

ZOO-101
PRINCIPLES OF CLASSIFICATION, ZOOGEOGRAPHY
& PALEOZOLOGY

75 Marks
100 lectures

PRINCIPLES OF CLASSIFICATION

UNIT1. CLASSIFICATION

20 lectures

15marks

1. Classification of animals –historical account.
2. Species concept.
3. Taxonomy and systematic,
4. Taxonomic hierarchy.

Unit 2. Code and approaches in Taxonomy

30 lectures

20 marks

1. International Code of zoological Nomenclature .
2. Concepts of chemotaxonomy and numerical taxonomy .
3. Approaches in taxonomy: morphometric and cytological techniques.
4. Basic concept of molecular techniques in taxonomy

ZOOLGEOGRAPHY & PALAEOZOLOGY

Unit 3. Zoogeography

25 lectures

20 marks

1. Zoogeographical regions of the world with characteristic fauna .
2. Marine realm and characteristics .
3. Barriers –types and significance ;
4. continental drift .
5. Discontinuous distribution

Unit 4. Palaeozoology

25 lectures

20 marks

1. Fossils and fossilization,
2. types of fossils;
3. trace fossils and living fossils.
4. Dating of fossils,
5. significance of fossils.
6. Geological time scale and associated fauna.

RECOMMENDED BOOKS

- 1.Darlington, P.J. The Zoogeography: The geographical distribution of animal .Wiley publication, NEW York.
- 2.Hobbs, C.L. Zoogeography . Ayer co pub; Reprint Edition.
- 3.Illies, J .1974 .Introduction to zoogeography .Macmillan .
- 4.International commission for zoological Nomenclature(ICZN). 1999 . International code ofzoological Nomenclature. Nature History Museum Cromwell Road, London S W 7 5BD-UK (AVAILABLE ONLINE FREE: W .W.W .iczn.org).
- 5.Kapoor, v.c Theory and practice of Animal Taxonomy Oxford –IBH publishing co., N Delhi ,Mumbai & Kolkata .
- 6.Mayer , E. Principles of systematic zoology . Mc-Graw Hill publication, New Delhi Simpson , G.C. Principles of Animal Taxonomy. Oxford –IBH publishing co, New Delhi
- 7.Tiwari, S.Readings in Indian zoogeography (vol.1) Today & Tomorrow printers & Publishers

Zoo-101P: Practicals on Principles of Classification, Zoogeography & Palaeozoology

25 marks

Taxonomic procedures

10marks

1. Collection of specimens, recording of : locality, co-ordinates, altitude, river basin, lake ,mountain range etc., method of catch, local name, description of characters, particularly colour in fresh. Labelling/tagging of specimens and its correlation with field record book.
2. Narcotization, Fixation and preservation techniques-wet, dry, slide preparation
3. camera-Lucid drawing of specimens.
4. Morphometric and meristic characters, data sheets and entry.
5. Description of a species.

Identification using dichotomous keys

Zoogeography & palaeontology

5 marks

Elementary knowledge about origin and evolution of groups of animals in Geological time scale.

Field Collection Trip and Report

5 marks

Viva voce

5 marks

Semester II
ZOO-202: functional Anatomy of Non-chordata

75 marks
100 lectures
20 marks

Unit 1. Protozoa, Metazoa and Porifera

25 lectures

1. Protozoa: Distinguishing characters and classification upon orders.
2. Structure, locomotion, Osmoregulation, nutrition, reproduction, life history and Pathogenicity of *Entamoeba Histolytica*,
3. Structure, locomotion, Osmoregulation, nutrition, reproduction, life history and Pathogenicity of *Trypanosoma gambiense*,
4. Structure, locomotion, Osmoregulation, nutrition, reproduction, life history and Pathogenicity of *Plasmodium vivax*,
5. Structure, locomotion, Osmoregulation, nutrition, reproduction, life history and Pathogenicity of *P. falciparum*.
6. Reproduction in paramecium and nutrition in euglena.
7. Metazoan : origin of metazoan ,metamerism and symmetry
8. Porifera: Distinguishing charaters and classification upto orders.
9. Canal system in Porifera
10. Skeleton system in Porifera
11. Economic importance of sponges.

Unit 2: Coelenterata, ctenophore, platyhelminthes and nemathelminths

25 lectures

20 marks

1. Coelenterate; structural organization and affinities
2. Platyhelminthes: structural organization in trematoda
3. Structural organization in cestoda .
4. Life cycle and parasitic adaptation in *Fasciola hepatica*
5. Life cycle and parasitic adaptation in *Taenia solium*.
6. Nemathelminthes; Distinguishing charaters and classification upto orders
7. Life cycle,pathogenecity and prophylaxis of *Ascaris lumbricoides*

Unit 3. Annelida ,Arthropoda ,Mollusca and Echinodermata 35 lectures 25 marks

1. Annelida; Distinguishing charaters and classification upto order,
2. Excretory system in Annelida,
3. Coelom in Annelida,

4. Trochophore larva-structure and affinities.
5. Arthropoda ;structural organization in different classes ,
6. Mouth parts of insects
7. Larval forms of crustacean
8. Larval forms of insecta.
9. Metamorphosis and life in insects.
10. Mollusca; structural organization in palecypoda ,gastropoda and cephalopoda,
11. Torision and detorsion in Gastropods ,
12. Structure and affinities of Neopilina.
13. Echinodermata; structural organization in different classes ;
14. Water vascular system in Echinodermata
15. Larval forms in Echinodermata

