

**REVISED B.Sc. BIOLOGY DEGREE SYLLABUS
SEMESTER SCHEME (2006-2007 ONWARDS)**

**I SEMESTER
PAPER : INVERTEBRATES (60 HRS.)**

1. Introduction – Principles of animal classification – with outline classification of Animal kingdom. 1 hr.

2. BIODIVERSITY – Levels of biodiversity – genetic, species, ecosystem level; number of species in different groups of animals – global, and India, ecological diversification 2 hrs.

3. Non-Chordata – General characters of the phylum and classification up to classes, with distinctive characters and suitable examples – salient feature of specified examples of each phylum to be given.


4. Phylum PROTOZOA
Examples – Amoeba, Entamoeba, Arcella, Euglena, Noctiluca, Opalina, Monocystis, Paramecium, Balantidium
Type study – structure, life history and pathogenicity of plasmodium vivax
General topic – Reproduction in Protozoa 6 hrs.

5. Phylum PORIFERA 4 hrs.
Examples – Leucosolenia, Sycon, Clathrina, Hyalonema, Spongilla, Euspongia

6. Phylum COELENTERATA
Examples – Hydra, Obelia, Aurelia, Rhizostoma, Gorgonia, Fungia, Madrepora
General topic – Polymorphism in Coelenterata 5 hrs.

7. Phylum PLATYHELMINTHES
Example – Planaria
Type study – Fasciola hepatica, Taenia solium (only life cycle)
General topic – Parasitic adaptations in Helminthes 6 hrs.

8. Phylum NEMATHELMINTHES
 Examples *Ascaris lumbricoides*, *Wuchereria bancrofti* (external & pathogenicity only) 2 hrs.
9. Phylum ANNELIDA
 Examples – *Pheritema*, *Nereis*, *Arenicola*, *Aphrodite*, *Sabellaria*, *Pontobdella*
 Type study – *Hirudinaria granulosa* – digestive, excretory, nervous and reproductive systems 7 hrs.
10. Phylum ARTHOPODA
 Examples – *Lepas*, *Balanus*, *Sacculina*, *Scolopendra*, *Scutigera*, *Palamnaeus*, *Aranea*, *Lepisma*, *Periplaneta*, *Poecilotheres pictus*, *Gryllotalpa*, *Carausius*, *Xenopsylla*, *Tachardia lacca* (Lac insect), *Papilio crino* (common banded peacock butterfly), *Cimex hemipterus* (bed bug, a vector), *Culex quinquefasciatus* (Filariasis Mosquito, a vector)
 Type study – *Penaeus* – appendages; digestive, nervous and reproductive systems.
 General topic – Economic importance of insects 12 hrs.
11. Phylum MOLLUSCA
 Examples – *Neopalina*, *Chiton*, *Dentalium*, *Patella*, *Haliotis*, *Cypraea*, *Strombus*, *Conus*, *Xancus*, *Pila*, *Limnaea*, *Mytilus*, *Pecten*, *Ostraea*
 Type study – *Unio* – structure, shell structure, circulatory system, reproductive system, a note on *Glochidium* larva
 General topic – Economic importance of mollusca 7 hrs.
12. Phylum ECHINODERMATA
 Examples – *Astropecten*, *Asterias*, *Ophiothrix*, *Salmacis*, *Echinus*, *Cucumaria*, *Holothuria*, *Antedon* 5 hrs.
13. Phylum Hemichordata – general characters, salient features of *Balanoglossus* 3 hrs.


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I semester PRACTICALS - 1

15 practicals of 3 hrs, each = 45 hrs.

1. Phylum PROTOZOA – Entamoeba, Euglena, Noctiluca, Opalina 1 prt.
2. Phylum PORIFERA – Leucosolenia, Hyalonema, Spongilla, spicules and gemmules 1 prt.
3. Phylum COELENTERATA – Obelia, Aurelia, Gorgonia, Fungia, Metridium 1 prt.
4. Phylum PLATYHELMINTHES – Planaria, Fasciola hepatica, Taenia solium, Schistosoma haematobium 1 prt.
5. Phylum NEMATHELMINTHES – Ancylostoma duodenale, Wuchereria bancrofti 1 prt.
6. Phylum ANNELIDA – Pheritima, Arenicola, Sabella, Aphrodite, Hirudinaria granulosa 1 prt.
7. Phylum ARTHROPODA – Penaeus, Sacculina, Scolopendra, Aranea, Lepisma, Grylotalpa, Carausius, Xenopsylla, butterfly, Cimex hemipterus (bed bug), Belostoma 2 prts.
8. Phylum MOLLUSCA – Chiton, Dentalium, Patella, Cypraea, Conus, Xancus, Limnaea, Mytilus, Unio, Sepia, Octopus, Nautilus, Cuttle bone, Glochidium larva 3 prts.
9. Phylum ECHINODERMATA – Astropecten, Ophiothrix, Echinus, cucumaria, Antedon, Bipinnaria larva
10. Phylum Hemichordata – Balanoglaossus 1 prt.
11. Dissection – demonstration only – with figures in record
 - a) Penaeus – appendages and nervous system
 - b) Cockroach – Mouth parts, digestive & female reproductive system3 prts.

Practical 1
SCHEME OF PRACTICAL EXAMINATION

Duration : 3hrs.

Max. marks : 40

- Q I Identify, classify and draw labeled diagram of A, B, C & D 3*4=12
(Identification 1 mark; classification 1 mark; Labeled diagram 1 mark)
- Q II Identify, classify up to orders, with distinctive characters of E, F, G, & H 3*4=12
(Identification 1 mark; classification 1 mark; characters 1 mark)
- Q III Identify and comment upon I & J (dissection part) 3*2=06
(Identification 1 mark; Labeled diagram 1 mark; comment 1 mark)
- Q IV Viva – Voce 05
- Q V Class records 05
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II SEMESTER
PAPER 2 : CHORDATA, COMPARATIVE ANATOMY &
ZOOGEOGRAPHY (60 HRS.)

1. General characters of the phylum Chordata, classification up to classes 1 hr.
2. Sub-phylum Urochordata – Herdmania, with distinctive characters;
sub-phylum Cephalochordata – Amphioxus, with distinctive characters 2 hrs.
3. Agnatha – distinctive characters; Cyclostomata – Petromyzon, Myxine general organization, distribution and ecology 3 hrs.
3. Gnathostomata – General characters of PISCES
Classification up to orders
 - a) Chondrichthyes – general characters, distribution with examples – Scoliodon, Narcine, Rhinobatus
 - b) Osteichthyes – general characters, distribution with examples – Muraena, Hippocampus, Synaptura, Echenis, Mackerel, Anabas, Ophiocephalus, Catla 6hrs.
6. AMPHIBIA – general characters and classification up to orders, Examples – Ichthyophis, Bufo. Rhacophorus, Ambystoma and Axolot I larva
Type study – Rana hexadactyla – external, digestive, respiratory, urinogenital system 6 hrs.
7. REPTELIA – general characters and classification up to orders (living); ecology, distribution of common chelonians, crocodiles (alligator and gavialis) and lizards. Examples – Bungarus, Hemidactylus, Calotes, Chameleon, Draco, Vipera russelii, Naja naja, Hydrophis, Phthon, Dendrophis 8 hrs.
8. A VES – general characters and classification up to orders; distinctive features of Archaeornithes and Neornithes with reference to Paleognathae, Impennae and Neognathae, giving suitable examples; a brief account on forest, wetland and shore birds; adaptation to flight
Examples – Apus melba (Alpine swift), Dicrurus adsimilis (kind crow), Gypus bengalensis (Bengal vulture), Larus ridibundus (black headed gull), Psittacula Krainer (rose ringed parakeet/parrot), Mulus migrans / Elanus caeruieu (black winged kite), Bubo bubo (Indian great horned owl), Monarcha azurea / Hypothymis azurea (black napped-Monarch flies catcher), Bubulcus ibis (cattle egret), Emperor Penguins (Aptenodytes forsteri) 9 hrs.

9. MAMMALIA – general characters and classification up to orders with examples; Distinctive features and distribution of Prototheria, Metatheria, orders Primates, Chiroptera, Cetacea, Perissodactyla, Artiodactyla, Carnivora, Rodentia, Proboscidea
Examples – Echidna, Ornithorhynchus, Didelphis, Macropus, Pteropus, Loris, Macaca mulatta, Elephas indicus, E. africanus, Funambulus palmarum, Rattus rattus, Hystrix, Panthera tigrina, P. leo, Horse, zebra, Axis axis, Balaenoptera rostrata, Delphinus delphis

Type study – Rabbit – externals, digestive, respiratory, cranial nerves, urinogenital systems 11hrs.

10. COMPARATIVE ANATOMY of vertebrates –
Evolutionary trends in the structure of Heart, Aortic arches, Brain and Kidney of Shark, frog, Lizard, Pigeon and Rabbit 10hrs.

11. ZOOGEOGRAPHY :

Zoogeographical realms – classification as adapted by Wallace;
Climatic conditions and Fauna of Oriental region.

Barriers of dispersal – topographic, vegetative and large bodies of water

Animal distribution – continuous and discontinuous distributions with examples;
geographic distribution of animal with reference to India 4 hrs.

II semester PRACTICALS 2

15 practicals of 3 hrs, each = 45 hrs.

1. Sub-phylum Urochordata – Herdmanja, Ascidian tadpole.
Sub-phylum Cephalochordata – Amphioxus, T.S. of Amphioxus thr. Pharynx
Cyclostomata – Petromyxon, Myxine 1 prt.
2. PISCES – Scoliodon, Narcine, Rhinobatus, Pristis, Hippocampus, Synaptura,
Echenis, Mackerel, Anabas, Ophiocephalus, Antennarius 2 prts.
3. AMPHIBIA – Ichthyophis, Bufo, Ambystoma and Axolotl Larva 1 prt.
4. REPTILIA – Bungarus, Calotes, Chameleon, Draco, Naja naja, Hydrophis,
Python, Green snake, Hemidactylus, Alligator, Chelone mydas 2 prts.
5. AVES – Parrot, Owl, Penguin, Wood pecker, Cattle egret, Duck, Kingfisher,
Pigeon, 1 prt.
6. MAMMALIA – Echidna, Ornithorhynchus, Macropus, Whale, Dolphin, Pteropus,
Loris, Porcupine 2 prts.
7. Distribution of animals – Peripatus, Dipnoi fish, Necturus, Proteus, Ambystoma,
Alytes, Hyalobates, Sphenodon, Phrynosoma, Ostrich, Kangaroo, and Duck billed
platypus 1 prt.
8. COMPARATIVE ANATOMY OR VERTEBRATES – Heart & Brain of Shark,
Frog, Pigeon and Rabbit 2 prts.
9. Endoskeleton of Rabbit – Skull, vertebrae, girdles and limb skeleton 1 prt.
10. Dissection – demonstration only with figures in record
Rat / Chick – digestive and respiratory system; kidney, heart & gonads 1 prt.
11. Field visit or Education tour is **COMPULSORY**
- Report of visit compulsory 1 prt.

Practical 2
SCHEME OF PRACTICAL EXAMINATION

Duration : 3 hrs.

Max. marks : 40

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|--|--------|
| Q I Identify, classify and draw labeled diagram of A, B & C (Identification 1 mark; classification 1 mark; labeled diagram 1 mark) | 3*3=09 |
| Q II Identify, classify up to orders, with distinctive characters of D, E & F (Identification 1 mark; classification 1 mark; characters 1 mark) | 3*3=09 |
| Q III Identify and comment upon G,H & I (Zoogeography Part) (Identification 1 mark; distribution & realm 1 mark) | 2*3=06 |
| Q IV Identify and comment upon J & K (comparative anatomy/dissection & osteology) (Identification 1 mark; explanation 1 mark; labeled diagram 1 mark) | 3*2=06 |
| Q V Viva – voce | 05 |
| Q VI Class records with Tour report | 05 |


Principal

**III SEMESTER
BIOCHEMISTRY AND PHYSIOLOGY (60 HRS)**

A. Biochemistry (18hrs)

1. Carbohydrates : Definition, classification, Structure & Biological importance with examples 3 hrs.
2. Proteins : Definition, classification, Structure (pri., sec., ter., & quat.,) and Biological importance with examples, fibrous and globular proteins 3 hrs.
3. Lipids : Definition, Classification, Structure & Biological importance of phospholipids, neutral lipids and glycolipids; saturated and unsaturated fatty acids with examples 3 hrs.
4. Enzymes : Definition, Classification (IUB system); Mechanism of enzyme action; specificity of enzymes; reversibility of enzyme action; enzyme inhibitors; A brief account of coenzymes, cofactors and ions; clinical importance of enzymes 5 hrs.
5. Vitamins : Definition, Classification, Structure & Biological importance and deficiency symptoms 4 hrs.

