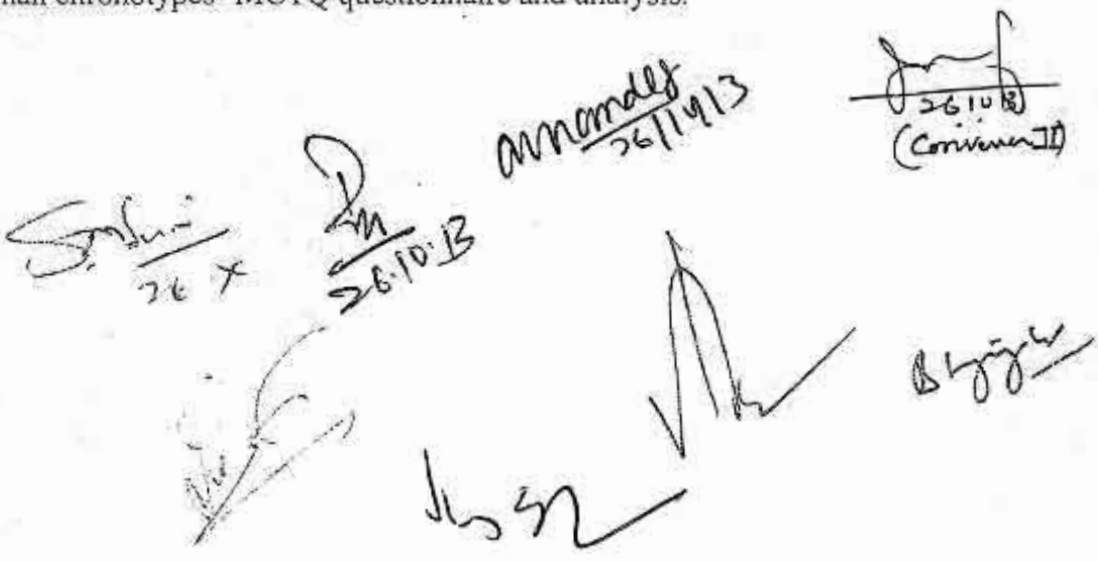
Unit 5: Biological clocks in human welfare - Clock and Human health, Chronopharmacology, Chronomedicine and Chronotherapy.

Suggested Readings:

1. Chronobiology Biological Timekeeping: Jay. C. Dunlap, Jennifer. J. Loros, Patricia J. DeCoursey (ed). 2004, Sinauer Associates, Inc. Publishers, Sunderland, MA, USA
2. Biologic Rhythms in Clinical and Laboratory Medicine. Touitou, Yvan; Haus, Erhard (Eds.) Springer-Verlag, 1992

PRACTICALS:

1. To study the phototaxis and geotaxis behaviour of earthworm.
2. Demonstration of methods of recording activity rhythms in fishes/birds/ mammals.
3. Assay of daily activity in human.
4. Ambulatory blood pressure monitoring and circadian rhythm analysis.
5. Quantifying oscillations from sample recorded data: phase, period and amplitude.
6. Recording of body temperature (Tb) of human.
7. Human chronotypes- MCTQ questionnaire and analysis.



M. Sc. (IV Semester) - Zoology
SPECIAL PAPER - ENTOMOLOGY.

Course XIII E: Morphology & Taxonomy of Insects - H4078

Unit I - General Principles of Insects Taxonomy.
Unit II - General Characters, Classification (up to families) & affinities of different order of Apterygota and Pterygota (Exopterygota & Enopterygota)
Unit III - Collection and Preservation of Insects - methods of insect collection, different methods of insect rearing, methods of insect preservation & maintenance of insect museum.
Unit IV - Insect Integument - Structure & function.
Unit V - Segmentation & body regions - Head, Thorax & abdomen-structure & appendages.

Course XIV E: Anatomy & Physiology - H4079

Unit I - Physiology of various systems (Digestive System, Respiratory Systerm, Circulatory System, Nervous System & Sense organs) .
Unit II - Effector organs (Sound producing organs & light prodcing organs)
Unit III - The endocrine system - Organization, structure of gland sand their hormones, endocrine function (In metamorphosis, reproduction , metabolism & osmoregulation)
Unit IV - Reproductive system - Male and Female reproductive organs and genetalia hermaphroditism, matting and transfer of sperms .
Unit V - Embryology - Gametogenesis, embryonic & post embryonic development , embryonic dynamics

Course XV E: Applied Entomology I - H4080

Unit I - Origin, evolution and distribution of Insects in time and space (oriental region) .
Unit II - Insect and their abiotic environmental effect of temperature, humidity and light.
Unit III - Symbiosis, Parasitism, Social life adaptation in Insects, Migration and Phase theory of Locust.
Unit IV - Beneficial insects - Apiculture, sericulture and Lac culture.
Unit V - Insect Plats Interaction: theory of Co evolution, Tri trophic interaction Host plant selection by phytophagous Insects.

