

Syllabus for Undergraduate Programme

Bachelor of Science in Zoology



Manipur University, Canchipur

Imphal-795003

Course Structure

Semester	Paper Code	Title of Paper	Total Marks
Semester-I (Elective- Zoology)	ZOO-101	Principles of Classification, Zoogeography and Palaeozoology	75
	ZOO-101P	Practicals based on ZOO-101	25
Total Semester-I			100
Semester-II (Elective- Zoology)	ZOO-202	Functional Anatomy of Non-Chordata	75
	ZOO-202P	Practicals based on ZOO-202	25
Total Semester-II			100
Semester-III (Elective- Zoology)	ZOO-303	Functional Anatomy of Chordata	75
	ZOO-303P	Practicals based on ZOO-303	25
Total Semester-III			100
Semester-IV (Elective- Zoology)	ZOO-404	Environmental Biology, Applied Zoology, Wildlife and Computer Application	75
	ZOO-404P	Practicals based on ZOO-404	25
Total Semester-IV			100
Semester-V (Elective- Zoology)	ZOO-509	Cell Biology, Genetics, Evolution and Biological Techniques	75
	ZOO-510P	Practicals based on ZOO-509	25
Total Semester-V			100
Semester-VI (Elective- Zoology)	ZOO-611	Animal Physiology, Histology, Developmental Biology and Biological Chemistry	75
	ZOO-612P	Practicals based on ZOO-611	25
Total Semester-VI			100
Semester-V (Honours- Zoology)	ZOO-505	Cell Biology and Genetics	100
	ZOO-506	Evolution, Ethology, Biotechnology and Bioinstrumentation	100
	ZOO-507P	Practicals based on ZOO-505 and ZOO-506	100
Total Semester-V (Honours)			300
Semester-VI (Honours Zoology)	ZOO-608	Animal Physiology and Endocrinology	100
	ZOO-609	Developmental Biology, Histology and Biological Chemistry	100
	ZOO-610P	Practicals based on ZOO-608 and ZOO-609	100
Total Semester-VI (Honours)			300

BSC 1ST SEMESTER SYLLABUS (ZOOLOGY)

ZOO-101: Principles of Classification, Zoogeography and Paleozoology **75 Marks**
100 lectures

PRINCIPLES OF CLASSIFICATION:

Unit 1: Classification: **20 lectures 15 marks**

Classification of animals-historical account. Species concept. Taxonomy and Systematics, Taxonomic hierarchy.

Unit 2: Code and approaches in Taxonomy: **30 lectures 20 marks**

International Code of Zoological Nomenclature. Concept of chemotaxonomy and numerical taxonomy. Approaches in taxonomy: Morphometric and cytological techniques. Basic concept of molecular techniques in taxonomy.

ZOOGEOGRAPHY AND PALAEOZOOLOGY:

Unit 3: Zoogeography **25 lectures 20 marks**

Zoogeographical regions of the world with characteristic fauna. Marine realm and its division and characteristics. Barriers-types and significance; Continental drift. Discontinuous distribution.

Unit 4: Palaeozoology **25 lectures 20 marks**

Fossils and fossilization, types of fossils; trace fossils and living fossils. Dating of fossils, significance of fossils. Geological time scale and associated fauna.

RECOMMENDED BOOKS:

1. Darlington, P.J. *The Zoogeography: The geographical distribution of animals*. Wiley Publication, New York.
2. Hubbs, 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 of zoological nomenclature*. Natural history Museum. Cromwell Road, London SW75BD-UK (available online free. www.iczn.org).
5. Kapoor, V.C. *Theory and practice of Animal Taxonomy*. Oxford-IBH Publishing Co., N.Delhi, Mumbai and Kolkata.
6. Mayer, E. *Principles of Systemic Zoology*. Mc-Graw Hill Publication, New Delhi.
7. Simpson, G.C. *Principles of Animal Taxonomy*. Oxford-IBH Publishing Co., New Delhi
8. Tiwari, S. *Readings in Indian Zoogeography (Vol.1)*. Today and Tommorrow Printers and Publishers

ZOO-101P: Practical on principles of classification, zoogeography and paleozoology

25 marks

Taxonomic Procedures:

10 marks

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.