B. Physiology (42 hrs)

1. Water as a solvent, pH, buffer action; Osmoregulation in animals – types, osmoregulation in shark, marine & fresh water teleosts, kangaroo rat and camel 3 hrs.
2. Digestion : Mechanism of digestion; chemical digestion; digestion and absorption of carbohydrates, proteins and lipids; hormonal control of digestion and absorption 3 hrs.
3. Respiration : external and internal respiration; respiratory pigments (Hb, haemocyanin, haemoerythrin); Physiology of respiration – exchange of gases transport of oxygen – oxygen dissociation curve, Bohr effect; transport of CO₂ - chloride shift, respiratory quotient 4 hrs.
4. Circulation : types of circulation; structure, function and regulation of human heart; blood pressure; blood clotting mechanism, blood cells; types of hearts 4 hrs.
5. Nitrogen excretion : in aquatic and terrestrial animals, types with examples; Ornithine cycle; physiology of urine formation – Counter current multiplier system in human 4 hrs.

6. Muscle contraction : Principal types of muscles; ultra structure of striated muscles; contractile proteins (5); mechanism of muscle contraction and relaxation – Sliding filament theory; chemical changes during muscle contraction; neuromuscular junction 4 hrs.
7. Nervous co-ordination : Structure of Neuron; Morphological types of neurosynapse; nature and conduction of nerve impulse; synaptic transmission; chemical transmitters in vertebrates. 4 hrs.
8. Sense organs : Classification of sense organs; statocysts; Lateral line system; Ampullae of Lorenzini; ear of mammals; eye of mammal; chemo-receptors; thermo-receptors; organs of Jacobson; echolocation 4 hrs.
9. Endocrine system : human endocrine glands; hormones and its role – pituitary, thyroid, parathyroid, pancreas, adrenal, testes, ovaries, placenta and pineal glands; Neuro-secretary releasing factors; hypothalamus and its stimulation and inhibitory effects; effects of hypo and hypersecretion of various hormones in humans 5 hrs.
10. Thermoregulation : Types and their temperature relations: thermogenesis and its regulation; adaptive changes of animals in cold environments 2 hrs.
11. Immunology : Bone marrow and primary lymphoid organs; Thymus; Bursa Fabricus; Payer's patches; T & B cells; antigens and antigenicity; immunoglobulins; structure of immunoglobulin G and immunization; a detailed account of AIDS 4 hrs.

III semester PRACTICALS 3

I BIOCHEMISTRY

15 practicals of 3 hrs. each = 45 hrs.

1. Qualitative detection in given samples, test to be conducted:
 - a) for glucose – Benedict's test
 - b) for starch - Iodine test
 - c) for protein – Biuret test, Xanthoprotein test
 - d) for lipids – Sudan III test, Greasy spot test

3 prts.
2. Qualitative detection of nitrogenous waste products in given samples, test to be conducted:
 - a) test for ammonia – Nessler's reagent test
 - b) test for urea – Specific urease test
 - c) test for uric acid – Folin's uric acid reagent test
 - d) test for creatinine – Jaffe's test

2 prts.
3. Salivary amylase activity test in human saliva

1 prt.
4. Dehydrogenase activity test in milk

1prt.
5. Commenting on the vitamins present with deficiency diseases
 - a) Vitamin A – Amaranthus, Coriander, Carrot
 - b) Vitamin B₁ & B₂ – Rice bran, Yeast
 - c) Vitamin C – Citrus fruits, Banana
 - d) Vitamin D – Fish liver oil
 - e) Vitamin E – Germinating seeds
 - f) Vitamin K – Cabbage and Tomato

1 prt.

II PHYSIOLOGY

1. Total RBC count in personal sample of blood
2. Total WBC count in personal sample of blood
3. Estimation of hemoglobin content in blood
4. preparation of Haemin crystals from blood
5. Estimation of clotting & bleeding time of blood
6. Sense organs -
 - a) Ampullae of Lorenzini
 - b) Ear of mammal
 - c) Eye of mammal
 - d) Compound eye in Insect
 - e) Muscle fiber – simple, striated and cardiac

7 prts.

Practicals 3
SCHEME OF PRACTICAL EXAMINATION

Time : 3 hrs.

Max. marks : 40

- Q I A Qualitative detection *Carbohydrates / Proteins / Lipids* (any one) of the following for samples **A₁ & A₂** (one should be blank) 05
- B Qualitative detection of *Anunonia / Urea / Uric acid / Creatinine* (any one) of the following samples **B₁ & B₂** (one should be blank) 05
(requirements 1 mark; conduction and procedure 3 mark; report 1 mark)
- Q II Physiology experiment any one of the following by lot **C** 12
[Salivary amylase; RBC count; WBC count; Dehydrogenase activity of milk; Haemin crystals; HB content; Clottin & bleeding time]
(requirements 1 mark; procedure 3 marks; conduct experiment 4 marks; demonstration/of observation/calculation 3 marks; report 1 mark)
Note: I & II experiment should be attested by the examiner
- Q III A Identify and comment on **D & E** (sources of any two vitamins) 2*2=04
- B Identify an comment on **F** (sense organ & muscle models / slides/ photocopies) 04
(Identification 1 mark; labeled diagram 1 1/2 marks; comments 1 1/2 marks)
- Q IV Viva-voce 05
- Q V Class records 05

IV SEMESTER
Paper 4 : Histology, Ethology & Ecology (60 hrs)

Histology (8hrs.)

Study of histological structure and functions of the following mammalian organs – Tongue, Pituitary, Stomach, Intestine, Testis, Ovary, Liver, Pancreas, Thyroid, Kidney, Adrenal

Ethology (26 hrs.)

1. Definition and types of animal behavior with example : Innate behavior – reflexes, instinct, motivation; Learning behavior – habituation, imprinting, conditioned reflexes, insight learning; Aggression and territoriality 4 hrs.
2. Social organization in animals – Honeybee (with communication), Ants, Termites, Macaques 3 hrs.
3. Animal migration :
 - A) Migration in fishes – types, Anadromous and catadromous migration with Hilsa and Eel as Indian examples.
 - B) Migration in birds – Methods of study, advantages, origin, pattern, mechanics, preparation, orientation and navigation.
Examples – Golden Plover, Artic tern, Whimbrel, Curlew, Sand piper, Green shank, Red shank, barb-headed geese, Cranes, Flamingoes, Yellow wagtail 7 hrs.
4. Courtship behavior – general principle, courtships of Three spined stickle back fish, Betta splendens, Frog, Peacock, Warbler, Baya 4 hrs.
5. Parental care : In fishes – Hippocampus, Arius
In amphibians – Ichthyophis, Rhacophorus
In birds – Jacana, Myna, Penguin, Sun bird
6. Nesting behavior – in Chironomous larva, wasps, birds like waver bird, bower bird and tailor bird 3 hrs.
7. Biological clock – its nature, types and significance 1 hrs.

Environmental Biology (26 hrs.)

1. Habitats : Marine habitat with zonation of sea; fresh water habitat Lentic and Lotic systems; Terrestrial habitat – a brief account of forest and desert biomes; ecological adaptation of water and desert animals 5 hrs.
2. Community ecology : community structure; ecological determinants; ecological stratification; ecotone and edge effect; ecological niches; ecological succession; climax community 2 hrs.
3. Ecosystem: Pond ecosystem; abiotic and biotic components; interaction between components; types of ecosystems with examples; natural and man engineered ecosystems and micro-ecosystems 4 hrs.
4. Food chains and energy flow : types of food chains with examples : food webs with examples : ecological pyramids with examples: energy flow and laws of Thermodynamics 4 hrs.
5. Limiting factors : concept, definition of Liebig's Law and Shelford's law 2 hrs.
6. Population ecology: Population density; natality and mortality; population growth rate; biotic potential – Allee's principle and Gause's principle 4 hrs.
7. Environmental pollution: with reference to India – air, water, soil, noise, visual Pollutions – sources, effects and control 4 hrs.
8. Global impacts: green house effect and acid rain 1hr.

IV semester PRACTICALS 3

I Histology 15 practicals of 3 hrs. each=45 hrs

1. Demonstration of Microtomy 1 prt.
2. Study of histological details with a note of physiology of the following mammalian organs – Skin, Pituitary; Stomach, small Intestine, Liver, Pancreas, Spleen, Kidney, Testis, Ovary and Adrenal 7 prts.

II Environmental Biology

1. pH of water samples
2. pH of soil samples
3. Estimation of CO₂ of the water samples
4. Estimation of O₂ of the water samples (Winkler's method)
5. Estimation of Chlorides of the water samples

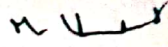
6. Visit to pond for study of ecosystem
 7. Behavioral biology specimens – Eel, Ichthyophis, male Hippocampus
 Rhacophorus, Termite and Ant
- 5prts.
2 prts.

Practicals 3
SCHEME OF PRACTICAL EXAMINATION

Time : 3 hrs.

Max. marks : 40

- Q I Stain, mount, identify and comment on the paraffin section provided 08
 (Stain – 2 marks; mount – 1 mark; identify – 1 mark; diagram – 2 mark; explanation – 2 mark)
- Q II Identify and comment on the slides **A & B** (histology slides) 3*2=06
 (Identification – 1 mark; comment with diagram – 2 marks)
- Q III Estimate the quantity of dissolve CO₂/ O₂/Cl₂ in the water sample provided (any one) 06
- Q IV Find the pH of the water/soil samples **C & D** provided (any one; 1 mark each) 02
- Q V Comment on the producer / consumer of a pond ecosystem **E** (any one) 02
- Q VI Identify and comment on **F & G** (behavioral specimens) 3*2=06
 (Identification – 1 mark; comment – 2 marks)
- Q VII Viva-voce 05
- Q VIII Class records 05


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V SEMESTER
PAPER 5.1
EVOLUTION, PALEONTOLOGY AND WILD LIFE (45 HRS.)

a. Evolution (17hrs.)

1. Theories of Organic evolution : Lamarckism and Neo-Lamarckism, Weisman's theory, Darwin-wallace theory of natural selection, De Veris theory of mutation. Synthetic theory of evolution – Gene mutation, gene flow, genetic drift, natural selection and isolation, Hardy-Weinberg's Equilibrium 7 hrs.
2. Evidences of Organic evolution : Evidences from comparative morphology, anatomy, biochemistry and embryology 5hrs
3. Speciation- concept of species- sympatric, allopatric speciation; pre and post zygotic isolation mechanism 3 hrs
4. Polymorphism: transient and balanced 2 hrs

b. Paleontology (10hrs)

1. An account of fossils, dating of fossils, preservation of fossils.
2. Paleontology of Dinosaurs: Tyrannosaurus, Brontosaurus, Pterosaurs, Ichthyosaurs and Archaeopteryx
3. Origin and evolution of horse and man 5 hrs.

c. Wildlife biology (18 hrs.)

1. Distribution of wild life in India : the Himalayan ranges; the peninsular India sub region; Deccan Plateau; the Western Ghats; Eastern hill chain; Aravali ranges; the Indian desert; tropical rain forest; wild life in Andaman and Nicobar Islands 4 hrs.
2. Animal relationships: Mutualism; commensalisms; parasitism; ammensalism; predation and competition with relevant examples 4 hrs.
3. Wildlife problems : hunting; over harvesting; habitat destruction due to over population; degradation; habitat shrinkage; possibilities of climatic changes; transgenic changes 5 hrs.
5. Wild life Conservation : Need; Agencies – Gove. and NGO's; Wildlife Protection act 1972; CITES; Red data book; Ramsar; CBD; Endangered fauna and flora of India 5 hrs.

paper 5.2
ECONOMIC ZOOLOGY (45HRS.)