Unit 4. Minor phyla

15 lectures

10 marks

1. Distinguishing charaters and examples of Nemertinea,
2. Distinguishing charaters and examples of Rotifera,
3. Distinguishing charaters and examples of Acanthocephala
4. Distinguishing charaters and examples of Sipunculida
5. Distinguishing charaters and examples of Echiurida ,
6. Distinguishing charaters and examples of Bryozoa (Ectoprota .)
7. Distinguishing charaters and examples of Brachyopoda and
8. Distinguishing charaters and examples of phoronida

Recommended Books

1. Anderson ,D.T. Invertebrate zoology .Oxford university press .
2. Brooks, W.K.Handbook of intvertebrate zoology .Kessinger Publishers.
3. Ekambranath, M. & Ananthakrishnan, TN 2000, Manual of Zoology, Part 1 &2. S.Vishwanathan printers and Publishers ,Chinnai .
4. Parker; T.J. & Haswell, W.A.A Text –book of zoology ,volume 1, McMillan co.

Zool-202P: Practicals on Function Anatomy of non-Chordata

25marks

Dissections .

7 marks

1. Nereis –digestive and nervous systems .
2. Cockroach- digestive ,reproductive and excretory systems.
3. Pila –digestive and nervous systems

Study permanent slides

2 marks

Paramecium entire ,conjugation Monocystis ,Euglena Trypanosoma ,L S of sycon ,sponging fibres obelia colony T.Sof Ascaris (mal&femal), T.S OF Fasciola and Taenia ,cercaria ,sporocystand redia of Fasciola scolex ,mature and gravid segments of Taenia ,mouth parts of Anopheles Housefly and cockroach ,bed bug (w/M),body louse (w/M) ,TS of gill of pila TSof arm of starfish.

Study of specimens

5 marks

Sycon, spongilla, physalia, porita, FaviaTubipora, Madrepora, Aurelia sea-anemoneAlcyonium, Taenia Hetronereis, Aphrodite, chaetopterus sabella Leech, Bonellia spider limulusmillipede centipede crab, peripatus scorpion, Termite, Daphnia Cyclops Balanus chiton,Dentallium pearl Oyester, Limax, Nautilus, Octopus sepia Loligo solen Aplysia starfish Antedon,Holothuria sea urchin, Brittle star.

Temporary mounts

3 Marks

Spicules and gemmules of sponge, Obelia colony, ovary and spermatheca and septal nephridiaof Earthworm, Parapodis of Nereis. Mouth parts of cockroach, house fly and mosquito. Radulaof Pila, Daphnia, Cyclops, Mysis.

Records Books

3 marks

Viva Voce

5 marks

ZOO-303 : Functional Anatomy of Chordata

75 marks
100 lectures
08 marks

Unit 1. General organization of Chordata **10 lectures**

1. General characters of chordate and classification upto classes.
2. Structural organization of Hemichordata,
3. Structural organization of Urochordata and
4. Structural organization of Cephalochordata.
5. Affinities of Amphioxus.

Unit 2. Agnatha and Pisces **15 lectures** **10 marks**

1. Petromyzon: external feature, digestive system, respiratory system and reproduction.
2. Scoliodon: external features; respiratory, circulatory and reproductive systems; brain and cranial nerves.
3. Air bladder of fishes
4. Accessory respiratory organ of fishes.
5. General characters and distribution of Lungfishes

Unit 3. Amphibia and Reptilia **20 lectures** **12 marks**

1. Amphibia: origin and evolution, distinctive characters and classification upto living orders with examples,
2. metamorphosis and neoteny in Amphibia.
3. Reptilia: distinctive characters and classification upto living orders with examples;
4. Affinities of Sphenodon;
5. Distinction between poisonous and non-poisonous snakes;
6. Biting mechanism in snakes;
7. Mesozoic reptiles.

Unit 4. Aves and Mammalia **25 lectures** **20 marks**

1. Aves: origin of birds;
2. distinctive characters and classification upto living orders with examples.
3. Pigeon: feathers; digestive, respiratory, circulatory, urino-genital and skeletal system; brain;
4. Distinctive characters of Ratitae & Carinatae with examples;
5. General characters of Archaeopteryx.
6. Perching mechanism in birds.

7. Mammal: origin of Mammals
8. General characters and classification of Prototheria,
9. General characters and classification Metatheria
10. General characters and classification Eutheria.
11. Dentition in mammals
12. placentation in mammals.
13. Rabbit: skeletal, excretory and reproductive systems.

Unit 5 Comparative anatomy

30 lectures

25 Marks

1. Integumentary system: integument and its derivatives.
2. Digestive system: alimentary canals and associated glands.
3. Circulatory system: heart and aortic arches.
4. Skeletal system: jaw suspension; visceral arches, vertebral column; limbs and girdles.
5. Nervous system: brain; cranial nerves; spinal nerves.
6. Urino-genital system: succession of kidney and evolution of urino-genital ducts.
7. Endocrine glands: pituitary, thyroid, adrenal, pancreas and gonads.