Narcotization, fixation and preservation techniques-Wet, Dry, slide Preparation

Camera-Lucida drawing of specimens

Morphometric and meristic characters, data sheets and data entry.

Description of a species

Identification using dichotomous keys.

Zoogeography and Palaeontology:

5 marks

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

Field collection trip and reports

5 marks

Viva Voce

5 marks

BSC 2ND SEMESTER SYLLABUS (ZOOLOGY)

ZOO-202: Functional Anatomy of non-chordata **75 marks**

Unit.1: Protozoa, Metazoa and Porifera **20 marks**

Protozoa: Distinguishing characters and classification upto orders.

Structure, locomotion, osmoregulation, nutrition, reproduction. Life history and pathogenicity of *Entamoeba histolytica*, *Trapanosoma gambiense*, *Plasmodium vivax*, *P. falciparum*. Reproduction in Paramecium and nutrition in Euglena.

Metazoa: Origin of metazoan, metamerism and symmetry.

Porifera: Distinguishing characters and classification upto Orders. Canal system, skeleton, Economic importance of sponges.

Unit.2: Coelenterata, Ctenophora, Platyhelminthes and Nematelminthes **20 marks**

Coelenterata: Structural organization and affinities.

Platyhelminthes: Structural organization in Trematoda and Cestoda. Life cycle and parasitic adaptation in *Fasciola hepatica* and *Taenia solium*.

Nematelminthes: Distinguishing characters and classification upto orders. Life cycle, pathogenicity and prophylaxis of *Ascaris lumbricoides*.

Unit.3: Annelida, Arthropoda, Mollusca and Echinodermata **25 marks**

Annelida: Distinguishing characters and classification upto Order. Excretory system, coelome, Trochophore larva-structure and affinities.

Arthropoda: Structural organization in different classes, mouth parts of insects, larval forms of Crustacea and Insecta. Metamorphosis and social life in insects.

Mollusca: Structural organization in Pelecypoda, Gastropoda and Cephalopoda, Torsion and detorsion in Gastropods, Structure and affinities of Neopilina.

Echinodermata: Structural organization in different classes; water vascular system, larval forms.

Unit.4: Minor Phyla **10 marks**

Distinguishing characters and examples of Nemertinea, Rotifera, Acanthocephala, Sipunculida, Echiurida, Bryozoa (Ectoprocta), Brachyopoda and Phoronida.

RECOMMENDED BOOKS:

1. Anderson, D.T. Invertebrate Zoology. Oxford University Press.
2. Brooks, W.K Handbook of Invertebrate Zoology. Kessinger Publishers.

3. Ekambranath, M. and Ananthakrishnan, T.N.2000. Manual of Zoology, Part 1 and 2. S.Vishwanathan Printers and Publishers, Chennai.

4. Parker, T.J and Haswell, W.A. A Text-book of Zoology, Volume 1, McMillan Co.

ZOO-202P: Practical on Functional Anatomy of Non-Chordata **25 marks**

Dissections: **7 marks**

Nereis-digestive and nervous system

Cockroach-digestive, reproductive and excretory systems.

Pila-digestive and nervous systems.

Study of permanent slides: **2 marks**

Paramecium entire, conjugation, Monocystis, Euglena, Trypanosoma, L.S of Sycon, sponging fibres, Obelia colony, T.S of Ascaris (male and female), T.S of Fasciola and Taenia, Cercaria, Sporocyst and 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, TS of arm of Star fish.