26/10/13 Amended 26/10/13 P.T.O. 26/10/13 Convener II

Course XVI E: Applied Entomology II - H4081

Unit I - Insects Pest of Crops. Pest of Sugar cane, Pes of Cotton, Pestof Paddy, Pest of fruits & Vegitables, Pest of stored grains, Pest of Forest.

Unit II - insects injurious to man and livestock - Importance, appearance, life cycle, control measurs.

Unit III - Insects control measurs: Natural control, applied control, Integrated pest management , Different phase of pest control.

Unit IV - Different types of insecticides. Their chemistry action and application, insecticide resistance.

Unit V - Insect hormone and its role, insects Pheromones and its role.

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(Convener II)

M.Sc. (IV Semester) – Zoology
PRACTICAL SYLLABUS

Duration 5 Hrs.

Specialize Course Entomology (Code H-862 P)

1. **Major Dissection**	Study of Anatomy including Central Nervous System by Dissection of Cockroach, Grass Hopper, Wasp, Honey Bee, House Fly, Mosquito, Bug, Beetle and Lepidopterous larvae etc.
2. **Minor Dissection**	Sting apparatus of Honey bee, wasp, Arista and Halters of House Fly, Alimentary canal of some common insects, Tentorium and Spiracle of Grasshopper etc.
3. **Permanent mounting**	of suitable materials from insects specified for dissection such as wings, halters, antennae, legs and mouth parts or material provided.
4. **Taxonomic identifications**	upto families specified in theory syllabus.
5. **Spotting**	Study of insects of Economic Importance, life stages, mode of damage, control of important pests and useful insects, study of Permanent slides of W.M. and sections of various organs etc. of insects. Study of Insecticides, their use, insecticide poising & antidotes.
6. Insect Collection & practical record	

MARKS DISTRIBUTION

Duration : 5 hours — Max.Marks : 100

Exercises	Max. Marks
1. Major Dissection	20
2. Minor Dissection	08
3. Mounting	07
4. Taxonomic Identification of two insects	15
5. Spotting (10)	20
6. Viva Voce	10
7. Record and collection	20

M.Sc. Zoology (Practical Syllabus)

Duration – 5 hrs | Ist Semester | MM: 100

1. Major Dissection - 20 Marks
   - Earthworm Reproductive System
   - Prawn/Squilla
   - Sepia/Loligo/Octopus
2. Minor Dissection– 10 Marks
   - Prawn
     - Statocyst, Hastate Plate
   - Earthworm
     - Nerve ring, Ovary, Septal Nephridia, Pharyngeal Nephridia
   - Sea-urchin
     - Aristotl lantern
   - Mouth parts of Mosquito, Housefly
3. Permanent Mounting 10 Marks
   - Material provided or material from dissected animal
4. Cytological exercises 10 Marks
   - Mitosis
     - Onion root tip Squash Technique
   - Giant Chromosome
     - Chironomous larva
5. Spotting 20 Marks
   - Economic Zoology
   - Evolutionary biology
   - Nonchordata
     - Specimen & Slides

   (Representation of the units in various courses of theory syllabus of M.Sc. I Semester)
6. Viva Voce 10 Marks
7. Records & Collection 20 Marks

M.Sc. Zoology (Practical Syllabus)

Duration – 5 hrs | **IInd Semester** | **MM: 100**

1. Enumeration of the number of RBC/WBC by Haemocytometer 20 Marks
   Estimation of % of haemoglobin by Haemometer
2. Numerical Problems (02) from Biostatistics 10 Marks
3. Numerical Problems (02) from Genetics 10 Marks
4. Biochemical tests from Proteins, Carbohydrates Lipids & Enzymes 10 Marks
5. Spotting (1-10) (representing each unit from theory course of II Sem.) 20 Marks
6. Viva Voce 10 Marks
7. Records & Collection 20 Marks

26.10.13 (Convener II)

M.Sc. Zoology (Practical Syllabus)