A. POULTRY

10 hrs

Aim and scope of poultry; poultry farm management; poultry breeds in India; rearing house equipments; poultry feed and its composition; broilers and layers rearing; nutritive value of eggs and meat; a note on diseases – viral, bacterial, protozoan, helminthes, genetic, ecto-parasites, nutritional deficiency diseases – of poultry birds, symptoms, remedies and their control

B. DAIRY FARMING

8 hrs.

Importance; scope and management of farm animals; breeds of cows and buffaloes; nutritional requirements; housing and hygiene of dairy animals; milk and milk byproducts; processing, preservation and marketing of milk; breeding techniques; artificial insemination; breeding programs to improve local breeds

C. SERICULTURE

10 hrs.

Components of sericulture : Moriculture – different species of mulberry; grainage activities; silkworm rearing; post harvest technology; life cycle and morphology of Bombyx mori; environmental conditions needed for rearing; modern rearing house; rearing equipments; chawki worm and adult worm rearing methods; non-mulberry silkworms; silkworm pest and predators; a note on silkworm diseases – Pebrine, Muscardine, Flacherie and Grasserie

D. AQUACULTURE

10 HRS.

Principle; scope, techniques and importance of culturing economically important aquatic organisms; brief account of culturing of Indian major exotic corps and fresh water prawn; induced breeding of major carps and seed fish; endocrine regulation of fish reproduction; a note on fish by products and fish diseases

E. APICULTURE

7 HRS.

Honey bee morphology; structural adaptation of mouth parts, honey sac; wax glands and sting apparatus; social life; different species and races; management of bee keeping (modern methods); economic importance of honey, wax, pollen, venom and bee pollination; a note on production of honey; its chemical composition and honeybee diseases

Semester V – Practical 5.1
EVOLUTION, PALEONTOLOGY, WILD LIFE AND ECONOMIC
ZOOLOGY

I Evolution

15 practicals of 3 hrs. each = 45 hrs.

1. Study of homologous organs – fore limb skeleton of frog and bird;
Study of analogous organs – Wing of bird and insects
Study of vestigial organs of man – vermiform appendix; coccyx; molar teeth 1 prt.
2. Comparative study of vertebrate embryos – shark, frog, lizard, fowl, rabbit/man 1 prt.

II Paleontology

Study of fossils – casts and moulds; study of Tyrannosaurus, Brontosaurus, Pterosaur, Ichthyosaurus; Archaeopteryx 1 prt.

III Wild life biology

1. Animal relationships :
for Mutualism – hermit crab and sea anemone; Trichonympha and termite
for commensalism – sucker fish and shark; Chaetopterus and crab
for parasitism – Ascaris, Saculina on crab, leech, mosquito
for predation- insect and frog; rat and snake
for ammensalism – Pencillium, Microcystis
for competition – squirrel and bird; grasshopper and rabbit. 1 prt
2. Endangered species (by nodels/pictures) – slender Loris; Pangolin; Musk deer; Great Indian Bustard; Great pied Hoenbill; Green sea turtle; Gharial; Varanus; Indian rock python 1 prt
3. Visit to nearby game sanctuary/bird sanctuary/national parks to study wild life (catalogue of animals observed to be submitted) 1 prt


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IV Economic zoology


1. Food fishes : Catla; Marigala; Anabas; Mackerel; Sardine; Mugil; Rohu; Channa; Shark 1 prt.
 2. Study of mouth parts and sting apparatus of honey bee; nature and use of bee hive; bee wax and honey 1 prt.
 3. Life cycle of Bombyx mori including externals; Mulberry and non-mulberry cocoons; diseases – Pebrine, Muscardine, Flacherie and Grasserie 1 prt.
 4. Byproducts of fisheries, poultry dairy and sericulture – fish oil; milk powder, egg powder; fowl excreta; dry cocoons and silk worm excreta 1 prt.
 5. Visit to poultry farm (report to be submitted) 1 prt.
 6. Visit to dairy farm (report to be submitted) 1 prt.
 7. Visit to veterinary hospital (report to be submitted) 1 prt.
 8. Visit to silk rearing centre (report to be submitted) 1 prt.
 9. Visit to aquaculture farm (report to be submitted) 1 prt.
- Field visit/ education tour is **COMPULSORY** 1 prt.
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Pra. 5.1 SCHEME OF PRACTICAL EXAMINATION

Time : 3 hrs.

Max.marks : 40

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|-------|---|--------|
| Q I | Comment on A, B (2 from evolution) & C (from paleontology) (Diagram 1 mark; description 2 marks) | 3*3=09 |
| Q II | Identify and comment on D (animal relationships), E & F (2 from endangered sps.) (Identification 1 mark; comment 2 mark) | 3*3=09 |
| Q III | Comment on G (food fishes), H (apiculture), I (sericulture) & J (byproducts of all the 3) (Identification 1 mark; comment 2 marks) | 4*3=12 |
| Q IV | Viva-voce | 05 |
| Q V | Classs records | 05 |
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Semester V – Practical 5.2 PROJECT WORK

Batches consisting of 4 students each are formed. They are given a suitable project work by the faculty in-charge of the batch. Each batch should conduct a survey and submit the report on the project under the able guidance of the batch in-charge. The project work should concentrate on the problems of surrounding area pertaining to zoology. Each batch should work as a team with suitable coordination among them. A copy of project report must be submitted to the department.

Pra. 5.2 SCHEME OF PRACTICAL EXAMINATION Project work and report

Time: 3 hrs.

Max. marks : 40

| | |
|------------------------------|----------|
| Q I Project submission | 25 marks |
| Q II Seminar / Presentation | 10 marks |
| Q III Viva-voce / Discussion | 05 marks |

VI SEMESTER
PAPER 6.1

CELL BIOLOGY AND DEVELOPMENTAL BIOLOGY (45 HRS.)

a. Cell biology (25 hrs.)

1. Introduction : History; tools and techniques and subdivision of cell biology
2. Chromosome : number, size of genome; morphology; heterochromatin and euchromatin; chemistry; fine structure chromosome models – nucleosome model; polytene and lampbrush chromosomes 6 hrs.
3. Nucleic acid : Identification of genetic material; Griffith's experiment; chemistry; Watson and Crick model of DNA; forms and types; replication of DNA; enzymes in DNA replication; types of RNA genetic and non-genetic RNAs; RNA processing (exons and introns) 4 hrs.
4. Protein bio-synthesis and Genetic code : components and mechanism; properties of genetic code – Wobble hypothesis 3 hrs.
5. Cancer biology : concept; types; characteristics; Oncogenes; immune system and cancer, tumor, carcinogenic agents (physical, chemical and biological); causes of human cancer, immunotherapy 4 hrs.
6. Mitosis : Introduction; centriole cycle; mitotic apparatus; chemical events during prophase; role of mitotic apparatus; chemical events during prophase; role of mitotic inhibitors; significance
Meiosis : Introduction; synaptonemal complex and recombination; mechanism of crossing over; significance 5 hrs.
7. Sex determination : types with examples; chromosomal and genic balance theory 3 hrs.

b. Developmental biology (20hrs.)

1. Cleavage and Blastula : Laws and types of cleavage with examples; effect of yolk on cleavage in frog and chick; types of blastula with examples 3 hrs.
2. Organizer phenomenon : Definition; potencies of the dorsal lip of the blastopore of amphibian gastrula; Brachet's experiment; experiment of Spemann and Mangold; induction; chemical nature, types and theories of organizer 3 hrs.

3. Chick embryology : structure of hen's egg; cleavage; blastula; gastrulation; origin and structure of primitive streak; structure of 18, 24, 48 hour, chick embryos; extra embryonic membranes of chick – development; structure and function of foetal membranes 5 hrs.
 4. Placenta : Yolk sac placenta, allantoic placenta; structure and functions of placenta; morphological and histological classification of placenta with examples 3 hrs.
 5. Early development of Human foetus : structure of a mature sperm; and Graafian follicle; ovulation; fertilization; morula; blastocyst; implantation; gastrulation; placenta; twins and multiple births 3 hrs.
 6. Fertilization : introduction – external and internal; mechanism, time and significance 3 hrs.
- Parthenogenesis : types with examples; artificial parthenogenesis; significance

Semester VI – Practical 6.1 Cytology and Embryology

15 practicals of 3 hrs. each = 45 hrs.

Cell biology

1. Study of Mitosis : permanent slides for different stages 1 prt.
2. Study of Meiosis : permanent slides for different stages 1 prt.
3. Preparation of Onion root tip squash and observation of stages 2 prts.
4. Preparation of Grass hopper testis squash and observation of stages 2 prts.
5. Study of salivary gland chromosomes of Drosophila 1 prt.
6. Structure of Cancer cell; carcinogenic agents – Tobacco, cigarette, use of perfumes and spices 1 prt.
7. Micrometry : measure chromosomes by using stage micrometer & oculometer 1 prt.
8. Vital staining of ovary of earthworm 1 prt.

Developmental biology

9. Frog embryology : V.S. of cleavage; blastula; gastrula; neurula 1 prt.
10. Chick embryology : study of egg of chick and whole mount of 18 hrs., 24 hrs., and 48 hrs. embryos; T.S. of 18 hrs, 24 hrs. embryos 2 prts.
11. Structure of mature sperm and Graafian follicle of human 1 prt.
12. Structure and physiology of human testis and ovary 1 prt.

Practical. 6.1
SCHEME OF PRACTICAL EXAMINATION

Time : 3 hrs.

Max. marks : 40

Q I Make squish preparation of Onion root tip/ Grass hopper testis/ salivary gland chromosome of Drosophila/Measurement of chromosome by micrometry.

(procedure 2 marks, preparation 2 marks, report 01mark)

06marks

Q II Identify with reasons A(from mitosis) B (from meiosis) & C(Carcinogen/cancer slide)

3x3=09

Q III Identify the slides D, E (frog embryology) F, G (Chick embryology)

&H (human embryology)

5x2=10

Q IV Viva-voce

05

Q V Class records

05

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Paper 6.2
GENETICS AND BIOTECHNOLOGY (45 HRS)

Genetics (25 hrs)

1. Mendilian Genetics: Life and work of Mendel; Mono and Dihybrid cross; Mendel's laws; Incomplete dominance 3 hrs.
2. Interaction of genes:
Supplementary factor 9: 3: 3:1- comb pattern in fowl
Dominant epistasis 13:3- plumage color in Leghorn
Recessive epistasis 9:3:4-coat color in pigs
Polygenic inheritance- skin color of man
Lethal genes - coat color in mice 5 hrs
3. Linkage and crossing over : types, crossing over, three point cross; construction of linkage map in *Drosophila*. 2 hrs
4. Nature and Nurture : Definition; experiment on *Potentilla glandulosa*; Himalayan Albino rabbit and human twins; Norm of reaction; Homeostasis; Phenocopy; Pleotropism; Penetrance and expressivity with examples 4 hrs
5. Multiple alleles- Inheritance of coat color in mice; Isoalleles; Pseudoalleles and position effect; ABO blood groups of man ; Rh factor 3 hrs
6. Sex linked inheritance: White eye in *Drosophila* and haemophilia and colorblindness in man; Y-linked genes.
7. Gene Mutation: Operon concept- lac operon; Mutation and its molecular basis; CIB technique 5hrs

Biotechnology (20 hrs)

1. Scope and basic concept of genetic engineering. 1 hr
2. Introduction to Animal tissue culture technique 1 hr
3. Enzymology of genetic engineering: Restriction enzymes; DNA ligase; Polymerase 2hr
4. Cloning vehicles: Plasmids, Cosmids, Lambda phage; shuttle vectors and yeast plasmids 2hr
5. Introducing cloned genes in to the host cells: Transformation, Transduction, Particle gun; electroporation; liposome mediated cultivation 5hrs
6. Analysis and expression of cloned genes in host cells: Restriction enzyme analysis; Southern blotting; Northern blotting; *in-situ* hybridization; DNA sequencing; RFLP; PCR; RAPD; DNA finger printing; Ligase; Polymerase chain reaction; DNA probes; Expression of cloned genes 8 hrs.
7. A brief account of transgenic animals. 1 hr.