Study of Specimens: **5 marks**

Sycon, Spongilla, Physalia, Porpita, Favia, Tubipora, Madrepora, Aurelia, Sea-anemone, Alcyonium, Taenia, Heteronereis, Aphrodite, Chaetopterus, Sabella, Leech, Bonellia, Spider, Limulus, Millepede, Centipede, Crab, Peripatus, Scorpion, Termite, Daphnia, Cyclops, Balanus, Chiton, Dentalium, Pearl Oyster, 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 nephridia of Earthworm, Parapoda of Nereis. Mouth parts of cockroach, housefly and mosquito. Radula of Pila, Daphnia, Cyclops, and Mysis.

Record Books **3 marks**

Viva Voce **5 marks**

BSC 3RD SEMESTER SYLLABUS (ZOOLOGY)

ZOO-303: Functional Anatomy of Chordata **75 marks**

Unit.1: General organization of Chordata **08 marks**

General characters of chordate and classification upto classes.

Structural organization of Hemichordata, Urochordata and Cephalochordata.

Affinities of Amphioxus.

Unit.2: Agnatha and Pisces

10 marks

Petromyzon: External feature, digestive system, respiratory system and reproduction.

Scoliodon: External features; respiratory, circulatory and reproductive systems; brain and cranial nerves.

Air bladder, accessory respiratory organ of fishes. General characters and distribution of lungfishes.

Unit.3: Amphibia and Reptilia

12 marks

Amphibia: Origin and evolution, distinctive characters and classification upto living orders with examples, metamorphosis and neoteny.

Reptilia: Distinctive characters and classification upto living orders with examples; affinities of Sphenodon; Distinction between poisonous and non-poisonous snakes; biting mechanism in snakes; Mesozoic reptiles.

Unit.4: Aves and Mammalia

20 marks

Aves: Origin of birds; Distinctive characters and classification upto living orders with examples.

Pigeon: feathers; digestive, respiratory, circulatory, urino-genital and skeletal system; brain; distinctive characters of Ratitae and Carinatae with examples; general characters of Archaeopteryx. Perching mechanism in birds.

Mammal: Origin; general characters and classification of Prototheria, Metatheria and Eutheria. Dentition and placentation in mammals.

Rabbit: Skeletal, excretory and reproductive systems.

Unit.5: Comparative anatomy

25 marks

Integumentary system: Integument and its derivatives.

Digestive system: Alimentary canals and associated glands.

Circulatory system: Heart and Aortic arches.

Skeletal system: Jaw suspension; visceral arches, Vertebral column; limbs and girdles.

Nervous system: Brain; cranial nerves; spinal nerves.

Urino-genital system: Succession of kidney and evolution of urino-genital ducts.

Endocrine glands: Pituitary, thyroid, adrenal, pancreas and gonads.

RECOMMENDED BOOKS:

1. Ekambranath, M and Ananthakrishnan, T.N.2000. Manual of Zoology, (Chordata) Part 1 and 2. S.Vishwanathan Printers and Publishers, Chennai.
2. Kent Jr.G.C.1969. Comparative Anatomy of the vertebrates. The C.V. Mosby Corn.Toppan, Japan.
3. Kingsley, J.S.1962. Bulletins of Comparative Anatomy, Central Book Depot, Allahabad.
4. Parker, T.J and Haswell, W.A. A Text-book of Zoology, Volume 2, McMillan Co, Bombay, Calcutta, Madras.
5. Sedgewicke, A. A student textbook of Zoology. Central Book Depot, Allahabad.
6. Wake, M.H. 1992. Hyman's Comparative Vertebrate Anatomy, 3rd Edn., The University of Chicago Press.
7. Weichert, C.K. Anatomy of the chordates. McGraw Hill Book Inc., New York.
8. Weichert, W.C and Presch, W.1997. Elements of Chordate Anatomy. Tata-McGraw Hill Publishers Co, Ltd., New Delhi.
9. 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

Scoliodon-afferent and efferent branchial vessels; V, VII, IX and X cranial nerve; internal ear and brain (to be taken out)

Frog or toad-V, VII and X cranial nerves

Calotes-arterial, venous and urino-genital systems.