RECOMMENDED BOOKS

1. Ekambranath, M. & Ananthakrishnan, T.N. 2000. Manual of Zoology, (Chordata) Part 1 & 2. S. Yishwanathan Printers and Publishers, Chennai.
2. Kent Jr. G.e. 1969. Comparative Anatomy of the vertebrates. The C.Y. Mosby Corn. Toppan, Japan.
3. Kingsley, J. S. 1962. Bulletins of Comparative Anatomy, Central Book Depot, Allahabad. Parker, T.J. & Haswell, W.A. A Text-book of Zoology, Volume 2, McMillan Co, Bombay, Calcutta, Madras.
4. Sedgewicke, A. A student textbook of Zoology. Central Book Depot, Allahabad.
5. Wake, M.H. 1992. Hyman's Comparative Vertebrate Anatomy, 3rd Edn., The University of Chicago Press.
6. Weichert, e.K. Anatomy of the Chordates. McGraw Hill Book Inc., New York.
7. Weichert, W.e. & Presch, W. 1997. Elements of Chordate Anatomy. Tata-McGraw Hill Publishers Co, Ltd., New Delhi.
8. Young, J. Z. The Life of Vertebrates. Oxford University Press, New York.

ZOO-303P
Practicals on Functional Anatomy of Chordata

25 marks

Dissections

6 marks

1. Scoliodon - afferent and efferent branchial vessels; V, VII, IX and X cranial nerve; internal ear and brain (to be taken out)
2. Frog or toad -V, VII and X cranial nerves.
3. Calotes - arterial, venous and urino-genital systems.

Study of specimems

6 marks

Amphioxus, Balanoglossus, Ascidian, Petromyzon, Myxine, Electric ray, Sea horse, Saw fish, Sucker fish, Hammer headed shark, Salamander, Hyla, Hemidactylus, Mabuia, Varanus, Turtle, Tortoise, Chameleon, Draco, Cobra, Viper, sea-snake, Krait, Parrot, Cuckoo, Kite, Myna, Flying fox, Duck-billed Platypus, Echidna.

Study of bones

5 marks

1. Toad or Frog - skull, lower jaw, pectoral & pelvic girdles, vertebrae
2. Calotes- skull, lower jaw, pectoral & pelvic girdles, atlas and axis.
3. Pigeon -lower jaw, cervical vertebrae, rib, pectoral and pelvic girdles and pygostyle.
Rabbit -skull, lower jaw, pectoral and pelvic girdles.

Practical Record

3marks

Viva-Voce

5 marks

ZOO- 404
Biodiversity, Environmental Biology, Applied Zoology and Computer Application

		75 Marks
Unit 1. Biodiversity	30 lectures	20 marks
<ol style="list-style-type: none">1. Biodiversity: concept; biodiversity hotspots; IUCN Redlist category,2. Wildlife of India with particular reference to Manipur; methods adopted 111 wildlife census.3. Concept of wildlife conservation, implementation, in-situ & ex-situ conservation, captive breeding, biotechnological intervention.4. Sanctuaries and National parks of India, Ramsar sites.		
Unit 2. Environmental Biology	30 lectures	20 marks
<ol style="list-style-type: none">1. Concept of Ecosystem. Major ecosystems, man made ecosystem and agro-ecosystem.2. Biotic and abiotic factors.3. Food chain and energy flow,4. Ecological niche, habitat, biosphere and biome.5. Ecological succession,6. Biological cycle: water, oxygen, carbon and nitrogen.7. Population. General features, natality, mortality, equilibrium density, immigration, emigration,8. Ecological pyramids, sex ratio, dispersal and dispersion; Leidig's law of minimum and Shelford's law of tolerance; concept of limiting factors and life table construction method.9. Environmental pollution. Types, sources, indicators, causes and control and prevention of pollution. Toxic effects of pesticides and industrial wastes. Biomagnification.		
Unit 3. Applied Zoology.	20 lectures	20 marks
<ol style="list-style-type: none">1. Apiculture : Species diversity, life history, rearing methods, diseases and economic utility of bees..2. Sericulture : Species diversity, life history, rearing methods, diseases and economic utility of tasar worms and mulberry silk worm.3. Fisheries. Culture and capture fishery. Fishes of commercial value: food and ornamental. Introduction to different pisciculture techniques: extensive and intensive pond fish culture.		
Unit 4. Computer Applications.	20 lectures	15 marks
<ol style="list-style-type: none">1. Basic concepts of computer: hardware and software, operating systems.2. Computer application in Biological sciences.3. Elementary knowledge of Bioinformatics, E- learning, Networking.4. Programmes used in biostatistics: SPSS, Minitab, phylogenetic study, modelling etc.		

RECOMMENDED BOOKS

1. Alfred, J.R.B. Das, A.K. & Sanyal, A.K. 1998. Faunal Diversity in India. Zoological Survey of India, Kolkata.
2. Annanthakrishnan, T.N. 1982. Bioresources Ecology. Oxford-IBH Publ Co., Pvt. Ltd. N.Delhi
3. Dandin, S.B., Jayaswal, J. & Giridhar. Handbook of Sericulture Technologies. Central Silk Board.(Ministry of Textiles, Govt. of India), CSB Complex, BTM Layout, Madivala, Bangalore-560068.
4. DOEACC. "CCC" Course on Computer Concepts. Doeacc Society, Electronics Niketan, 6CGO Complex, New Delhi-I 10003.
5. French, C.S. Data Processing and Information Technology. BPB Publication.
6. Kormondy, E.J. Concepts of Ecology. Patience-Hall, India
7. Krebs, C.J. 1972. Ecology, the experimental analysis of distribution and abundances. Harper. Intl. Edn., Harper & Row Publ. London.
8. Newman, M.C. Fundamental of Ecotoxicology. Lewis Publishers, Washington DC.
9. Odum, E.P. Ecology. Oxford-IBH Publishing Co., New Delhi, Mumbai & Kolkata.
10. ;Rajaraman, V.Fundamentals of Computers. Prentice-Hall, India Ltd., New Delhi.
11. www.iucnredlist.org. (Official website of IUCN)

ZOO-404P

Practicals on Biodiversity, Environmental Biology, Applied Zoology and Computer Application

25 Marks

Environmental Biology

8 Marks

1. Study of ecosystem of a pond. Identification of biotic and abiotic components. Recording of turbidity, temperature and pH. Estimation of Oxygen (Winkler's method) and Carbon dioxide (phenolphthalein method) of pond water.
2. Population study by tagging experiment (to track the movement of animals)- marking, releasing & recapturing method.