VI semester – Practical 6.2
Genetics and Bio-technology

15 practicals of 3 hrs. each = 45 hrs.

- | | |
|---|---------|
| 1. Genetic problems : Monohybrid ratio; Dihybrid ratio; Sex linkage – eye color in Drosophila; color blindness and haemophilia in man | 3 prts. |
| 2. Study of blood groups (ABO & Rh) with special reference to mode of inheritance; Identification of blood groups and problems on inheritance of blood groups | 2 prts. |
| 3. Drosophila study: | |
| a) Culture of Drosophila | 2 prts. |
| b) Identification of male and female flies | 1 prt. |
| c) Study of life cycle | 1 prt. |
| d) Mounting of sex comb | 1 prt. |
| e) Study of mutants | 1 prt. |
| 4. Study of DNA finger printing; PCR; RAPD; RFLP | 2 prts. |
| 5. Study of Plasmids, Cosmids and Vectors (photographs can be used) | 1 prt. |
| 6. A visit to a biotechnology institution and report | 1 prt. |

Pra. 6.2 SCHEME OF PRACTICAL EXAMINATION

Time : 3 hrs.

Max. marks : 40

- | | |
|---|--------|
| Q I Identify the blood group (ABO & Rh) / prepare sex comb of Drosophila (by lot) | 06 |
| Q II Identify with reasons A & B (any two from three below) | 3x2=06 |
| [i] from egg, lava, pupa, male and female Drosophila | |
| [ii] from Drosophila mutants (any one) | |
| [iii] a Monohybrid cross problem | |
| Q III Genetic problem (any two problem, excluding monohybrid cross) | 5x2=10 |
| Q IV Identify and comment on C & D (from biotechnology) | 4x2=08 |
| Q V Viva-voce | 05 |
| Q VI Class records | 05 |

THEORY QUESTION PAPER PATTERN

Subject Code no --

Page no ---

---semester B.Sc., degree examination

May/Nov 200-

Semester scheme

Zoology

Paper I to VI : with chapter heading

Time : 3 hrs.

Max. marks : 50

Instructions to the candidates:

1. Objective type question should be answered in the first two pages of the answer book

2. Draw labeled diagrams wherever necessary

1. Objective type question:

Answer in a word or a phrase or a sentence

5x1=05 marks

1

2

3

4

5

II. Write short notes on any **THREE** of the following:

3x3=09 marks

6

7

8

9

10

III. Explain briefly any **FOUR** of the following :

5x4=20 marks

11

12

13

14

15

16

IV. Long answer questions:

Answer any **TWO** of the following

8x2=16 marks

17

18

19

20

-000-

Zoology Semester Syllabus (Revised)

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CURRICULUM IN ZOOLOGY FOR B. Sc. (UG) I SEMESTER

Theory: Paper 1 : Diversity and Functional Anatomy of Non-Chordates (60 HRS.)

This paper deals with the diversity of Non-chordates. This paper will help students to understand the diversity of various species among non-chordates including organization of animal body architecture, principles of classification, general characteristics of different phyla along with specific type study.

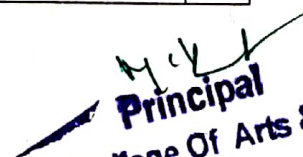
| Units | TITLE | hrs |
|-------|--|-----|
| 1 | <p>Introduction</p> <p>Animal Architecture: i) Body symmetry- types – spherical symmetry, radial symmetry, biradial symmetry and bilateral symmetry. ii) Organization- the hierarchical organization of protoplasmic level, cellular level, tissue level and organ level of organization. iii) Germ layers- diploblastic and triploblastic condition. iv) Coelom- origin and types– acoelom, pseudocoelom, eucoelom (enterocoelom and schizocoelom). v) Metamerism- types – pseudometamerism, true metamerism. vi) Cephalization.</p> <p>Principles of animal classification: An outline classification of Animal kingdom. - binomial nomenclature; international rules of Zoological nomenclature (brief account); New trends in systematics: Numerical taxonomy (Phenetics), Cladistics (Phylogenetic systematics), Molecular systematics.</p> | 7 |
| 2 | <p>Phylum Protozoa: General characters, classification of the phylum up to classes with examples. Type study – structure, life history and pathogenicity of <i>Plasmodium vivax</i></p> <p>Locomotion in Protozoa: Locomotory organelles and modes of locomotion, Reproduction in Protozoa</p> | 6 |
| 3 | <p>Phylum Porifera: General characters, classification of the phylum up to classes with examples. General study – Cell types, skeleton, canal system(Asconoid, Syconoid, Leuconoid and Rhagonoid types). Reproduction in sponges.</p> | 5 |
| 4 | <p>Origin of Metazoa: Blastea and Gastrea theories and Hadzi's theory</p> | 2 |
| 5 | <p>Phylum Coelenterata: General characters, classification of the phylum up to classes with examples. Type study – Obelia- Morphology & Life history. Coral and Coral reefs, types and importance of coral reefs. Polymorphism in coelenterata</p> | 4 |
| 6 | <p>Phylum Platyhelminthes: General characters, classification of the phylum up to classes with examples. Type study- <i>Taenia solium</i> - Structure, reproduction, life cycle and pathogenesis. Parasitic adaptations in helminthes.</p> | 4 |
| 7 | <p>Phylum Nematelminthes: General characters, classification up to classes with examples. Pathogenicity of <i>Ascaris</i> & <i>Wuchereria</i> Role of <i>Turbatrix aceti</i> (vinegar eels) and <i>Brachionus</i>.</p> | 3 |
| 8 | <p>Phylum Annelida: General characters, classification up to classes with examples. Type study – <i>Hirudinaria granulosa</i> – Morphology, Excretory, digestive and reproductive systems.</p> | 3 |
| 9 | <p>Phylum Arthropoda: General characters, classification up to classes with examples. Type study – <i>Panurginus</i> – appendages, concept of serial homology, digestive system, nervous system and Crustacean larvae: Nauplius, Zoea, cypris and mysis larval stages. Web building spiders, Structure and affinities of peripatus, Metamorphosis of insects. Economic importance of insects.</p> | 10 |
| 10 | <p>Phylum Mollusca: General characters, classification up to classes with examples. Type study – <i>Unio</i>– structure, shell structure, Reproduction and life cycle. General study – Shells in Mollusca. Torsion in Gastropoda, Diversity of Cephalopods-<i>Nautilus</i>, <i>Sepia</i> & <i>Octopus</i></p> | 9 |
| 11 | <p>Phylum Echinodermata: General characters, classification up to classes with examples. Type study: Star fish– Morphology, digestive and water vascular systems. <i>Bipinnaria</i> and <i>Auricularia</i> larvae.</p> | 5 |
| 12 | <p>Phylum Hemichordata: General characters Type study: <i>Balanoglossus</i> – Morphology and Affinities of Hemichordata</p> | 2 |

B.Sc. ZOOLOGY PRACTICAL PAPER I

DIVERSITY AND FUNCTIONAL ANATOMY OF NON-CHORDATES

(15 practicals of 3 hrs, each = 45 hrs).

| | Title | Pr |
|---|--|----|
| 1 | Introduction to practicals- Microscopy-Laboratory handling of Compound & dissection microscope and stereoscopic microscopes. | 1 |
| 2 | Protozoa: Study of permanent slides – Study of <i>Entamoeba</i> , <i>Euglena</i> , <i>Noctiluca</i> , <i>Blattidium</i> , and <i>Elphidium</i> Temporary slide preparation and observation of protozoan culture. (<i>Amoeba</i> , <i>Euglena</i> , <i>Paramecium</i> , <i>Vorticella</i> , <i>Stentor</i>) and soil protozoans | 2 |
| 3 | Porifera: Specimen study: <i>Sycon</i> , <i>Hyalonema</i> , <i>Spongilla</i> . Permanent slides : spicules and gemmule. Temporary slide preparation and observation of spicules | 1 |
| 3 | Coelenterata Specimen study: <i>Physalia</i> , <i>Aurelia</i> , <i>Gorgonia</i> , <i>Fungia</i> , <i>Metridium</i> Permanent slides: study of T.S. of <i>Hydra</i> , <i>Obelia</i> colony, | 1 |
| 4 | Platyhelminthes & Nemathelminthes Specimen study – <i>Planaria</i> , <i>Fasciola hepatica</i> , <i>Taenia solium</i> , <i>Schistosoma</i> <i>Ascaris lumbricoides</i> , <i>Ancylostoma duodenale</i> . T.S of <i>Ascaris</i> | 1 |
| 5 | Annelida Specimen study: <i>Pheritema</i> , <i>Nereis</i> , <i>Sabella</i> , <i>Aphrodite</i> , <i>Hirudinaria granulose</i> . | 1 |
| 6 | Arthropoda Specimen study: <i>Penaeus</i> , <i>Sacculina</i> , <i>Scolopendra</i> , <i>Scorpion</i> , <i>Aranea</i> , <i>Lepisma</i> , <i>Gryllotalpa</i> , <i>Carausius</i> , butterfly, <i>Rhinoceros beetle</i> , <i>Cimex hemipterus</i> (bed bug), wasp . Permanent slides: Mouth parts cockroach & Mosquito | 2 |
| 7 | Mollusca Specimen study: <i>Chiton</i> , <i>Dentalium</i> , <i>Cypraea</i> , <i>Conus</i> , <i>Limnaea</i> , <i>Mytilus</i> , <i>Unio</i> , <i>Sepia</i> , <i>Octopus</i> , Permanent slides: <i>Glochidium</i> larva, Shells of <i>Xancus</i> , <i>Cypraea</i> , scallop, <i>Nautilus</i> and Cuttle bone. | 2 |
| 8 | Echinodermata Specimen study: <i>Astropecten</i> , <i>Ophiothrix</i> , <i>Echinus</i> , <i>Cucumaria</i> , <i>Antedon</i> , Slides of <i>Bipinnaria</i> & <i>Echinopluteus</i> larvae, Aristotle lantern, <i>Pedicellaria</i> Hemichordata – <i>Balanoglossus</i> , Slide of <i>Tornaria</i> larva | 2 |
| 9 | Demonstration of animations /model/pictures Mountings- Appendages of prawn, Mouth parts of Cockroach, mosquito, honey bee, Spiracles of cockroach (dead commercially available specimens) | 2 |


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B.Sc. Zoology Practical Paper 1
SCHEME OF PRACTICAL EXAMINATION

Duration : 3 Hrs.

Max. Marks : 40

- Q I. Mounting :A- Make temporary preparation & comment . 3marks
(A- Protozoan culture/mouth parts of mosquito)
B - Identify and comment 3 marks
(any one appendage of prawn, Identification & diagram 2 marks, description-1mark)
- Q II. Identify, classify and comment with labeled diagram of C , D,E,F, G, H, I &J8X3=24marks
(Identification 1/2 mark; classification 1/2 mark; Labeled diagram 1 mark, Description 1 mark).
- Q III . Viva Voce 05 marks
- Q IV. Class records 05marks
.....