Study of specimens

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

Toad or Frog: Skull, lower jaw, pectoral and pelvic girdles, vertebrae.

Calotes: Skull, lower jaw, pectoral and pelvic girdles, atlas and axis.

Pigeon: Lower jaw, cervical vertebrae, rib, pectoral and pelvic girdles and pygostyle.

Rabbit: Skull, lower jaw, pectoral and pelvic girdles.

Practical Record **3 marks**

Viva-Voce **5 marks**

BSC 4th SEMESTER SYLLABUS (ZOOLOGY)

ZOO-404: Biodiversity, Environmental Biology, Applied Zoology and Computer Application **75 marks**

Unit.1: Biodiversity **20 marks**

Biodiversity: Concept; biodiversity hotspots; IUCN Redlist category.

Wildlife of India with particular reference to Manipur; methods adopted in wildlife census. Concept of wildlife conservation, implementation, in-situ and ex-situ conservation, captive breeding, biotechnological intervention. Sanctuaries and National parks of India, Ramsar sites.

Unit.2: Environmental Biology **20 marks**

Concept of Ecosystem. Major ecosystems, manmade ecosystem and agro-ecosystem.

Biotic and abiotic factors. Food chain and energy flow, ecological niche, habitat, biosphere and biome. Ecological succession, Biological cycle: Water, Oxygen, Carbon and Nitrogen.

Population: General features, natality, mortality, equilibrium density, immigration, emigration, 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.

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 marks**

Apiculture and Sericulture: Species diversity, life history, rearing methods, diseases and economic utility of bees, tasar worms and mulberry silk worm.

Fisheries: Introduction to different pisciculture techniques: Extensive and intensive pond fish culture.

Unit.4: Computer Applications **15 marks**

Basic concepts of computer: Hardware and software, operating system, computer application in Biological sciences. Elementary knowledge of Bioinformatics, E-learning, Networking, Programmes used in biostatistics: SPSS, Minitab, Phylogenetic study, modelling etc.

RECOMMENDED BOOKS:

1. Alfred, J.R.B. Das, A.K. and 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. and 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, 6 CGO Complex, New Delhi-110003.
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 and 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 and Kolkata.
10. Rajaraman, V. Fundamentals of Computers. Prentice-Hall, India Ltd., New Delhi. www.iucnredlist.org. (Official website of IUCN).

ZOO-404P: Practicals on Biodiversity, environmental Biology, Applied Zoology and Computer Application

Environmental Biology

8 marks

Study of ecosystem of a pond. Identification of biotic and abiotic components. Recording of turbidity, temperature and pH. Estimation of Oxygen (Wrinkler's method) and Carbondioxide (Phenolphthalein method) of pond water.

Population study by tagging experiment (to track the movement of animals)-marking, releasing and recapturing method.

Applied Zoology

5 marks

Study of life history stages of a Honey bee, a Silk moth and a fish. Morphological differences among the different castes of Honey bee.

Wildlife

5 marks

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

Viva-Voce

7 marks

BSC 5th SEMESTER SYLLABUS (ZOOLOGY HONOURS)

ZOO-505: Cell Biology and Genetics

100 marks

CELL BIOLOGY

Unit.1: Cellular organization

15 marks

Prokaryotic and eukaryotic cells. Intercellular adhesion and interaction. Extra-nuclear organization of cells: Concept of unit membrane, active and passive transport.

Unit.2: Cytoplasmic organelles

15 marks

Plasma membrane. Structure and function of mitochondria, endoplasmic reticulum, ribosomes, lysosomes, cilia, flagella, cell vacuoles, Golgi body, micro bodies.

Unit.3: Nuclear organization

10 marks

Nucleus: Nuclear envelope, Nuclear matrix, nucleolus, chromosomes, chromatids, Karyotyping, supernumerary chromosomes, chromatin-euchromatin and heterochromatin.