Applied Zoology

5 marks

1. Study of life history stages of a Honey bee..
2. Study of life history stages of a Silk moth .
3. Study of life history stages of a fish.
4. Morphological differences among the different castes of Honey bee.

Wildlife

5Marks

Visit to Wildlife sanctuary or ZoolNational Park/any other worth visiting site and study of the available animals.

Viva- Voce

7Marks

ZOOLOGY GENERAL (5th SEMESTER)

ZOO-510

Cell Biology and Genetics, Evolution & Biological Techniques

75 marks
100 Lecturers

- Unit 1: Cell Biology** **35 lectures** **20 marks**
Characteristics of Prokaryotic and Eukaryotic cell, Chemistry of cell constituents, Concept of unit membrane, Structure and function of cell organelles – Plasma Membrane, Mitochondria, Golgi Bodies, Endoplasmic Reticulum, Ribosomes, Lysosomes.
Chromosomes: Polytene & Lampbrush chromosomes, Euchromatin, Heterochromatin, Mutation. Gene: Structural alteration and their significance; deletion, duplication, inversion, translocation.
Cell division: Mitosis & Meiosis, cell cycle, sex determination in drosophila and man. Molecular expression of gene: gene action, protein synthesis and its regulation – Lac operon model.
- Unit 2: Genetics** **20 lectures** **15 marks**
Mendel's laws, monohybrid and dihybrid cross, back cross, test cross, quantitative inheritance, gene variation, incomplete dominance, co-dominance, complementary genes, lethal genes, crossing over and linkage, genetic diseases and counselling, Human Genome Project.
- Unit 3: Evolution & Adaptation** **15 lectures** **15 marks**
Neo Lamarkism, Darwinism, Neo Darwinism, Evidence of Evolution, Hardy-Weinberg Law, genetic drift, mutation theory, variation – types and causes, Natural selection, speciation, Fossil type and significance, Geological Time Scale.
- Unit 4: Ethology** **10 lectures** **10 marks**
Social behavior in honey bee and termites; Parental care in insects, fishes and amphibians; Migration in insects, fishes and birds; Courtship and defensive behavior in insects, fishes and birds.
- Unit 5: Biotechnology & Bioinstrumentation** **20 lectures** **15 marks**
Introduction, history and importance of Biotechnology, Principles and techniques of plant and animal cell cultures. Recombinant DNA Technology, GMO's Application of Biotechnology in Agriculture, Health care and industries; Gene therapy, transgenic animals.
Elementary ideas of Bioinformatics
Principles of microscopy, Spectrophotometry, Electrophoresis, Chromatography, PCR and ELISA.

ZOO-510P

Practical on Cell Biology & Genetics, Evolution, Adaptation, Ethology, Biotechnology & Bioinstrumentation

25 marks

Cell Biology & Genetics

7 marks

Squash preparation of onion root tip for the study of mitosis.

Temporary and permanent squash preparation of grasshopper testes for the study of Meiosis.

Temporary preparation of the salivary gland chromosomes of *Drosophila/Chironomous/* Grasshopper and rat.

Study of permanent slides of Autosomes and sex chromosomes of grasshopper and rat.

Demonstration of sex chromatin (Barr body)

Adaptation & Ethology

5 marks

Study of mimicry in insects and animals: stick insect, leaf insect, moth, cicada, sea horse, flat fish, remora, flying lizard, bat etc.

Study of different types of nests of animals.

Study of parental care

Biotechnology & Bioinstrumentation

5 marks

Demonstration of alcohol fermentation using yeast/ curd making using starter culture.

Preparation of standard curve of amino acids and proteins.

Demonstration of oil emersion technique in microscopy.

Separation of tissue extract using centrifuge.

Demonstration of electrophoresis – paper/ gel.

Practical Records

3 marks

Viva Voce

5 marks

ZOOLOGY HONOURS (5th SEMESTER)
ZOO-H505
Cell Biology and Genetics

100 marks
120 Lecturers

CELL BIOLOGY

Unit 1. Cellular organization.	15 lectures	15 marks
<ol style="list-style-type: none">1. Prokaryotic and eukaryotic cells.2. Intercellular adhesion and interaction.3. Extra-nuclear organization of cells: concept of unit membrane, active and passive transport.		
Unit 2. Cytoplasmic organelles.	20 lectures	15 marks
<ol style="list-style-type: none">1. Plasma membrane.2. Structure and function of mitochondria,3. Structure and function of endoplasmic reticulum,4. Structure and function of ribosomes, lysosomes,5. Structure and function of cilia,6. Structure and function of flagella,7. Structure and function of cell vacuoles,8. Structure and function of Golgi body,9. Structure and function of microbodies,		
Unit 3. Nuclear organization.	10 lectures	10 marks
<ol style="list-style-type: none">1. Nucleus: nuclear envelope, nuclear matrix, nucleolus,2. chromosomes, chromatids, karyotyping, supernumerary chromosomes, chromatin-euchromatin and heterochromatin .		
Unit 4 Cell regulatory mechanism	15 lectures	15 marks
<ol style="list-style-type: none">1. Cell cycle,2. mitotic and meiotic cell division, regulation of cell division.3. DNA· replication;4. Molecular expression of gene action:5. Protein synthesis and its regulation, Lac Operon and Tryptophan Operon model		