Suggested Readings:

1. Barnes R.D. 1968. Invertebrate Zoology, 2nd Edn. Saunders Philadelphia.
2. Barrington, E.J.W.1967. Invertebrate structure and function. Neelson, London.
3. Hymann, L.H. 1940-67. The Invertebrate, Vol. I-IV. Mc Graw- Hill, New York.
4. Marshall, A.J. and Williams, W.D. (Eds.). 1995. Text book of Zoology – Invertebrates, B.S. Publishers.
5. Russell-Hunter, W.D. 1968. A biology of lower Invertebrates. Macmillan Company, New York.
6. Russell-Hunter, W.D. 1969. Biology of higher Invertebrate. Macmillan Company, New York.
7. Sedgewick Volumes
8. Parker and Haswel Vol. I
9. R. L. Kotpal Volumes Invertebrates
10. A Manual of Zoology by EkambarnathIyer andVishwanathan
- 11.Ruppert and Barnes, R.D. (2006). Invertebrate Zoology, VIII Edition. Holt Saunders International Edition.
- 12.Invertebrate Structure and Function Paperback– 2012 by Barrington E J W(Author)
- 13.Barnes, R.S.K., Calow, P., Olive, P.J.W., Golding, D.W. and Spicer, J.I. (2002).
- 14.Invertebrate Zoology - E. L. Jordan and Verma
- 15.Biology of Animals Vol-1- Ganguly, Sinha, Adhikari
16. Zoology for degree students- Dr. V.K. Agarwal
- 17.Anderson, D. T.: Invertebrate Zoology. 2e, 2001, Oxford Uty. Press
18. Integrated Principles of Zoology 17th Edition(2016) Cleveland Hickman

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CURRICULUM IN ZOOLOGY FOR B. Sc. (UG) II SEMESTER

THEORY: PAPER 2 : DIVERSITY AND FUNCTIONAL ANATOMY OF CHORDATES (60 Hours)

This paper deals with the diversity and anatomy of Chordates. This will help students to understand the diversity of various species among chordates. Students will learn general characteristics of different phyla from Protochordates to Mammalia along with specific type study. This paper also deals with comparative anatomy of vertebrates, and paleontological and evolutionary aspects.

| Units | TITLE | hrs |
|-------|---|-----|
| 1 | Introduction: General characters of Chordates, classification up to classes, origin of chordates(Combined theory . E.J.W. Barrington (1965)) | 3 |
| 2 | Protochordates: General characters of Sub-phylum Urochordata –Morphology of Ascidia, Ascidian tadpole and retrogressive metamorphosis. Distinctive features of Sub-phylum Cephalochordata –Amphioxus– Morphology, Structure of pharynx and feeding mechanism in <i>Branchiostoma</i> sp. | 4 |
| 3 | Subphylum Vertebrata: Division Agnatha – distinctive characters and classification upto classes. Cyclostomata – Petromyzon, Myxine general organization, Ammocoete larva and its significance. | 2 |
| 5 | Gnathostomata – General characters of PISCES, Chondrichthyes and Osteichthyes. Classification up to Classes. Type study : <i>Scoliodon</i> -Morphology, Digestive system, Respiratory system, Circulatory system, Central nervous system & Urinogenital system General study- Accessory respiratory structure in teleosts, Salient features of Dipnoi fishes. | 8 |
| 4 | Class Amphibia: General characters and classification of living Amphibians upto orders, with suitable examples. Paedomorphosis with special reference to Axolotl larva. Endemic anuran species of Western Ghats- <i>Nyctibatrachus</i> & <i>Nasikabatrachus</i> . Origin of tetrapod limbs. | 5 |
| 5 | Class Reptilia -General features and Classification up to order level. Snake venom, Poison apparatus of snakes and evolution of temporal fossae. | 5 |
| 6 | Class Aves – General characters and classification up to subclasses; distinctive features of Archaeornithes and Neornithes with reference to Paleognathae, Impennae and Neognathae with suitable examples; a brief account on forest, wetland and shore birds; adaptation to flight Beak and feet modifications in birds | 8 |
| 7 | Class Mammalia: – general characters and classification up to orders with examples; Distinctive features and distribution of Prototheria, Metatheria & Eutheria, Distinctive features of mammalian orders (Rodentia, Carnivora, Chiroptera, Cetacea, Proboscidea, Ungulata – Perissodactyla and Artiodactyla, and Primates –Platyrrhini and Catarrhini) with examples. Dentition in Mammals- Types, Dental formula of dog, cow and man, Type study – Rabbit – Morphology, digestive, respiratory, Central Nervous System, cranial nerves, urinogenital systems. | 9 |
| 8 | Comparative anatomy of vertebrates: – vertebrate integument and its derivatives Evolutionary trends in the structure of Heart, Brain, and Kidney of Shark, frog, Lizard, Pigeon and Rabbit. | 10 |
| 9 | Paleontology : An account of fossils, dating of fossils, conservation methods of fossils. Paleontology of Dinosaurs: Tyrannosaurus, Brontosaurus, Pterosaurs, Ichthyosaurs and Archaeopteryx. | 6 |

B.Sc. ZOOLOGY PRACTICAL PAPER II
DIVERSITY AND FUNCTIONAL ANATOMY OF CHORDATES
 (15 practicals of 3 hours each = 45 Hours).

| | | |
|---|--|----------|
| 1 | Sub-phylum Urochordata – Herdmanjia, Ascidian tadpole. Sub-phylum Cephalochordata – Amphioxus, T.S. of Amphioxus through Pharynx Cyclostomata – Petromyson, Myxine | Prs 1 |
| 2 | Pisces – Scoliodon, Narcine, sting ray, Rhinobatus, Pristis, Hippocampus, Synaptura, Echenis, Mackerel, Anabas, Ophiocephalus, Antennarius, Dipnoi fishes Mounting & temporary slide preparation of placoid, ctenoid, cycloid scales and Ampullae of Lorenzini. | 3 |
| 3 | Amphibia – Ichthyophis, Bufo, Ambystoma and Axolotl Larva, Necturus, Alytes, <i>Nasikabatrachus sahyadrensis</i> . | 1 |
| 4 | Reptilia – Bungarus, Calotes, Chameleon, Draco, Naja naja, viper, Hydrophis, Python, Green snake, Hemidactylus, Alligator, Chelone mydas, Sphenodon, Phrynosoma. Fossil models- Tyrannosaurus, Brontosaurus, Pterosaurs, Ichthyosaurs and Archaeopteryx | 3 |
| 5 | Aves –Owl, Penguin, Ostrich, Wood pecker, Duck, Kingfisher, Pigeon, Gypus bengalensis (Bengal vulture), Psittacula (parrot), <i>Milvus migrans</i> (black winged kite), Bubulcus ibis. | 2 |
| 6 | Mammalia: Echidna, Ornithorhynchus, Macropus, Whale, Dolphin, Pteropus, Loris, Porcupine Macaca mulatta, Funambulus palmarum, Rhinoceros, <i>Axis axis</i> . | 2 |
| 7 | Comparative Anatomy of Vertebrates – Heart & Brain of Shark, Frog, Pigeon and Rabbit | |
| 8 | Endoskeleton of Rabbit – Skull, vertebrae(atlas, axis & typical thoracic), girdles and limb skeleton | 1 |
| 9 | Demonstration of systems by animations /model/pictures Rat– digestive, respiratory system and urinogenital system | 1 |

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B.Sc. Zoology Practical Paper 2
SCHEME OF PRACTICAL EXAMINATION

Duration : 3 Hrs.

Max. Marks : 40

Q I. Mounting : Make temporary preparation & comment on A (Scales)..... 03marks

Q II. Demonstrate B (Demonstration model/Endoskeleton)..... 03marks

Q III. Identify, classify and comment with labeled diagram of C, D, E, F, G, H, I & J... 8x3=24marks
(Identification 1/2 mark; classification 1/2 mark; Labeled diagram 1 mark,
Description 1 mark- 6 specimens, 1 comparative anatomy and 1 from Paleontology).

Q IV. Viva – Voce

05 marks

Q V. Class records

05marks

Suggested Readings:

1. Kardong, K. V. (2005) Vertebrates Comparative Anatomy, Function and evolution. IV Edition. McGrawHill Higher Education.
2. Kent, G. C. and Carr R.K. (2000). Comparative Anatomy of the Vertebrates. IX Edition. The McGraw-Hill Companies.
3. Young, J.Z. (2004). The life of vertebrates. III Edition. Oxford university press.
4. Bhaskaran, K. K. & Biju Kumar, A.: Textbook of Zoology (Chordata), Manjusha
5. Dhani, P. S. & Dhani, J. K.: Chordate Zoology. R. Chand & Co
6. EkambaranathaAyyar, M. & Ananthakrishnan, T. N.: A Manual of Zoology. Vol. II Part I & II
7. Harvey Pough, F. et al.: Vertebrate Life. Pearson Ednlnc, Indian Edn
8. Jordan, E. L. & Verma, P. S.: Chordate Zoology S. Chand & Co, New Delhi
9. Kardong, K. V.: Vertebrates: Comparative Anatomy, Function and Evolution. 1995, WCB
10. Kotpal, R. L.: Modern Textbook of Zoology: Vertebrates. Rastogi
11. Romer, A. S.: The Vertebrate Body: 1992 reprint, Vakils, Fetteh & Simons, Bombay
12. Salim Ali: The Book of Indian Birds. BNHS, Oxford
13. Sedgewick Volumes
14. Parker and Haswell Vol. II
15. Comparative Anatomy by Romer

CURRICULUM IN ZOOLOGY FOR B. Sc. (UG) III SEMESTER

Theory: Paper III : Ecology, Ethology and Biodiversity (60 Hrs)

This paper deals with ecological components and systems, social organization of animals and diversity of animals. You will understand the principles, various processes and factors pertaining to ecosystem. In addition, you will understand the diversity of animals, their distribution and status with reference to India, and the behaviour of animals, their social organization, etc.

| | | |
|----|---|----|
| 1 | Concepts of Ecology & Environment: Definition-Environment, Ecology & Ecosystem; Environmental concepts - Atmosphere, Hydrosphere, Lithosphere & Biosphere, Environmental factors - Abiotic factors (Climate & Edaphic) & Biotic factors. Ecosystem :Concept, components, properties and functions; Ecosystem Processes - Energy flow in ecosystem and laws of thermodynamics, primary productivity, Biomass and productivity measurement, food chain, food web & ecological pyramids. | 8 |
| 2 | Animal relationships: Mutualism; commensalism; parasitism; ammensalism; predation and competition with relevant examples | 4 |
| 3 | Community ecology : community structure; ecological determinants; ecological stratification; ecotone and edge effect; ecological niches; concepts ecological succession; climax community | 3 |
| 4 | Limiting Factors - basic concepts- Lotbigs law of minimum, Shelford's law of tolerance, combined concept of limiting factors. Light and temperature as limiting factors. | 2 |
| 5 | Habitat Ecology : Marine habitat with zonation of sea, fresh water habitat: Lentic and Lotic systems; Terrestrial habitat - a brief account of forest and desert biomes; ecological adaptation of water and desert animals. | 4 |
| 6 | Population ecology: Properties of population- density, natality, mortality, age distribution, biotic - Potential- Allee's principle and Gause's principle, environmental resistance and carrying capacity, population growth forms, J and S shaped curves, emigration, immigration and migration, population fluctuation. | 4 |
| 7 | Environmental toxicology : Definition, scope and importance, Toxicants, Toxicity, LC50, LD50, classification of toxic agents. Biomagnification, Green house effects and global warming, sewage and sewage treatment. | 4 |
| 8 | Ecosystem monitoring - GIS (Graphic information system) role of remote sensing in ecology. (Global positioning system) GPS and its application and Ecosystem Modeling (Brief account only). | 3 |
| 9 | ETHIOLOGY -Types of animal behavior with example - innate behavior - reflexes, instinct, motivation; Learning behavior - habituation, imprinting, conditioned reflexes; insight learning; Aggression and territoriality; pheromones and behavior. | 4 |
| 10 | Social organization in animals : Honeybee (with communication),- Termites, Macaques and Elephant. | 3 |
| 11 | Animal migration : A) Migration in fishes - types, Anadromous and catadromous migration with salmon and Eel as examples. B) Migration in birds - Types/pattern, Methods of study, advantages, mechanics, preparation, orientation and navigation. | 5 |
| 12 | Courtship behavior : General principle, courtships of Three spined stickle back fish, Beta splendens, Frog, Peacock. | 2 |
| 13 | Parental care and Nesting behavior Parental care : In fishes - Hippocampus & Arius In amphibians - Ichthyophis&Rhinophorus In birds - Jacana & Penguin. | 2 |
| 14 | Nesting behavior - in Waver bird, bover bird & tailor bird | 2 |
| 15 | Biological clock - its nature, types and significance:Chronobiology in human health and diseases BIODIVERSITY : Levels of biodiversity — genetic, species, ecosystem level; number of species in different groups of animals — global, and India, Values of Biodiversity & Biodiversity hotspot-Western Ghats. Threats to Biodiversity, Man-wild life conflict, Biodiversity conservation and management: Conservation strategies: <i>in situ</i> , <i>ex-situ</i> , National parks, Sanctuaries and Biosphere reserves: Wild life conservation - Wildlife Protection Act, 1972, Role of Government and Non-Governmental organizations in wild life conservation. International efforts : Convention on Biological Diversity (CBD), International Union for Conservation of Nature and Natural Resources (IUCN), Convention for International Trade of endangered species, RAMSAR, Red data book, & endangered fauna of India. | 10 |