Duration – 5 hrs | **IIIrd Semester** | MM: 100

1. Major Dissection - 15 Marks
   - Wallago/Mystus/any other Edible fish – Cranial Nerves
2. Minor Dissection– 10 Marks
   - Velum, pharyngeal wall, wheel organ of Amphioxus etc.
3. Permanent Mounting 10 Marks
   - From Dissected animal/provided material
4. Spot from Ecology (One) 05 Marks
5. Spots from Animal behaviour (One) 05 Marks
6. Spots from Embryology (One) 05 Marks
7. Spots (1-10) 20 Marks
   - Specimen, Slides & Osteology of Chordata (as per representative of theory Syllabus)
8. Viva Voce 10 Marks
9. Records 20 Marks

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Amended 26/10/13

26.10.13 (Convener II)

M.Sc. Zoology (Practical Syllabus)

Duration – 5 hrs | Special IVth Semester (Cytology & Cytogenetics) | MM: 100

1.	Plasmolysis	10 Marks
2.	Electrophoresis of protein	10 Marks
3.	Centrifugation	10 Marks
4.	DNA staining	10 Marks
5.	Cytology Different stages of mitosis	05 Marks
6.	Instrumentation	05 Marks
7.	Spotting	20 Marks
8.	Viva	10 Marks
9.	Records	20 Marks

M.Sc. Zoology (Practical Syllabus)

Duration – 5 hrs | **IVth Semester (Fish & Fisheries)** | **MM: 100**

1. Major Dissection - 10 Marks
   - Cranial nerves of Wallago
   - Cranial nerves of Mystus
   - Cranial nerves of Labeo
   - Cranial nerves of Sting ray
2. Minor dissections – 10 Marks
   - Accessory respiratory organs of
     - Clarias
     - Heteropneustis
     - Anabas
   - Electric organs of Torpedo
   - Weberian Ossicle of Wallago
   - Internal ear of Scoliodon
   - Pituitary
   - Biometry of a local fish
3. Mounting – 10 Marks
   - Placoid scales
   - Cteniod scales
   - Cycloid scales
   - Rhomboid scales
   - Scale showing lateral line
   - Preparation of blood film
   - Chromatophore
4. Water analysis – 10 Marks
   - pH, turbidity, salinity, DO, TDS
5. Spotting (4 specimens + 4 slides + 2 bones) 20 Marks
6. Identification (1 Cyprinid + 1 Silurid) 10 Marks
7. Viva 10 Marks
8. Records 20 Marks

M.Sc. (IV Semester) – Zoology
PRACTICAL SYLLABUS

Duration 5 Hrs.

Specialize Course Entomology (Code H-862 P)

1. **Major Dissection** — Study of Anatomy including Central Nervous System by Dissection of Cockroach, Grass Hopper, Wasp, Honey Bee, House Fly, Mosquito, Bug, Beetle and Lepidopterous larvae etc.
2. **Minor Dissection** — Sting apparatus of Honey bee, wasp, Arista and Halters of House Fly, Alimentary canal of some common insects, Tentorium and Spiracle of Grasshopper etc.
3. **Permanent mounting** — of suitable materials from insects specified for dissection such as wings, halters, antennae, legs and mouth parts or material provided.
4. **Taxonomic identifications** — upto families specified in theory syllabus.
5. **Spotting** — Study of insects of Economic Importance, life stages, mode of damage, control of important pests and useful insects, study of Permanent slides of W.M. and sections of various organs etc. of insects.
   Study of Insecticides, their use, insecticide poising & antidotes.
6. Insect Collection & practical record

MARKS DISTRIBUTION

Duration : 5 hours — Max.Marks : 100

Exercises	Max. Marks
1. Major Dissection	20
2. Minor Dissection	08
3. Mounting	07
4. Taxonomic Identification of two insects	15
5. Spotting (10)	10
6. Viva Voce	10
7. Record and collection	20

26.10.13
(Convener II)

PROGRAM OUTCOME (PO)

PROGRAM SPECIFIC OUTCOME (PSO)

COURSE OUTCOME (CO)

I. PROGRAM OUTCOME (PO):

The curriculum adopted contains teaching material that help to develop educated students, learning provided for intellectual solution of problem, imparting skills and practices through incorporating updated methods/techniques, inclusion of ICT and E-learning for making informed, aware citizen having passion to contribute for nation building in the field of Zoology.

PO_1 Syllabus aims to amalgamate general concept pertaining to program.