GENETICS

Unit 5. Genetics.	35 lectures	35 marks
<ol style="list-style-type: none">1. History of Genetics,2. Mendelian inheritance patterns: quantitative inheritance,3. Linkage maps.4. Gene interactions: incomplete dominance, co-dominance, supplementary genes, 'complementary genes, epistasis, position effect, atavism, lethal gene, multiple alleles-hemolytic disease of new born (HDN).5. Sex determination in Drosophila and man.6. Genetics of blood group.7. Modern concept of gene.		

8. Point mutation, chromosomal aberrations, chromosome number, form and rearrangement with reference to speciation in *Drosophila*, polyploidy (molecular basis of mutations).
9. Non-chromosomal inheritance, human genetics, diseases of single gene inheritance, normal and abnormal karyotypes, genetic counselling.

Unit 6. Molecular Genetics and Tools.

10 lectures

10 marks

1. RFLP (Restriction Fragment Length Polymorphism)
2. RAPD (Randomly Amplified Polymorphic DNA),
3. AFLP (Amplified Fragment Length Polymorphism),
4. Application of RFLP in DNA fingerprinting.
5. Polymerase Chain Reaction (PCR).
6. Human genome project.

RECOMMENDED BOOKS

1. Barke, J.D.C. Cell Biology. Williams & Wilkins Co.
2. deRobertis, E.D.P. & deRobertis, E.M.F. Cell and Molecular Biology. Holt-Saunders International Edn.
3. Gardener, E.J. Principles of Genetics. John Wiley & Sons Inc., New York.
4. Lehninger, A.L., Nelson, D.L. & Cox, M.M. Principles of Biochemistry. CBS Publishers & Distributors, Delhi.
5. Prescott, D.M. Methods in Cell Biology, Bookman Associates, Jaipur. Strickberger, M. W. 2005. Genetics. Prentice-Hall of India, New Delhi
6. Swanson, c.P., Mezz, T & Young, W.J. Cytogenetics: Chromosomes in divisions, Inheritance and Evolution. Prentice-Hall of India, New Delhi.

ZOOLOGY HONOURS (5th SEMESTER)

ZOO-H506

Evolution, Adaptation, Ethology, Biotechnology & Bioinstrumentation

Unit 1. Evolution

30 lectures

30 marks

1. History of evolutionary thought.
2. Origin of life.
3. Evidences of evolution,
4. Modern concept of organic evolution, Hardy-Weinberg law, Sewall-Wright effect. Role of mutation in evolution.
5. Variation.
6. Natural selection- directional, stabilizing and disruptive types. .
7. Isolating mechanism and their role in evolution.
8. Speciation.
9. Evolution of man.

Unit 2~ Adaptation.

20 lectures

15 marks

1. Srtuctural adaptations of animals with Cursorial modes of life.
2. Srtuctural adaptations of animals with Aquatic modes of life
3. Srtuctural adaptations of animals with Volant modes of life
4. Basic concepts of adaptations of animals to deep sea, desert and cave.
5. Basic concepts of adaptations of animals to deep sea,.
6. Basic concepts of adaptations of animals to deep desert.
7. Basic concepts of adaptations of animals to cave.
8. Colouration and mimicry in animals.
9. Adaptive radiation and convergence.

Unit 3. Ethology

25 lectures

20 marks

1. Description and types of animal behaviour.
2. Learning in animals.
3. Types of communications in insects. Pheromones and their role.
4. Parental care in fishes.
5. Courtship behaviour in fishes and birds.
6. Biological Rhythm: Circadian rhythm.
7. Migration in insects, fishes and birds.

SYLLABUS OF B.SC.ZOOLOGY (M.U.)

Y. K. COLLEGE, WANGJING

Unit 4. Biotechnology**30 lectures****25 marks**

1. Introduction, history, scope, importance and types of biotechnology.
2. Importance of viruses, bacteria, algae and fungi in biotechnology.
3. Biotechnology of alcohol fermentation and bio- insecticide.
4. Principles and techniques of animal cell cultures.
5. Brief idea of health care biotechnology, production of human insulin.
6. Elementary knowledge of genetic engineering. In-vitro fertilization in human and other assisted reproductive technology (ART). Transgenic animals.

Unit 5. Bioinstrumentation**15Lecturers****10Marks**

1. General principles and brief ideas on the types of Microscopy,
2. General principles and brief ideas on the types of Spectrophotometry,
3. General principles and brief ideas on the types of Electrophoresis,
4. General principles and brief ideas on the types of Chromatography and
5. General principles and brief ideas on the types of Centrifugation

RECOMMENDED BOOKS

1. Alcock, 1. Animal behaviour- an evolutionary approach. Sinauer Associates Inc., Massacheussets
2. Chandrasekharan, M.K. Biological Rhythm. Vishwanathan Printers, Chennai.
3. Lull, R.S. 1976. Organic Evolution. Light & Life Publisher.
4. Plummer, D.T. An Introduction to Practical Biochemistry. Tata-McGraw Hill Publ., New Delhi.
5. Trehan, K. Biotechnology. John Willey & Sons.
6. Wilson, K. and Walker, J. 2000. Practical Biochemistry, Principles and Techniques, 5th Edn. Cambridge University Press.