B.Sc. ZOOLOGY PRACTICAL PAPER III

Ecology, Ethology and Biodiversity (15 practicals of 3 Hrs each)

Ecology:

10 practicals

1. pH of water samples
2. pH of soil samples
3. Estimation of dissolved CO₂ of water samples
4. Estimation of dissolved O₂ of water samples (Winkler's method)
5. Estimation of dissolved chlorides of water samples
6. Visit to a pond for the study of ecosystem: Collection and observation of planktons and consumers
7. Estimation of total hardness in water samples

8. Animal relationships :

- for Mutualism – hermit crab and sea anemone; Trichonympha and termite
- for commensalism – sucker fish and shark; Chaetopterus and crab
- for parasitism – Ascaris, Sacculina on crab, leech, mosquito
- for predation- insect and frog; rat and snake
- for ammensalism – Penicillium, Microcystis
- for competition – squirrel and bird;

Ethology :

2 practicals

9. Eel, Ichthyophis, Male Hippocampus, Rhacophorus, termites and honey bee colony.
10. Nesting patterns of Tailor bird and Weaver bird.

Biodiversity:

3 practicals

11. Endangered fauna of India- Slender Loris, Pangolin, Python, Great Indian Bustard, Varanus, Gharial, Horn bill, Musk deer, Green sea turtle.
12. Visit to wildlife sanctuary/safari/Nature camp (Field visit report in record)

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B.Sc. ZOOLOGY PRACTICAL PAPER III
SCHEME OF PRACTICAL EXAMINATION

Duration: 3 Hours

Max. Marks: 40

Q 1. Identify and comment on the given specimens **A and B.** (from Biodiversity) 2x3= 6 marks

Q 2. Identify and comment on **C,D** (Ethology), **E&F**(Animal relationships) 4x3=12 marks

Q 3. Estimate the quantity of dissolved CO₂/O₂/ Cl₂ / total hardness in given sample **G.** (Principle-1mark, Requirement-1, Procedure-2, Observation and report -4 marks) 8 marks

Q 4. Find the pH of the soil/water samples **H and I.** 2 marks

Q 5. Identify and comment on **J** (pond ecosystem) 2 marks


Q 6. Viva Voce. 5 marks

Q 7. Class records 5 marks

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Suggested Readings:

1. Animal behaviour by Alock(2013)
2. Survival strategies by R. Gadakar(1997)
3. Introduction to Animal behaviour by Manning A. & M.S.Dawkins(2012)
4. Animal Behaviour by Robert A(1966) 17
5. Learning and instinct in animals by Thorpe(1956)
6. Ethology bu Reena Matur(1998)
7. Ecology by Charles J. Krebs(2009)
8. Fundamentals of Ecology by Eugene P. Odum(1953)
9. Elements of Ecology by Clarke(2015).


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CURRICULUM IN ZOOLOGY FOR B. Sc. (UG) IV SEMESTER

THEORY : PAPER IV : ANIMAL PHYSIOLOGY, BIOCHEMISTRY AND BIOSTATISTICS (60 Hrs)

This paper teaches you the physiological processes, mechanisms which control the various physiological processes, various systems organization, endocrine glands and their hormonal secretions, Fundamentals of Biomolecules and their structure and functions. In addition, you will understand the essential statistical methods used in biology.

| | | |
|----|---|----|
| 1 | Osmoregulation in animals: Types, osmoregulation in shark, marine & fresh water teleosts, kangaroo rat and camel. | 2 |
| 2 | Digestion : Mechanism of digestion; chemical digestion and absorption of carbohydrates, proteins and lipids ;nervous and hormonal control of digestion balanced diet, nutritional disorders - PEM, deficiency of iron, iodine and calcium, lifestyle diseases, role of fibres and probiotics. | 4 |
| 3 | Respiration : external and internal respiration; respiratory pigments (Hb, haemocyanin, haemoerythin); Physiology of respiration — exchange of gases transport of oxygen — oxygen dissociation curve, Bohr effect; transport of CO ₂ -chloride shift, respiratory quotient. | 3 |
| 4 | Circulation : types of circulation & hearts, Blood - Composition and functions, mechanism of blood clotting, disorders of blood clotting, anticoagulants, heartbeat, conducting system and pace maker, control of cardiac activity, electrocardiogram, angiogram, angioplasty. | 4 |
| 5 | Excretion: Nitrogen Excretion in animals, Ammonotelism, Urotelism, Uricotelism, Guanotelism; Vertebrate Kidney - Function and regulation of vertebrate kidney; osmotic and Ionic Regulation. | 3 |
| 6 | Nervous System : Nerve Cells; Types, Structure of Multipolar neurons ; Nerve Impulse ; Membrane Potential ; Action Potential, Conduction of nerve impulse ; Synaptic Transmission, Neurotransmitters, Neurodegenerative disorder ; Alzheimers diseases. | 7 |
| 7 | Human endocrine glands - pituitary, thyroid, parathyroid, pancreas, adrenal, testes, ovaries and placenta ; hypothalamus and its stimulatory and inhibitory effects ; effects of hypo and hypersecretion of various hormones in human. | 4 |
| 8 | Muscle physiology : types of muscles ultra structure of Vertebrate Skeletal Muscles, Mechanism and control of Muscle Contraction. Properties of muscles :- Twitch, Tetanus, tone summation, all-or-none, principle and muscle fatigue. | 4 |
| 9 | Thermoregulation in animals: Effects of temperature, Acclimation and Acclimatization; Temperature Regulation in Poikilotherms and Homeotherms ;Hibernation, Aestivation, and daily torpor, Behavioural and Physiological Adjustments: Heat Production, Heat Loss, Heat Exchanges, Regulatory Mechanisms. | 3 |
| 10 | Sense organs : Classification of sense organs; structure and physiology of ear ; eye of mammal; BIOCHEMISTRY : Carbohydrates: Structure and Biological importance: Monosaccharides, Disaccharides, Polysaccharides and Glycoconjugates. Glycolysis, Krebs Cycle, ETS, Gluconeogenesis, Glycogenesis. Lipids : Structure, classification and biological importance of saturated and unsaturated fatty acids, Tri-acylglycerols, Phospholipids, Glycolipids, Steroids. Proteins: Amino acids: Types and Biological importance of amino acids. Proteins: structure (Pri., Sec., ter., and quat.), and Biological importance with examples, fibrous and globular proteins. | 10 |
| 11 | Enzymes : Definition, Classification (IUB system); Mechanism of enzyme action; specificity of enzymes; reversibility of enzyme action; Enzyme kinetics; Factors affecting rate of enzyme-catalyzed reactions; Derivation of Michaelis-Menten equation, Concept of Km and Vmax, enzyme inhibitors; A brief account of coenzymes cofactors; clinical importance of enzymes | 4 |
| 12 | Vitamins : Definition, Classification and Biological importance and deficiency Symptoms. | 3 |
| 13 | BIOSTATISTICS: Introduction, Variable and attributes; Sampling methods: Qualitative sample, Quantitative sample, Random sample, Non random samples. Arrangement of data; Frequency distribution. Graphical presentation of data: Line diagram; Bar diagram; Pie chart; Histogram. Measures of central tendency: Arithmetic mean, Mode; Median. Measures of dispersion: Variance; Standard deviation; Standard error of mean. | 10 |

B.Sc. ZOOLOGY PRACTICAL PAPER IV

IV semester : Practical Paper 4: Physiology, Biochemistry and Biostatistics. (15 practicals of 3 Hours each).

Physiology & Biochemistry:

- | | |
|---|--------------|
| 1. Total RBC count | 2 practicals |
| 2. Total WBC count | 1 practical |
| 3. Differential count of WBC | 1 practical |
| 4. Estimation of Hb | 1 practical |
| 5. Estimation of bleeding and clotting time | 1 practical |
| 6. Preparation of Haemin crystals | 1 practical |
| 7. Estimation of protein by colorimetric test | 1 practical |
| 8. Sense organs: Structure of Ear and Eye of Mammals | 1 practical |
| 9. Types of Muscles slides – simple, striated and cardiac | 1 practical |
| 10. Commenting on the vitamins present with deficiency diseases | 1 practical |

Vitamin A – Amaranthus leaves & Carrot

Vitamin B₁ & B₂ – Rice bran, Yeast

Vitamin C – Citrus fruits, Banana

Vitamin D – Milk & Fish liver oil

Vitamin E – Germinating seeds

Vitamin K – Cabbage and Spinach

- | | |
|--|-------------|
| 11. Qualitative detection of following; Glucose- Benedict's test Starch -Iodine test Proteins - Biuret test | 1 practical |
| 12. Qualitative detection of Nitrogenous wastes; Ammonia - Nessler's reagent test ; Urea - Urease test Uric acid - Folin's uric acid reagent test; Creatinine - Jaffe's test | 1 practical |

Biostatistics:

- | | |
|---|-------------|
| 13. Construction of graphs using the given data- Histogram, Bar diagram, Pie diagram and Line diagram. | 1 practical |
| 14. Measuring central tendency using the given data. Mean, Mode and Median | 1 practical |

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B.Sc. ZOOLOGY PRACTICAL PAPER IV

SCHEME OF THE PRACTICAL EXAMINATION

Duration: 3 Hours

Max. Marks: 40

- Q 1. Conduct the experiment and report. (by lot). 10 marks
(Principle-2marks, Requirement-1, Procedure-3, Observation and report -4 marks)
- Q 2. Conduct qualitative detection test for samples 2X3=6 marks
a) (proteins/starch/glucose) b) (Nitrogenous wastes)
- Q 3. Identify and comment on **A, B and C** 3X3= 9marks
(A-Sense organs /types of muscles, B & C vitamin samples)
- Q 4. Biostatistics:
Construct a graph using the given data (Line/Bar/Pie/Histogram) 5 marks
/Measure of central tendency.
- Q 5. Viva voce. 5 marks
- Q 6. Class records. 5 marks.