PO_2 Aims to develop zoologist who translated the knowledge in diverse areas interesting with zoology.

PO_3 Evolve ability to critical/intellectual thinking, scientific attitude, solution-oriented approach, process skills like communication, new research technology, aware about judicious use of recourses and practice ethics in own life as well as institution.

PO_4 Develop competitive strength for job in diverse fields.

PO_5 Develop self-employability and entrepreneurship.

PO_6 Setting up of lifelong learning.

II. PROGRAM SPECIFIC OUTCOME (PSO):

The program offers divers knowledge and learning in zoology through teaching, practical's/experiments/virtual dissection, discussions, field trips etc., and aims to balance class based and real practical approach to understand function of animal diversity, structure, function and evolution. It also familiarize the students to provide specific knowledge about-

1. Diversity of animals, their habitat, morphology, anatomy and reproduction.
2. About cellular structure, genetics, physiology and biochemistry of animal cell.

3. Economic importance animals, fossil form and course of evolution to modern forms.

III. COURSE OUTCOME:

Maximum Marks: 150 **Practical=50** **No of Lectures: 60**

Class-B.Sc.- Zoology IstYear

Course outcome

Course Code-I /Paper- B120

After the completion of the course the students will be able to understand following aspects:

1. Get familiar with lower non-chordate animal.
2. Indentify the prototypic examples of the phylum and other important animals too.
3. Get familiar with the economic importance of lower non-chordate animals and different disease caused by them.
4. Get familiar with morphology, physiology, reproduction, development and classification of the lower non-chordate animals.

Course code-II / Paper- B121

After the completion of the course the students will be able to understand following aspects:

1. Get familiar with higher non-chordate animals.
2. Identify the prototypic examples.
3. Knows the economic importance of higher non-chordate animals.
4. Get familiar with morphology, physiology, reproduction, development and classification of the higher non-chordate animals.

Course code-III /Paper-B122

After the completion of the course the students will be able to understand following aspects:

1. Get familiar with the basic principles of genetics, ultra structure and function of cell organelles and cell.
2. Could differentiate the difference between DNA and RNA.
3. Familiar with the chromosome structure and function, role in heredity and variation.
4. Knows the basis of sex determination, sex linked characters, genetic diseases and eugenics.

Maximum Marks: 150 **Practical=50** **No of Lectures: 60**

Class-B.Sc.- Zoology IInd Year

Course outcome

Course Code-I /Paper-B220

After the completion of the course the students will be able to understand following aspects:

1. Able to classify animals of Hemichordata, Cephalochordata and Urochordata.
2. Familiar with detailed structure, morphology, physiology and development of the lower-Chordates.
3. Classify different classes of Pisces, Amphibia, Reptilia, Aves and Mammalia
4. Able to differentiate poisonous and non-poisonous snakes and biting mechanism of snakes.

Course Code-II/ Paper- B221

After the completion of the course the students will be able to understand following aspects:

1. Get familiar with geological and geographical distribution of characteristic fauna.
2. Get familiar with origin and evolution of life, different theories on evolution and human evolution.

3. Able to explain how gametes are formed, fertilization takes place and types of cleavage.
4. Get familiar with developmental process and fate map of chick.

Course Code-III/ Paper-B222

After the completion of the course the students will be able to understand following aspects:

1. Get familiar with the physiology of Digestion, Respiration, Blood circulation, Excretion, Neural transmission, Endocrine glands and thermoregulation.
2. Able to classify carbohydrate, lipids and proteins.
3. Get familiar with classification and function of enzymes.

Maximum Marks: 150 **Practical=50** **No of Lectures: 60**

Class-B.Sc.- Zoology IIIrd Year

Course outcome

Course Code-I/ Paper-B320

After the completion of the course the students will be able to understand following aspects:

1. Get familiar with parasites of domestic animals and humans.
2. Get familiar with vectors and pests like Gundhi bug, Sugarcane leaf hopper, Rodents, Termites and Mosquitoes.
3. Get familiar with animal breading and their culture.
4. Get familiar with wildlife, endangered species.
5. Knows important national parks, sacturies etc.
6. Get aware with different projects for in-situ and ex-situ conservation of wild life.

Course Code-II/Paper- B321

After the completion of the course the students will be able to understand following aspects:

1. Get familiar with the genetic engineering and its application in agriculture, medical area and energy production.
2. Able to explain concept of immunity, antigens, antibody, vaccines and immunological reactions.
3. Familiar with various biological tools and techniques like pH meter, Colorimetry, microtomy, spectrophotometry, centrifugation, microscopy, chromatography and electrophoresis.
4. Get familiar with different biostatic principals employed for study of different biological data for a meaningful result.