ZOOLOGY HONOURS (5TH SEMESTER)
ZOO-H507P

**Practicals on Cell Biology and Genetics Evolution, Adaptation,
Ethology, Biotechnology and Bioinstrumentation**

100 marks

Cell Biology and Genetics

30 marks

1. Squash preparation of onion root tip for the study of mitosis Temporary and permanent squash
2. Preparation of the grasshopper testis for the study of meiosis.
3. Temporary squash preparation of the salivary gland chromosomes of *Drosophila* and *Chironomus*.
4. Study of permanent slides showing autosomes and sex chromosomes of a grasshopper and a mammal.
5. Karyotyping of chromosomes.
6. Demonstration of Sex Chromatin (Barr body) Demonstration of mitochondria by supra vital staining (Janus green)

Adaptation

10 marks

1. Study of mimicry in insects: stick insect, leaf insect, moth, cicada, sea horse, flat fish, remora, flying lizard, bat etc.

Ethology

10 marks

1. Tagging (paper/aluminium) of animals and recapture to study patterns of migration.
2. Study of different types of nests of animals.
3. Study of Parental Care

Biotechnology

10 marks

1. Demonstration of alcohol fermentation using yeast.
2. Demonstration of soyabean fermentation using starter culture
3. Demonstration of curd making using starter culture

Bioinstrumentation

10 marks

1. Preparation of standard curve of amino acid and protein (bovine serum albumin).
2. Measurement of cell/spore size using micrometer.
3. Demonstration of oil emulsion technique in microscopy.
4. Separation of tissue extract using centrifuge.
5. Demonstration of electrophoresis- paper/gel

Practical Records

5marks

Slide Submission Mitosis, Meiosis and Salivary Gland Chromosomes

10 marks

Viva Voce

15 marks

SCHEME OF PRACTICAL EXAMINATION FOR ZOO-507P

All questions are compulsory. There will be no options. The question setter will select any one from the options available below for a particular examination.

- | | |
|---|-----------------|
| 1. Anyone of the following | 10 marks |
| a. Temporary slide preparation of Mitosis from onion root tip | |
| b. Temporary slide preparation of Meiosis from Grasshopper testis/mammals | |
| c. Salivary gland chromosome of Drosophila/Chironomus larva | |
| d. Vital staining of Mitochondria | |
| 2. Demonstration of Barr body, stained and temporary mount | 10 marks |
| 3. Karyotyping of images of chromosomes provided | 10 marks |
| 4 Demonstration of Alcohol Soyabean/Curd fermentation | 10 marks |
| 5. Anyone of the following: | 10 marks |
| a. Preparation of Calibration curve of Amino acid/Protein | |
| b. Measurement of Cell/Spore size using micrometer | |
| c. Preparation of tissue extract by centrifugation | |
| d. Setting up and demonstration of Electrophoresis | |
| 6 Comment on adaptation: mimicry/camouflage of animal | 10 marks |
| 7 Anyone of the following: | 10 marks |
| a. Demonstration of tagging experiment for migration of animals | |
| b. Demonstration of nesting behaviour/parental care of animals | |
| 8. Permanent slide submission | 10 marks |
| (Mitosis-2; Meiosis-2; Salivary gland chromosome-I) | |
| 9 Practical Record | 5 marks |
| 10. Viva Voce | 15 marks |

ZOOLOGY GENERAL (6th SEMESTER)

ZOO-611

Animal Physiology, Histology, Developmental Biology & Biological chemistry

75 marks
100 Lecturers

- Unit 1: Animal Physiology** **30 lectures** **20 marks**
Nutritional requirements, Digestion and absorption of proteins, carbohydrates and lipids, Vitamins and minerals. Composition and function of blood and lymph, blood group, Rh factor, coagulation of blood, transport of oxygen and carbon dioxide. Physiology of urine formation, Osmoregulation. Ultrastructure of muscle and mechanism of muscle contraction; Stress physiology; Nerve impulse transmission; Reflex action; Neurotransmitters; Structure and function of eye and ear.
- Unit 2: Endocrine glands** **15 lectures** **15 marks**
Endocrine glands: Structure of pituitary, thyroid, adrenal, pancreas, gonads. Hormones secreted by the glands and their functions. Mechanism of hormone action.
- Unit 3: Histology** **15 lectures** **10 marks**
Microscopic anatomy of the following organs of frog/toad and mammals: Skin, stomach, intestine, pancreas, liver, lungs, kidney, spinal cord, arteries, veins, testis and ovary.
- Unit 4: Developmental Biology** **25 lectures** **15 marks**
Gametogenesis: spermatogenesis and oogenesis; Fertilization, in-vitro fertilization; parthenogenesis. Types of eggs; cleavage pattern in animals; Blastulation and Gastrulation, development of three germinal layers in animals, frog and chick; organizer concept, placenta and types. Organogenesis: Central Nervous System, heart, kidney. Study of stem cells.
- Unit 5: Biological Chemistry** **15 lectures** **15 marks**
Scope and its importance. Chemistry of carbohydrates, proteins, lipids and nucleic acids.
Enzymes: nature, classification and functions. Co-enzymes and prosthetic group. Mechanism of enzyme action. Glycogenolysis and glycogenesis. Urea cycle.