Unit.4: Cell regulatory mechanism

15 marks

Cell cycle, mitotic and meiotic cell division, regulation of cell division. DNA replication; Molecular expression of gene action: Protein synthesis and its regulation, Lac Operon and Tryptophan Operon model.

GENETICS

Unit.5: Genetics

35 marks

History of genetics, Mendelian inheritance patterns: Quantitative inheritance, linkage maps.

Gene interactions: Incomplete dominance, Co-dominance, Supplementary genes, complementary genes, epistasis, position effect, atavism, lethal gene, multiple alleles-hemolytic disease of new born (HDN). Sex determination in *Drosophila* and man.

Genetics of blood group. Modern concept of gene.

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

Unit.6: Molecular Genetics and Tools

10 marks

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

RECOMMENDED BOOKS

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

ZOO-506: Evolution, Adaptation, Ethology, Biotechnology and Bioinstrumentation

100 Marks

Unit.1: Evolution

30 marks

History of evolutionary thought. Origin of life. Evidences of evolution, Modern concept of organic evolution, Hardy-Weinberg law, Sewall-Wright effect.

Role of mutation in evolution. Variation. Natural selection-directional, stabilizing and disruptive types.

Isolating mechanism and their role in evolution. Speciation. Evolution of man.

Unit.2: Adaptation

15 marks

Structural adaptations of animals with Cursorial, Aquatic and Volant modes of life. Basic concepts of adaptations of animals to deep sea, desert and cave. Colouration and mimicry in animals. Adaptive radiation and convergence.

Unit.3: Ethology

20 marks

Descriptive and types of animal behavior. Learning in animals.

Types of communications in insects. Pheromones and their role. Parental care in fishes. Courtship behavior in fishes and birds.

Biological Rhythm: Circadian rhythm.

Migration in insects, fishes and birds.

Unit.4: Biotechnology**25 marks**

Introduction, history, scope, importance and types of biotechnology.

Importance of viruses, bacteria, algae and fungi in biotechnology.

Biotechnology of alcohol fermentation and bio-insecticide.

Principles and techniques of animal cell cultures.

Brief idea of health care biotechnology, production of human insulin.

Elementary knowledge of genetic engineering.

In-vitro fertilization in human and other assisted reproductive technology (ART).

Transgenic animals.

Unit.5: Bioinstrumentation**10 marks**

General principles and brief ideas on the types of Microscopy, Spectrophotometry, Electrophoresis, Chromatography and Centrifugation.

RECOMMENDED BOOKS

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

ZOO-507P: Practical on Cell Biology and Genetics, Evolution, Adaptation, Ethology, Biotechnology and Bioinstrumentation**100 marks****Cell Biology and Genetics****30 marks**

Squash preparation of onion root tip for the study of mitosis

Temporary and permanent squash preparation of the grasshopper testis for the study of meiosis.

Temporary squash preparation of the salivary gland chromosomes of Drosophila and Chironomus.

Study of permanent slides showing autosomes and sex chromosomes of a grasshopper and a mammal.

Karyotyping of chromosomes.

Demonstration of Sex Chromatin (Barr body)

Demonstration of mitochondria by supra vital staining (Janus green)

Adaptation **10 marks**

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

Ethology **10 marks**

Tagging (paper/aluminium) of animals and recapture to study patterns of migration.

Study of different types of nests of animals. Study of Parental Care.

Biotechnology **10 marks**

Demonstration of alcohol fermentation using yeast.

Demonstration of soyabean fermentation using starter culture

Demonstration of curd making using starter culture

Bioinstrumentation **10 marks**

Preparation of standard curve of amino acid and protein (bovine serum albumin).

Measurement of cell/spore size using micrometer.

Demonstration of oil emulsion techniques in microscopy.

Separation of tissue extract using centrifuge.