REFERENCE BOOKS:

1. Lehninger principles of biochemistry Albert L. Lehninger
2. Complete guide to vitamins, minerals, nutrients & supplements H. Winter Griffith
3. Biostatistics by Khan and Khannum(1994).
4. Elements of Biostatistics by Prasad(2016)
5. Animal Physiology by Hoar(1966)
6. Review of Medical Physiology by Ganong(2012)
7. Human Physiology by A.C. Guyton(2006)
8. Animal Physiology by Randol(2001)
9. Animal Physiology by P.S. Verma

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CURRICULUM IN ZOOLOGY FOR B. Sc. (UG) V SEMESTER

V SEMESTER THEORY: PAPER 5.1 : CELL BIOLOGY, MICROBIOLOGY AND IMMUNOLOGY(25+10+10=45hrs)

| Units | TITLE | hrs |
|-------|--|-----|
| | CELL BIOLOGY | |
| 1.1 | Ultra structure of animal cell and cell organelles Plasma membrane: structure - Fluid mosaic model, role of lipids in maintaining fluidity of cell membrane. Cell to cell interactions, surface markers, functions and Cell junctions. Ribosomes - different types, subunits, functions. Centrioles and basal bodies- structure and functions. Cytoskeleton- microtubules, microfilaments and intermediate filaments- structure and functions | 10 |
| 1.2 | Chromatin: organization of chromatin, Euchromatin and Heterochromatin , packaging (nucleosome), Metaphase chromosome, polytene and lampbrush chromosomes. | 3 |
| 1.3 | Cell Divisions: Cell cycle G1, S, G2, and M phases & (G0); and Cell cycle regulation. Amitosis, endomitosis, Mitosis-Stages, mitotic apparatus; role of mitotic inhibitors. Meiosis- Stages (Meiosis I stages only), synaptonemal complex and mechanism of crossing over & its significance. Significance of Mitosis and Meiosis | 5 |
| 1.4 | Cancer biology: types; characteristics of cancer cells, tumors, dedifferentiation of cancer cells, oncogenes and tumor suppressor genes. carcinogenesis, Carcinogenic agents (physical, chemical and biological); immunotherapy. Apoptosis. | 7 |
| 2.1 | MICROBIOLOGY Architecture of bacteria and virus. Nutritional requirements in bacteria and nutritional categories, different types of cultural media Microbial replication strategy: bacteria and virus (lytic, lysogenic cycle). Genetic recombination in bacteria: basic concept of transformation, conjugation, and transduction. Microbial interactions-Symbiosis, commensalism. Mutualism between microbes, microbes and plants, microbes and animals. A brief account of Microbial diseases in man -viral – chicken pox, measles, herpes, hepatitis;; bacterial – diphtheria, pneumonia; fungal –aspergillosis, candidiasis. | 10 |
| 3.1 | IMMUNOLOGY Definition, types of immunity; Innate, and acquired immunity, primary and secondary lymphoid organs(Thymus and lymph nodes); types of immune cells, T & B cells and their functions; , antigens, antigenicity , various forms of antigen- antibody reaction, MHC molecules, immunoglobulins :classification, structure& functions of IgG, Hypersensitivity-allergens, Allergy-causes and types Immune response during bacterial (tuberculosis), parasitic (malaria) and viral (HIV) infections, vaccines –attenuated, heat killed and toxoids with examples Monoclonal antibodies. | 10 |

CURRICULUM IN ZOOLOGY FOR B. Sc. (UG) V SEMESTER

V SEMESTER THEORY: PAPER 5.2 APPLIED ZOOLOGY, HISTOLOGY AND BIOTECHNIQUES (30+10+05=45hrs)

| Units | TITLE | hrs |
|-------|---|-----|
| | APPLIED ZOOLOGY | |
| 1.1 | Parasitology - Host-parasite Relationship, Definitive host, Intermediate host, Life history and pathogenicity of <i>Entamoeba histolytica</i> & <i>Schistosoma haematobium</i> . | 4 |
| 1.2 | Insect vectors: Classification & adaptations of Insect vectors, Insects of Medical Importance : Effects and control of <i>Anopheles</i> , <i>Culex</i> , <i>Aedes</i> , <i>Xenopsylla cheopis</i> Insect pests: Effects and Control of <i>Sitophilus oryzae</i> , <i>Achaea janata</i> , <i>Pyrilla perpusilla</i> , & <i>Callosobruchus chinensis</i> | 5 |
| 1.3 | Apiculture: Species, Honey bee morphology and structural adaptations ,Modern methods of bee keeping, economic importance of honey, bee wax & venom; a note on formation of honey& its chemical composition . | 4 |
| 1.4 | Lac culture: Lac cultivation & processing and uses of lac | 1 |
| 1.5 | Vermiculture : Indigenous and exotic Species of earthworms– epigeic, endogeic and anecic species . Methods of vermicomposting.. | 2 |
| 1.6 | Sericulture: Mulberry and Non-mulberry silk worms, Life cycle of <i>Bombyx mori</i> . Silk proteins and structure of silk gland. Mulberry silkworm rearing (Chawki and adult worm rearing). | 3 |
| 1.7 | Poultry: Scope, Poultry breeds, Rearing of broilers and layers and poultry diseases(Nutrition deficiency, Bacterial, viral, protozoan , Helminthes and ectoparasites) | 3 |
| 1.8 | Dairy farming: Breeds of Cattle, Collection, processing, preservation and marketing of milk. Cattle breeding techniques: Artificial insemination, Super ovulation and embryo transplantation. | 3 |
| 1.9 | Aquaculture Culturing of Indian major carps and Induced breeding technique, Rearing of ornamental fishes , Culturing of Indian fresh water prawn and Fresh water pearl culture | 5 |
| 2.1 | HISTOLOGY of mammalian organs: Histological structure and functions of Liver, Intestine, Pancreas, Spleen, Kidney, Pituitary, Thyroid , Adrenal glands, testis and ovary. Histochemistry: stains and staining – Types: natural and synthetic dyes, mordents and their mode of action. Immuno-histochemical staining methods. ,Histopathology -Degenerative changes and histopathological manifestations in liver cirrhosis and nephrosis. | 10 |
| 3.1 | BIO-TECHNIQUES Microtechnique: – fixation, embedding, microtomy, staining (simple and differential) and mounting Immuno assay: Principle and applications. Separation techniques: Principle and applications of Centrifugation. Principle and applications of spectrophotometry, Electrophoresis(gel electrophoresis) and Chromatography(Paper chromatography) . | 05 |

B.SC. ZOOLOGY SEMESTER V – PRACTICAL 5.1

CELL BIOLOGY, MICROBIOLOGY, APPLIED ZOOLOGY, HISTOLOGY & BIO-TECHNIQUES

- 15 practicals

1. Study of Mitosis : permanent slides for different stages
2. Study of Meiosis : permanent slides for different stages
3. Preparation of Onion root tip squash and observation of stages of mitosis
4. Preparation of Grasshopper testis squash and observation of stages of meiosis
5. Study of salivary gland chromosomes and lamb brush chromosomes
6. Micrometry: measuring of microscopic objects by using stage micrometer & oculometer
7. Study of mouth parts and sting apparatus of honey bee.
8. Study of life cycle of Bombyx mori, Silk glands, Mulberry & Non-mulberry cocoons
9. Study of Indian major carps – Catla, Mrigal & Rohu.
10. Study of By-products of Poultry, Dairy & Aquaculture
11. Study of histological details with a note on physiology of the following mammalian organs –
Intestine, Liver, Pancreas, Spleen, Kidney, Testis, Ovary and Adrenal
12. Gram staining of bacteria
13. Principle and applications of Centrifuge, Spectrophotometer, Gel electrophoresis & chromatography.

B.SC. ZOOLOGY PRACTICAL PAPER 5.1 -SCHEME OF PRACTICAL EXAMINATION

Time : 3 hrs.

Max.marks : 40

- Q I Make squash preparation of Onion root tip/ Grass hopper testis/
Measurement of cell organelle by micrometry / gram staining (by lot) 6marks
- Q II Identify with reasons A(from mitosis) B (from meiosis) & C(Giant chromosome) 3x2=6marks
- Q III Comment on D , E ,F & G (Apiculture, Sericulture, Aquaculture & Byproducts) 4x2=8marks
- Q IV Identify and comment on the slides H & I (histology slides) 2x3=6marks
- QV Comment on J (Instrument) 4marks
- Q VI Viva voce 5marks
- Q VII Class records 5marks

B.SC. ZOOLOGY SEMESTER V – PRACTICAL PAPER- 5.2

PROJECT WORK

Batches consisting of 4 -6 students each are formed. They are given a suitable project work by the Zoology faculty in-charge of the batch. Each batch should conduct survey/observations/experiments and submit the report on the project under the guidance of Zoology faculty. The project work should concentrate on the problems /animals of surrounding area pertaining to zoology. Each batch should work as a team with suitable coordination among them. A copy of project report must be submitted to the department.

PRACTICAL PAPER 5.2-SCHEME OF PRACTICAL EXAMINATION

Project work and report

Time: 3 hrs.

Max. marks : 40

Q I Project submission:

Title and Objectives (about 100 words) should be mentioned clearly in answer book 20 marks

Q II Seminar / Presentation

15 marks

Q III Viva voce / Discussion

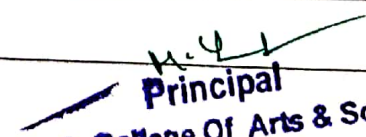
5 marks


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CURRICULUM IN ZOOLOGY FOR B. Sc. (UG) VI SEMESTER

THEORY: PAPER 6.1 GENETICS, MOLECULAR BIOLOGY AND EVOLUTION (18+12+15=45hrs)

| Units | TITLE | hrs |
|-------|--|-----|
| | GENETICS | |
| 1.1 | Mendel's laws of inheritance, Incomplete dominance, Interaction of genes: Supplementary factor 9: 3: 3:1- comb pattern in fowl, Dominant epistasis 13:3- plumage color in Leghorn, Recessive epistasis 9:3:4-coat color in pigs, Polygenic inheritance- skin color of man. Lethal genes - coat color in mice . Co-dominance, Multiple alleles- ABO blood groups of man ; Rh factor; Isoalleles; Pseudoalleles and position effect. | 8 |
| 1.2 | Sex-linked inheritance: eye color in Drosophila and haemophilia and colorblindness in man; Y- linked genes. Inheritance of sex influenced and sex-limited characters inheritance. Pleiotropy , Sex determination system-XX-XY, XX-XO, ZW-ZZ. Genic balance theory & gynandromorphs | 4 |
| 1.3 | Linkage, Crossing Over and Chromosomal Mapping, Recombination frequency, two factor and three factor crosses. | 2 |
| 1.4 | Mutations: Types of mutations (spontaneous & Induced with examples), Detection of induced mutations by CIB technique Hereditary diseases in man: Autosomal (Down's syndrome), sex chromosome(Turner's & Klienfelter's syndromes), Diseases due to mutation-Sickle cell anemia. | 3 |
| 1.5 | Concept of gene: Units of gene(Cistron, Recon & muton), split genes and jumping genes . | 1 |
| 2.1 | MOLECULAR BIOLOGY Nucleic acid : chemistry; Watson and Crick model of DNA; forms of DNA and types of RNA DNA Replication: DNA Polymerases, mechanism of replication in prokaryotes & eukaryotes Transcription: RNA polymerases and mechanism of transcription in prokaryotes & eukaryotes, Processing of eukaryotic pre mRNA. | 8 |
| 2.2 | Translation: Genetic code, Properties of the genetic code and Wobble Hypothesis; Process of Protein synthesis –translation process. Gene regulation: positive and negative regulation, activators, repressors, enhancers, silencers and promoter elements. | 5 |
| 3.1 | EVOLUTION Theories of Organic evolution : Lamarckism , Drawin-wallace theory of natural selection, Synthetic theory of evolution – Gene mutation, gene flow, genetic drift, isolation, and Natural selection, types of selection. Hardy-Weinberg's Equilibrium Evidences of Organic evolution: Evidences from comparative anatomy & biochemistry. Biogenetic law & embryological evidences | 7 |
| 3.2 | Speciation- concept of species- Allopatric, sympatric, peripatric and parapatric Speciation; Reproductive isolation- pre and post zygotic isolation mechanism Polymorphism: transient and balanced | 3 |
| 3.3 | Evolution of horse and man using fossil data. | 4 |


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CURRICULUM IN ZOOLOGY FOR B. Sc. (UG) VI SEMESTER