ZOOLOGY HONOURS (6TH SEMESTER)
ZOO-H608
Animal Physiology, Endocrinology and Immunology

100 marks
100 lectures

ANIMAL PHYSIOLOGY

Physiology with special reference to mammals

- | | | |
|--|--------------------|-----------------|
| Unit 1. Nutrition | 15 lectures | 12 marks |
| Nutritional requirements-macro and micronutrients, digestion and absorption | | |
| Unit 2 Heart, Blood and Circulation | 15 lectures | 12 marks |
| <ol style="list-style-type: none">1. Origin, conduction and regulation of heart beat; cardiac cycle, electrocardiogram,2. Composition and function of blood, blood group and Rh factor, haemoglobin and haemopoiesis;3. Peripheral circulation, blood pressure and blood coagulation. | | |
| Unit 3 Respiration | 15 lectures | 12 marks |
| <ol style="list-style-type: none">1. Mechanism and control of breathing.2. Transport of oxygen and carbon dioxide,3. Oxygen dissociation curves of haemoglobin, Bohr effect, Haldane effect, chloride shift | | |
| Unit 4 Excretion | 15 lectures | 12 marks |
| <ol style="list-style-type: none">1. Physiology of urine formation,2. Mechanism of micturition,3. Role of kidney in water regulation, salt and acid-base balance. | | |
| Unit 5 Muscle, Nerve and Sense organs | 25 lectures | 20 marks |
| <ol style="list-style-type: none">1. Ultrastructural, chemical and physiological basis of skeletal muscles,2. muscle contraction; molecular mechanism of muscle contraction, Cori's cycle.3. Nerve impulse. Nature, origin and propagation of nerve impulse along a neuron; synapse and myo-neural junction.4. Integrative functions of central nervous system.5. Sense organs: functions of organs related with vision, sound perception, taste, smell and touch.6. Electroencephalogram (EEG) | | |

ENDOCRINOLOGY

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|--|---------------------|-----------------|
| Unit 6. Endocrinology | 25 lectures | 25 marks |
| <ol style="list-style-type: none">1. Definitions of endocrine glands,2. neurosecretory cells.3. Functions and hormones' secreted by the following glands: pineal, hypothalamus, pituitary, thyroid, thymus, parathyroid, islets of Langerhans, adrenal, testis, and ovary. Miscellaneous hormones secreted by gastrointestinal system, kidney, placenta and heart and their functions. | | |
| Unit 7. Immunology | 10 Lecturers | 7Marks |
| <ol style="list-style-type: none">1. Introduction to immunology, innate immunity and acquired immunity,2. Structure and types of Ig, antigen-antibodies reaction,3. mechanism of immune responses,4. Brief idea of HIV and AIDS. | | |

RECOMMENDED BOOKS

1. Bell, G., Davidson, J.N. & Smith, D.E. Textbook of Physiology and Biochemistry. ELBS and
2. Churchill Livingstone.
3. Ganong, W.F. Medical Physiology. McGraw-Hill Publ., N. Delhi
4. Guyton, A.C. & Hall, J.E. Textbook of Medical Physiology. 9th Edn., Elsevier, a division of Reed Elsevier India Pvt., Ltd.
5. Keele, C., Neil, E. & Joels, N. Samson Wright's Applied Physiology. Oxford University Press, Bombay, Calcutta, Madras.
6. Prosser, C.L. & Brown, F.A. Comparative Animal Physiology. W.B. Saunders Cor
7. Philadelphia, Toppan Co. Tokyo, Japan.
8. Rastogi, S.C. Essentials of Animal Physiology. Wiley Eastern Ltd.
9. Schil-Nelson, K. Animal Physiology, Adaptation and Environment. Cambridge University Press.
10. Turner, C.L. General Endocrinology. W.B. Saunders, Toppan Co. Ltd., Tokyo, Japan.

ZOOLOGY HONOURS (6TH SEMESTER)
ZOO-H609
Developmental Biology, Histology and Biological Chemistry
100 marks
120 lectures

DEVELOPMENTAL BIOLOGY

Unit 1. Gametogenesis, Fertilization & Parthenogenesis 20 lectures 20 marks

1. Spermatogenesis, oogenesis and vitellogenesis.
2. Egg maturation, egg membranes, polarity of egg.
3. Fertilization and Parthenogenesis.

Unit 2. Animal egg, early stages of development, foetal membranes

20 lectures 20 marks

1. Types of animal eggs,
2. patterns of cleavage.
3. Blastulation and gastrulation in frog. Germ layers and their derivatives and homologies.
4. Blastulation and gastrulation in chick. Germ layers and their derivatives and homologies
5. Fat maps.
6. Structure and development of extra-embryonic membranes.
7. Placenta and its types.