Demonstration of electrophoresis-paper/gel

Practical Records **5 marks**

Slide Submission: Mitosis, Meiosis and Salivary Gland Chromosomes **10 marks**

Viva Voce **15 marks**

BSC 6th SEMESTER SYLLABUS (ZOOLOGY HONOURS)

ZOO-608: Animal Physiology, Endocrinology and Immunology **100 marks**

ANIMAL PHYSIOLOGY

Physiology with special reference to mammals

Unit.1: Nutrition: **12 marks**

Nutritional requirements-macro and micronutrients, digestion and absorption.

Unit.2: Heart, Blood and Circulation

12 marks

Origin, conduction and regulation of heart beat; cardiac cycle, electrocardiogram, composition and functions of blood, blood group and Rh factor, haemoglobin and haemopoiesis; peripheral circulation, blood pressure and blood coagulation.

Unit.3: Respiration

12 marks

Mechanism and control of breathing. Transport of oxygen and carbon dioxide, oxygen dissociation curves of haemoglobin, Bohr Effect, Haldane effect, chloride shift.

Unit.4: Excretion

12 marks

Physiology of urine formation, mechanism of micturition, role of kidney in water regulation, salt and acid-base balance.

Unit.5: Muscle, Nerve and Sense organs.

20 marks

Ultrastructural, chemical and physiological basis of skeletal muscles, muscle contraction; molecular mechanism of muscle contraction, Cori's cycle.

Nerve impulse. Nature, origin and propagation of nerve impulse along a neuron; synapse and myo-neural junction. Integrative functions of central nervous system.

Sense organs: Functions of organs related with vision, sound perception, taste, smell and touch. Electroencephalogram (EEG).

ENDOCRINOLOGY

Endocrinology

25 marks

Definitions of endocrine glands, neurosecretory cells.

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

7 marks

Introduction to immunology, innate immunity and acquired immunity, structure and types of Ig, antigen-antibodies reaction, mechanism of immune responses, brief idea of HIV and AIDS.

RECOMMENDED BOOKS

1. Bell, G., Davidson, J.N and Smith, D.E. Textbook of Philosophy and Biochemistry. ELBS and Churchill Livingstone.
2. Ganong, W.F. Medical Physiology. McGraw-Hill Publ., N.Delhi

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

ZOO-609: Developmental Biology, Histology and Biological Chemistry **100 marks**

DEVELOPMENTAL BIOLOGY:

Unit.1: Gametogenesis, Fertilization and Parthenogenesis **20 marks**

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

Unit.2: Animal egg, early stages of development, foetal membranes **20 marks**

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

Unit.3: Organogenesis, Tissue interactions and Metamorphosis **20 marks**

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

HISTOLOGY AND BIOLOGICAL CHEMISTRY

Unit.4: Histology **15 marks**

Basic principles of histological techniques. 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 **25 marks**

Biological chemistry, its scope and importance. Chemistry of carbohydrates, proteins, lipids and nucleic acids, enzymes, nature, classification and functions of enzymes.

Co-enzymes and prosthetic groups. Enzyme actions.

Intermediary metabolism. Carbohydrate. Embden-Meyerhoff pathway, TCA cycle, Glycogenolysis and glycogenesis, gluconeogenesis. Biological oxidations with special reference to the role of the electron transport system. Basic concept of Bioenergetics.

Lipid: Oxidation of fatty acids, fate of glycerol, ketone body formation and utilization. Interaction of carbohydrate and lipids.

Proteins: Metabolism of amino acids. Oxidative deamination, trans-aminations, decarboxylation, enzymology of urea cycle. Fate of glucogenic and ketogenic amino acids. Interrelationship of metabolic pathways.

RECOMMENDED BOOKS

1. Balinsky, B.I. Introduction to Embryology. Saunder College Publishers, Philadelphia.
2. Browder, L.W. Developmental biology. Saunders college Publishing, Philadelphia.
3. Fawcett.D.W. Bloom and Fawcett. A textbook of histology. Hodder Arnold publication.
4. Jayaramanan, L.1981. Laboratory manual on Biochemistry. New Age International Publishers, New Delhi-110002
5. Murray, R.K. Granner, D.K Maya, P.A and Rodwell, V.W. Harper's Biochemistry. McGraw Hill Publ.
6. Lehninger, A.I. Nelson, D.L and cox M.M. Principles of Biochemistry. CBSD Publishers and Distributors, Delhi.