Course Code-III/ Paper-B322

After the completion of the course the students will be able to understand following aspects:

1. Get familiar with the ecosystem, different factors of an ecosystem, food web, food chain, population and ecological succession.
2. Able to explain Morphology and physiology of microbes and various diseases produced by them.
3. Able to explain patterns of animal behavior, biological learning and memory, biorhythm, migration of birds and the cause of migration.
4. Get familiar with types of pollution, control of environmental pollution.
5. Get familiar with different toxicants, toxic effects on animals.

M. Sc. Zoology

For Semester System:

1. Theory exam: 50 Marks (+ 50 Marks of Internal Exam)= 100 marks
2. **Internal**- 1. Test- 20 (15+5)+ 20(15+5) = 40 Marks

   2. Assignments 10 Marks = 10 Marks

   Total= 40+10=**50 Marks**

3. Practical Exam: 100 Marks

Maximum Marks:100 **Practical=100** **No of Lectures: 60**

Class-M.Sc.- Zoology Ist Semester

Course outcome

Course Code- course I, H1062

After the completion of the course the students will be able to understand following aspects:

1. Get familiar with the different taxonomic zoological principals and their applications to animals.
2. Able to explain concept of species, different concepts and intraspecific species.
3. Get familiar with different procedures in taxonomy.
4. Get familiar with economic importance of animals as food, dairy product, piggery, pearl industry, leather and in wool industry.
5. Get familiar with economically important insects, their biological control and biological indicators.

Course Code- course II, H1063

After the completion of the course the students will be able to understand following aspects:

1. Get familiar with origin of life, origin of economically important animals.
2. Get familiar with distribution of animals in space with respect to time.
3. Get familiar with different concepts of evolution, molecular evolution, molecular divergence and molecular clock.
4. Get familiar with mechanisms of evolution.
5. Get familiar with evidences of evolution.

Course Code- course III, H1064

After the completion of the course the students will be able to understand following aspects:

1. Get familiar with general characters outline of classification of protozoa, porifera, cnideria, cteniphora, helminthes, annelid, arthropoda, onycophora, mollusca and echinodermata.
2. Able to explain locomotion and reproduction in protozoan.
3. Able to explain skeleton and regeneration in porifera.
4. Get familiar with gadration and metagenesis in coelenterates.
5. Get familiar with specific features of cnideria,ctenophore, helminthes, annelid, arthropoda, onychophora, mollusca and echinodermata.
6. Get familiar with minor non-coelomate phyla, minor coelomate phyla and hemichordate.

Course Code- course IV, H1065

After the completion of the course the students will be able to understand following aspects:

1. Get familiar with the cell theory, comparative analysis of prokaryotic and eukaryotic cells.
2. Get familiar with cell cycle, Cdks and cancer.
3. Get familiar with cell membrane structure theories, components and their specific functions.
4. Get familiar with cytoskeleton, cell organelles origin, nuleus and nuclear membrane.
5. Get familiar with prokaryotic and eukaryotic genome.
6. Able to explain cell communication, cell adhesion and cell division and cell commitment during development.

Maximum Marks: 100 **Practical=100** **No of Lectures: 60**

Class-M.Sc.- Zoology IInd Semester

Course outcome

Course Code- course V, H2062

After the completion of the course the students will be able to understand following aspects:

1. Get familiar with biostatistics basic concept.
2. Get familiar with measures of dispersion, correlation analysis and test of significance.
3. Get familiar with bioinformatics and basics of operating systems and internet.
4. Get familiar with primary database, secondary database, sequence database, biological laboratory, genebank, DNA database, protein family and database.

Course Code- course VI, H2063

After the completion of the course the students will be able to understand following aspects:

1. Get familiar with the Mendelian principle and method of gene transfer.
2. Get familiar with the chromosome structure and gene mapping.
3. Get familiar with population genetics and somatic cell genetics.
4. Get familiar with genetic techniques and gene code.
5. Get familiar with gene disorders and organization of genetic metrials.

Course Code- course VII, H2064

After the completion of the course the students will be able to understand following aspects:

1. Get familiar with blood circulation and cardiovascular system.
2. Get familiar with nervous system and sense organs.
3. Get familiar with respiratory system, excretory system and digestive system.
4. Get familiar with thermoregulation, stress and adaptation to stress.