Unit 3 Organogenesis, Tissue interactions & Metamorphosis 20 Lecturer 20Marks

1. Organogenesis of central nervous system, sense organs, heart and kidney.
2. Tissue interactions (inductions) In development.
3. Metamorphosis-retrogressive and progressive.
4. Regulation of metamorphosis in Anura and Insecta.
5. Organizer concept

HISTOLOGY & BIOLOGICAL CHEMISTRY

Unit 4. Histology 20 lectures 15 marks

1. Basic principles of histological techniques.
2. Microscopic anatomy of the following organs of a mammal: skin, stomach, intestine, pancreas, liver, lung, kidney, spinal chord, nerves, heart, arteries, veins, capillaries, lymph nodule, spleen, testis and ovary

Unit 5. Biological Chemistry 40 lectures 25 marks

1. Biological chemistry, its scope and importance.
2. Chemistry of carbohydrates, proteins, lipids and nucleic acids,
3. Enzymes, nature, classification and functions of enzymes. Co-enzymes and prosthetic groups. Enzyme actions.
4. Intermediary metabolism. Carbohydrate. Embden-Meyerhoff pathway, TCA cycle, Glycogenolysis and glycogenesis, gluconeogenesis.
5. Biological oxidations with special reference to the role of the electron transport system.

6. Basic concept of Bioenergetics
7. Lipid. Oxidation of fatty acids, fate of glycerol,
8. Ketone body formation and utilization.
9. Interaction of carbohydrate and lipids.
10. Proteins. Metabolism of amino acids.
11. Oxidative deamination, trans-aminations, decarboxylation, enzymology of urea cycle.
12. Fate of glucogenic and ketogenic aminoacids.
13. Interrelationship of metabolic pathways.

RECOMMENDED BOOKS

1. Balinsky, B.I. Introduction to Embryology. Saunder College Publishers, Philadelphia.
2. Browder, L.W. Developmental Biology. Sauders College Publishing, Philadelphia
3. Fawcett, D.W. Bloom & Fawcett- A textbook of histology. Hodder-Arnold Publication.
4. Jayaraman, J.1981. Laboratory Manual in Biochemistry. New Age International Publishers, , New Delhi-II 0002.
5. Murray, R.K., Granner, D.K., Mayer, P.A. & Rodwell, V.W. Harper's Biochemistry. McGraw-Hill Publ
6. Lehninger, A.L., Nelson, D.L. & Cox, M.M. Principles of Biochemistry. CBSD Publishers & Distributors, Delhi.

ZOOLOGY HONOURS (6TH SEMESTER)

ZOO-H610P.

Practicals on Animal Physiology, Endocrinology, Immunology, Developmental Biology, Histology & Biological Chemistry

100 marks

Animal Physiology

30 marks

1. Effects of isotonic, hypotonic and hypertonic solutions on erythrocytes
2. Counting of RBC using Haemocytometer
3. Counting of WBC using Haemocytometer
4. Estimation of haemoglobin percentage of a blood sample: amphibia or mammal.
5. Preparation of haemin crystals.
6. Coagulation of blood
7. Recording of frog's heart beat. Demonstration of the effect of acetylcholine, atropine and epinephrine on the heart beat.

Endocrinology

10 marks

1. Dissection of endocrine gland in rat
2. Study of permanent slides: sections of pituitary, thyroid, adrenal, pancreas, testis and ovary.

Immunology

10marks

Determination of ABO and Rh factor of Blood.

Developmental Biology

6 marks

1. Study of developmental stages of frog (permanent slides, WM): cleavage, gastrula and neurula
2. Study of developmental stages of chick (permanent slides, WM): 18, 24, 36, 48 and 72 hours of incubation.
3. Study of permanent slides of sections of blastula and gastrula of chick.
4. Study of permanent slides of sections of neurula and external gills of frog.

Histology

16 marks

1. Microtomy - fixation, embedding, block making, sectioning, staining and mounting of tissues.
2. Study of permanent slides - sections of oesophagus, stomach, duodenum, ileum, pancreas, lung, kidney and skin of mammal.
3. Study of permanent slides - sections of oesophagus, stomach, duodenum, ileum, pancreas, lung, kidney and skin of amphibian

Biological Chemistry

10 marks

1. General test for identification of carbohydrate, lipid and protein
2. Separation of amino acid using paper chromatography
3. Colorimetric estimation of protein from a calibration curve (provided)

Practical Record

8marks

Slide Submission

5 marks

Viva- Voce

10 marks

SCHEME OF PRACTICAL EXAMINATION FOR ZOO-H610P

All questions are compulsory. There will be no options. The question setter will select any one from the options available below for a particular examination.

- | | |
|--|----------------------|
| 1 Anyone of the following: | 12 marks |
| a. Counting of RBC, | |
| b.Counting of WBC | |
| c.Estimation of Haemoglobin percentage | |
| 2. Anyoneof the following: | 8 marks |
| a.Effects of isotonic, hypotonic and hypertonic solution on erythrocytes | |
| b.Preparation of Haemin crystals | |
| c.Coagulation of Blood | |
| 3. Anyone of the following: | 10 marks |
| a.Recording of heart beat of Frog | |
| b.Demonstration of effects of acetylcholine, atropine and epinephrine on heart beat of frog | |
| 4. Determination of ABO and Rh blood group | 10 marks |
| 5. Anyone of the following: | 10 marks |
| a.Detection of carbohydrate/lipid/protein in tissue sample | |
| b.Separation of amino acid by paper chromatography | |
| c.Colorimetric estimation of Protein/Amino acid | |
| 6 Section cutting and stretching of ribbon from the paraffin block supplied for histology | 5 marks |
| 7. Dissection of an endocrine gland | 4 marks |
| 8 Identification and comment on slides, 3 each of Endocrinology Histology and embryology | (2x9)18 marks |
| 9 Record Books | 5 marks |
| 10. Submission of histology (microtomy) slides (10 slides) | 5 marks |
| 11. Viva Voce | 10 marks |