ZOO-610P: Practical on Animal physiology, Endocrinology, Immunology, Developmental biology, Histology and Biological chemistry **100 marks**

ANIMAL PHYSIOLOGY

30 Marks

Effects of isotonic, Hypotonic and Hypertonic solutions on erythrocytes. Counting of RBC and WBC using Haemocytometer. Estimation of haemoglobin percentage of a blood sample, amphibian or mammal. Preparation of haemin crystals. Coagulation of blood; Recording of frog's heart beat; Demonstration of the effect of acetylcholine, atropine and epinephrine on the heartbeat.

ENDOCRINOLOGY:

10 Marks

Dissection of endocrine gland in rat; Study of permanent slides; Sections of pituitary, Thyroid, Adrenal, Pancreas, Testis and Ovary.

IMMUNOLOGY:

10 Marks

Determination of ABO and Rh factor of blood

DEVELOPMENTAL BIOLOGY

6 Marks

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

HISTOLOGY

16 Marks

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

BIOLOGICAL CHEMISTRY

10 Marks

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

Lipid: Oxidation of fatty acids, fate of glycerol, Ketone body formation and utilization. Interaction of carbohydrates and lipids.

Proteins: Metabolism of amino acids. Oxidative deamination, transaminations, decarboxylation, enzymology of urea cycle. Fate of glucogenic and ketogenic amino acids. Interrelationship of metabolic pathways.

Practical record

8 marks

Slide submission

5 marks

Viva-Voce

10 marks

PROPOSED SYLLABUS FOR BACHELOR OF SCIENCE

ELECTIVE ZOOLOGY (SEMESTER-V)

ZOO-509: Cell Biology and Genetics, Evolution and Biological Techniques

75 marks

Unit.1: Cell Biology

20 marks

Characteristics of Prokaryotic and Eukaryotic cells. Chemistry of cell constituents. Concept of unit membrane. Structure and function of cell organelles-Plasma membrane, Mitochondria, Golgi Bodies, Endoplasmic Reticulum, Ribosomes, Lysosomes.

Chromosomes: Polygene and Lampbrush chromosomes, Euchromatin, Heterochromatin, Mutation. Gene: Structural alterations and their significance; Deletion, duplication, inversion, translocation.

Cell division: Mitosis and Meiosis, Cell cycle, Sex determination in Drosophila and Man. Molecular expression of gene action: Protein synthesis and its regulation. Lac Operon model.

Unit.2: Genetics **15 marks**

Mendel's laws, monohybrid and dihybrid cross, back cross, test cross, qualitative 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 and Adaptation **15 marks**

Neo Lamarckism, 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.

Zoogeographical regions of the world with fauna. Desert, cave and deep sea adaptation.

Unit.4: Ethology **10 marks**

Social behavior in honey bee and termites; parental care in insects, fishes and amphibian; migration in insect, fishes and birds. Courtship and defensive behavior in insects, fishes and birds.

Unit.5: Biotechnology and Bioinstrumentation **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 and Genetics, Evolution, Adaptation, Ethology, Biotechnology and Bioinstrumentation **25 marks**

Cell Biology and Genetics **7 marks**

Squash preparation of onion root tip for the study of mitosis

Temporary and permanent squash preparation of the grasshopper testis for the study of meiosis. Temporary preparation of the salivary gland chromosomes of Drosophila/Chironomus/Grasshopper and Rat. Study of permanent slides of Autosomes and Sex chromosomes of grasshopper and rat. Demonstration of Sex Chromatin (Barr body).

Adaptation and Ethology **5 marks**

Study of mimicry in insects: 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 and Bioinstrumentation**5 marks**

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

Preparation of standard curve of amino acid and protein.