THEORY: PAPER 6.2 DEVELOPMENTAL BIOLOGY AND ANIMAL BIOTECHNOLOGY (27+18=45hrs)

| Units | TITLE | hrs |
|-------|---|-----|
| | DEVELOPMENTAL BIOLOGY | |
| 1.1 | Gametogenesis; spermatogenesis & structure of mammalian sperm. Oogenesis, structure of mammalian ovum. Types of eggs: Based on amount of yolk and distribution of yolk with examples. Mosaic and regulative eggs, Cleidoic egg and its significance. | 3 |
| 1.2 | Fertilization: Definition, Types, Mechanism of fertilization and significance. Parthenogenesis :. Definition. , Natural parthenogenesis (arhenotoky and thelytoky) , Artificial parthenogenesis and Significance of parthenogenesis. | 4 |
| 1.3 | Patterns of cleavage – radial, biradial, spiral and bilateral cleavage with examples. Influence of yolk on cleavage. | 2 |
| 1.4 | Blastulation: Comparative account with reference to Frog and Chick. | 2 |
| 1.5 | Fate maps- Presumptive organ forming areas and fate maps in Frog and Chick. | 1 |
| 1.6 | Gastrulation in Chick upto primitive streak.. Foetal membranes of chick – development; structure and function of foetal membranes | 3 |
| 1.7 | Role of organizers in development: Transplantation experiments of Spemann and Mangold, Chemistry of Organiser. | 2 |
| 1.8 | Placenta: Types - Yolk sac and Chorio-allantoic placentation. Deciduate and non deciduate placenta; morphological and histological placental types with suitable examples | 2 |
| 2.1 | Regeneration: Definition and types – morphollaxis and epimorphosis with examples. Regeneration in Planarians | 2 |
| 2.2 | Reproductive cycles: Oestrous and Menstrual cycles and their regulation. | 2 |
| 2.3 | Early development of Human foetus : fertilization; morula; blastocyst; implantation; placenta; twins and multiple births , Assisted reproductive techniques . Sexually transmitted diseases and prevention. | 4 |
| 3.1 | ANIMAL BIOTECHNOLOGY Genetic engineering: Introduction, scope and basic concept of genetic engineering. Enzymology of genetic engineering: Restriction enzymes; DNA ligase; Polymerases | 2 |
| 3.2 | Cloning vectors: Plasmids, phage vector, cosmids, shuttle vectors and artificial chromosomes as vectors | 3 |
| 3.3 | Introducing cloned genes in to the host cells: Transformation, Transduction, Particle gun; electroporation; liposome mediated method. | 2 |
| 3.4 | Restriction enzyme analysis; Southern blotting; Northern blotting; <i>in-situ</i> hybridization; RFLP; AFLP; RAPD; DNA finger printing and PCR. | 6 |
| 3.5 | Production of cloned and transgenic animals: Methods of Gene transfer-Nuclear Transplantation, Retroviral Method, DNA microinjection Applications of transgenic animals and knockout mice. | 2 |
| 3.6 | DNA sequencing: Sanger method Genome, Human genome project, genomics & proteomics. | 3 |

B.Sc ZOOLOGY SEMESTER VI – PRACTICAL 6.1 (15 practicals of 3 hrs each)
GENETICS, MOLECULAR BIOLOGY AND EVOLUTION

1. Genetic problems : Dihybrid ratio(One animal and one human); Sex linkage – eye color in Drosophila & color blindness in man; Construction of pedigree charts for haemophilia
2. Study of blood groups (ABO & Rh) with special reference to mode of inheritance; Identification of blood groups and problems on inheritance of blood groups (3 problems)
3. Preparation of Buccal smear for sex chromatin
4. Drosophila study:
 - a) Culture of Drosophila
 - b) Identification of male and female flies
 - c) Study of life cycle
 - d) Mounting of sex comb
 - e) Study of mutants
5. Isolation of DNA from any tissue.
6. EVOLUTION i).Study of Homologous organs: Fore limb bones of terrestrial Vertebrates (Frog& Bird) ii). Study of Analogous organs: Wing of Insect and Bird iii). Study of Vestigial organs: Appendix and Molar tooth. iv) Study of Connecting links: Peripatus and Tornaria larva. v) Study of living fossils: Limulus & Sphenodon vi) Problems related to calculation of allelic frequency using Hardy-Weinberg Equilibrium (at least 3 problems).

PRACTICAL PAPER. 6.1
SCHEME OF PRACTICAL EXAMINATION

Time : 3 hrs.

Max. marks : 40

- | | |
|--|------------|
| Q I Identify the blood group (ABO & Rh) / prepare sex comb of Drosophila /Isolation of DNA /Buccal smear staining for sex chromatin (by lot) | 7marks |
| Q II Identify with reasons A & B (any two from three below) [i] from egg, lava, pupa, male and female Drosophila [ii] from Drosophila mutants (any one) | 2X3=6marks |
| Q III Genetic problem (two problems) marks | 2X4=8 |
| Q IV Comment on C, D (Specimens related to evolution) & E (allelic frequency Problem) | 3X3=9marks |
| Q V Viva voce | 5marks |
| Q VI Class records | 5marks |

B.Sc ZOOLOGY SEMESTER VI – PRACTICAL 6.2(15 practical of 3 hrs each)

DEVELOPMENTAL BIOLOGY AND ANIMAL BIOTECHNOLOGY

1. Early development of Frog: Cleavage, Blastula, Gastrula and Neurula.
2. Development of Chick: 18 hrs, 24 hrs, 48 hrs and 72 hrs incubation stages
3. Human embryology: T.S of testis & ovary; Structure of mature sperm & Graafian follicle .
4. Application of DNA Fingerprinting in criminology (photograph of electrophoretic pattern to be given for interpretation by the students)- at least four problems worked out in record.
5. Construction of restriction maps from the data provided.
6. Study of Cloning vectors: pBR 322, pUC18, Phage vector, Cosmid, Shuttle vector
7. Study of Genetic Engineering techniques through photographs i) Southern Blotting ii) Northern Blotting iii) DNA Sequencing (Sanger's Method) iv) PCR v) RAPD vi) RFLP
8. Visit to Biotechnology lab/ company.

**PRACTICAL PAPER. 6.2
SCHEME OF PRACTICAL EXAMINATION**

Time : 3 hrs.

Max. marks : 40

- | | |
|---|--------------|
| Q I Identify with reasons A&B (Frog embryo stages) C& D (Chick embryo stages) and E (Human) | 5x3=15marks |
| Q II DNA finger print analysis of given photograph | 3 marks |
| Q III Comment on F (cloning vector); G & H (GE techniques) | 3X4= 12marks |
| Q IV Viva-voce | 5marks |
| Q V Class records | 5marks |

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Suggested Readings:

1. Parasitology (Protozoology and Helminthology) – K. D. Chatterjee, Chatterjee Medial Publishers.
2. Economic Zoology by Shukla and Upadayana(2016).
3. Economic Zoology by Recna and Mattur(2006).
4. Cell biology by C.B. Power Vol I and II(2010)
5. Cell biology by Tomer(2005)

6. Cellular and Molecular Biology Rastogi publication(2017)
7. Bloom and D. Faweett. Text book of histology. 10th Ed.
8. Janis Kuby. 1997. Text book of Immunology. 3rd Ed.
9. Histology by Bailey(1975) 10. Histology by Bevelander(1979)
11. Histology by Ham(1987)
12. Histology by Berry(2015)
13. Genetic Engineering by Sandhya Mitra(2015)
14. Gene cloning by Brown(2016)
15. Molecular biotechnology by Sathyanarayana U(2008)
16. Biotechnology by S.S. Purohith(2012)|
17. Transgenic animals by M.M.Ranga(2006)
18. Animal Biotechnology by M.M. Ranga(2007)
19. Molecular Biotechnology by Chennarayappa(2007)
20. Human Genetics by Mange and Mange(1993)
21. Principles of Genetics by Robert H Tamarin Ta Ta McGraw- Hill pub(2004).
22. Genetics by Monroe W. Strickberger , Mac Millan Pub(2008)
23. Introduction to Embryology by Balinsky B.L.(1970)
24. Development by Beril N J and Karpotata(1978)
25. Developmental biology by Gilbert(2016)
26. Embryology by Gilbert and Raunio(1997)
27. Embryology by Barath 6. Chick Embryology by Patten(1971)
28. Gilbert, S.F. 2006. Developmental Biology (9th edn).

29. Gardner. J.E., Simmons, J.M and D.P. Snustad. 2007. Principles of Genetics (8th edn)..
30. Griffiths et al., 2002. Modern Genetic Analysis. W.H. Freeman, NY, USA.
31. Hartl, L.D., and E.W. Jones. 2009. Genetics: Analysis of Genes and Genomes (7th edn).
33. Herskowitz I.H, 1977. Principles of Genetics . Collier Macmillan.
34. Lewin B, 2008 . Genes (9th edn). Jones and Barlett Publishers Inc.
35. Klug, W.S. and Michael R. Cummings, 2009. Concept of Genetics.
36. Molecular Biology of Gene (5th edn.). Pearson Education Inc.
37. Systems Biology-Definitions & Perspectives.
38. Attwood T.K. and Parry Smith, D. 2006. Introduction to Bioinformatics. Pearson Education.
39. Bourne P. E and Weissig H, 2003. Structural Bioinformatics. Wiley -Liss. USA
40. Ghatak K.L. 2011. Techniques and Methods in Biology. PHI Learning Pvt. Ltd. New Delhi
41. Gupta A. 2009. Instrumentation and Bio-Analytical Techniques. Pragati Prakashan, Meerut.
42. Cooper, G.M. and Hausman, R.E. 2009. The cell: A Molecular Approach
43. Arora, D.R. and Arora, B. 2008. Text Book of Microbiology. CBS Publishers
44. Chakraborty, P. A. 2009. Text Book of Microbiology. New Central Book Agency.
45. Das, H.K. 2007. Text book of Biotechnology. Wiley India Pvt. Ltd.
46. Singh .B.D. 2006. Biotechnology. Kalyani Publishers, New Delhi.
47. Essentials of Biotechnology. Ane Books Pvt. Ltd.!
48. Ivan M. Roitt, 2002. Essential of Immunology. ELBS, New Delhi.
49. Khan. F.H. 2009. The Elements of Immunology. Pearson Education.
50. Richard Coico and Geoffrey Sunshine. 2009. Immunology: A short course.
51. C.B.L. Srivastava, Fish Biology, Narendra Publishing House
52. K. D. Chatterjee (2009). Parasitology: Protozoology and Helminthology. Knobil, E. et al. (eds). The Physiology of Reproduction. Raven Press Ltd.
53. Griffiths, A.J.F., J.H. Miller, Suzuki, D.T., Lewontin, R.C. and Gelbart, W.M. (2009).


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Q.P.Code-.....

Theory Question paper pattern

SEMESTER B.Sc. DEGREE EXAMINATION May/Nov 201-
Semester scheme
ZOOLOGY

Time : 3 Hours

Max. Marks : 50

Instructions to the candidates:

1. Draw labeled diagrams wherever necessary
2. All questions are compulsory

I. Answer any **FIVE** of the following questions:

- 1.
- 2.
- 3.
- 4.
- 5.
- 6.
- 7.

5x2=10 marks

II. Explain briefly any **FOUR** of the following:

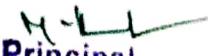
- 8
- 9
- 10
- 11
- 12
- 13

4x5=20 marks

III. Answer any **TWO** of the following :

- 14
- 15
- 16

2x10=20 marks


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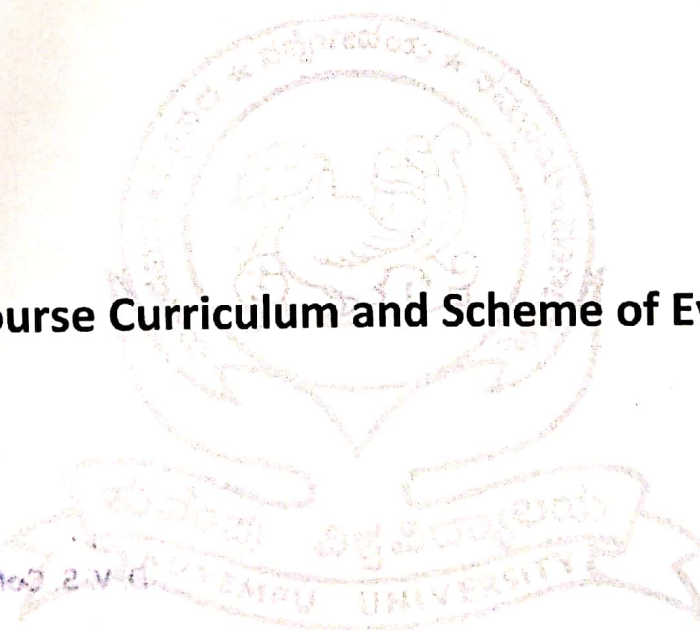


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B.Sc., BOTANY PROGRAMME

Course Curriculum and Scheme of Evaluation



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