Course Code- course VIII, H2065

After the completion of the course the students will be able to understand following aspects:

1. Get familiar with the structure of atom, molecules and chemical bonding.
2. Get familiar with composition, structure and function of biomolecules.
3. Get familiar with stabilizing interaction of biomolecules.
4. Get familiar with biophysical chemistry.
5. Get familiar with conformation of proteins, conformation of nucleic acids, stability of protein and nucleic acids.

6. Get familiar with metabolism of carbohydrate, lipids, amino acids, nucleotides and vitamins.
7. Get familiar with principles of catalysis, enzymes, enzyme kinetics and mechanism of enzymatic regulations.

Maximum Marks: 100 **Practical=100** **No of Lectures: 60**

Class-M.Sc.- Zoology IIIrd Semester

Course outcome

Course Code- course IX, H3062

After the completion of the course the students will be able to understand following aspects:

1. Get familiar with protochordates origin and evolution, general organization and their affinities.
2. Get familiar with vertebrate ancestry and evolution.
3. Able to comparative account integumentary system and urinogenital system of chordate groups.
4. Familiar with general characters, special characters and general organization of pisces, amphibian, reptiles, birds and mammals.
5. Get familiar with flight adaptations in birds, migration in birds and territory behavior.

Course Code- course X, H3063

After the completion of the course the students will be able to understand following aspects:

1. Get familiar with the theories of development and basic concepts of development.
2. Get familiar with parthenogenesis.
3. Able to explain gametogenesis, fertilization and gastrulation.

4. Get able to explain metamorphosis and regeneration.
5. Able to explain aging, teratology and neoplasia.

Course Code- course XI, H3064

After the completion of the course the students will be able to understand following aspects:

1. Get familiar with environment, its biotic and abiotic factors.
2. Get able to explain habitat and niche.
3. Get familiar with population ecology, species interaction, community ecology and ecological succession.
4. Get familiar with global environmental changes, biodiversity status, biodiversity changes, management and its approaches.

Course Code- course XII, H3065

After the completion of the course the students will be able to understand following aspects:

1. Get familiar with stereotypic behavior and individual behavior pattern.
2. Get able to explain learning and memory, and communication.
3. Get familiar with environmental perceptions and biological rhythm.
4. Get familiar with neural and hormonal control of behavior, pheromones and behavior, neuroendocrine control of behavior, and social behavior.

Maximum Marks: 100 Practical=100 No of Lectures: 60

Class-M.Sc.- Zoology IV Semester

Course outcome

Course Code- course XIIIB, H 4066

After the completion of the course the students will be able to understand following aspects:

1. Get familiar with origin and affinities of fishes, important prototypes of fishes, geographic distribution of fishes.

2. Get familiar with migration of fishes, homing and terotary recognition, and schooling in fishes.
3. Get familiar with body forms and its diversity in fishes.
4. Get familiar with biological significance of endoskeleton and musculature in fishes, coloration in fishes.
5. Get familiar with electric organs in fishes and luminescent organs in fishes.

Course Code- course XIVB, H 4067

After the completion of the course the students will be able to understand following aspects:

1. Get familiar with food, digestion and nutrition in fishes.
2. Get familiar with blood vascular system, respiratory system and air breathing in fishes.
3. Get familiar with excretion and osmoregulation in fishes.
4. Get familiar with nervous system and sense organs in fishes.
5. Get familiar with reproduction, development and endocrine glands in fishes.
6. Get familiar with different adaptations in fishes and fish venom.

Course Code- course XV, H4068

After the completion of the course the students will be able to understand following aspects:

1. Get familiar with history of fishery science in India and about world fishery.
2. Get familiar with cultivation of fishes.
3. Get familiar with riverine fishery, reservoir fishery and cold water fishery.
4. Get familiar with marine capture fishery and crustacean fishery.
5. Get familiar with ecology and productivity of pond, lake, river etc.
6. Get familiar with environment and fish and fishing methods

Course Code- course XVIB, H4069

After the completion of the course the students will be able to understand following aspects:

1. Get familiar with pisciculture objectives in India and south Asia.
2. Gat familiar with fish breeding and hatchery technology.
3. Get familiar with fish diseases, etiology, prophylaxis and treatments.
4. Get familiar with fish processing techniques and quality assurance.
5. Get familiar with fish genetics and biotechnology.
6. Get familiar with fish transport and marketing, fishery education and management.