Demonstration of oil emulsion technique in microscopy.

Separation of tissue extract using centrifuge.

Demonstration of electrophoresis-paper/gel

Practical records

3 marks

Viva-Voce

5 marks**RECOMMENDED BOOKS:**

1. DeRobertis, E.D.P and deRobertis, E.M.F. Cell and Molecular Biology. Holt-Saunders International Edn.
2. Gardener, E.J. Principles of Genetics. John Wiley and Sons Inc., New York.
3. Lehninger, A.L., Nelson, D.L and Cox, M.M. Principles of Biochemistry CBSD Publishers and Distributors, Delhi.
4. Srickberger, M.W.2005. Genetics. Prentice-Hall of India, New Delhi
5. Chandrasekharan, M.K. Biological Rhythm. Vishwanathan Printers, Chennai.
6. Lull, R.S.1976. Organic Evolution. Light and Life Publisher.
7. Plummer, D.T. An Introduction to Practical Biochemistry. Tata-McGraw Hill Publ., New Delhi.
8. Trehan, K. Biotechnology. John Willey and Sons.

PROPOSED SYLLABUS FOR BACHELOR OF SCIENCE**ELECTIVE ZOOLOGY (SEMESTER-VI)****ZOO-611: Animal Physiology, Histology, Developmental Biology and Biological Chemistry****75 marks****Unit.1: Animal Physiology****20 marks**

Nutritional requirements. Digestion and absorption of protein, carbohydrate 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 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**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**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 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.

ZOO-612P: Animal Physiology, Histology, Developmental Biology and Biological Chemistry**25 marks****Animal Physiology****7 marks**

Effects of isotonic, hypotonic and hypertonic solutions on erythrocytes

Counting of RBC and WBC using Haemocytometer

Estimation of haemoglobin percentage of a blood sample: Amphibia or mammal.

Preparation of haemin crystals.

Study of permanent slides**6 marks**

Study of permanent slides: Sections of pituitary, thyroid, adrenal, pancreas, testis and ovary.

Study of developmental stages of frog (permanent slides, WM): Cleavage, gastrula and neurula.

Study of developmental stages of chick (permanent slides, WM): 18,24,36,48 and 72 hours of incubation.

Study of permanent slides of sections of blastula and gastrula of chick and neurula and external gills of frog. Sections of oesophagus, stomach, duodenum, ileum, pancreas, lung, kidney and skin of mammal and amphibian.

Biological Chemistry **4 marks**

General test for identification of carbohydrate, lipid and protein

Practical Record **3 marks**

Viva-Voce **5 marks**

RECOMMENDED BOOKS

1. Ganong, W.F. Medical Physiology. McGraw-Hill Publ., New Delhi.
2. Guyton, A.C. and Hall, J.E. Textbook of Medical Physiology. 9th Edn., Elsevier, a division of Reed Elsevier India Pvt., Ltd.
3. Keele, C., Neil, E and Joels, N. Samson Wright's Applied Physiology. Oxford University Press, Bombay, Calcutta, Madras.
4. Prosser, C.L and Brown, F.A. Comparative Animal Physiology. W.B. Saunders Cor Philadelphia, Toppan Co. Tokyo, Japan.
5. Schil-Nelson, K. Animal Physiology, Adaptation and Environment. Cambridge University Press.
6. Turner, C.L. General Endocrinology. W.B Saunders, Toppan Co. Ltd., Tokyo, Japan.
7. Balinsky, B.I. Introduction to Embryology. Saunder College Publishers, Philadelphia.
8. Jayaramanan, L.1981. Laboratory manual on Biochemistry. New Age International Publishers, New Delhi-110002
9. Murray, R.K. Granner, D.K Maya, P.A and Rodwell, V.W. Harper's Biochemistry. McGraw Hill Publ.
10. Lehninger, A.I. Nelson, D.L and cox M.M. Principles of Biochemistry. CBSD Publishers and Distributors, Delhi.