West Bengal State University
Berunanpukuria,Barasat, North 24 Parganas,Kolkata:700126

Following is the syllabus finalized by the Under Graduate Board of Studies in Zoology, Fishery and Industrial fisheries, Sericulture of the W.B.S.U. for the 3-year B. Sc. Honours Course in Zoology. The Part I syllabus has been given in details here which is to be followed from the academic session of 2010-2011. A detailed curriculum on the Part I syllabus is also available now. The details of the Part II and Part III syllabus will follow.

ZOOLOGY

Full marks-800

B.Sc Part-I (1st Year) Zoology (Honours)

PART-I (200 Marks)

Paper-01: Diversity of Animals and Animal behaviours
Theory (Full Marks 100)

Module ZH101 : Living kingdoms and protozoans (10)

1. Introduction to the modern classification of living organisms into Kingdoms, magnitude of diversity of living organisms: estimated species richness

2. Introduction to the Kingdom Protozoa: Classifications (up to Phylum only) and examples; Special topics (brief outlines only): contractile vacuoles, structures of cilia, reproduction in *Paramoecium.*

Module ZH102: Non-Chordates (35)

1. Species diversity and classifications of non-chordate phyla (upto the levels as mentioned below) with salient features and prominent examples of the animal groups:
Poriferans, Cnidarians, Ctenophorans, Platyhelminths, Aschelminthes, Annelids, Molluscs, Echinoderms, Arthropods (upto subclass),
Rotifera, Bryozoa, Hemichordata (only salient features of the Phyla)

2. Special topics to understand the diversity of non-chordate structures and functions:
2.1 Body planes and symmetries, coelom, deuterostome vs protostome (only preliminary conceptual outlines)
2.2 Polymorphisms in Cnidaria
2.3 Coral reef: types, formation, distribution, conservation significance
2.4 Torsions in Gastropods
2.5 Cyclomorphosis in Rotifers
2.6 Excretion in invertebrates with special reference to flame cells, nephridia, coelomoducts and malpighian tubules
2.7 Gas exchange by gills and trachea in Arthropods
2.8 Water vascular system and haemal system in Echinoderms
2.9 Brief overview of invertebrate larval forms

Module ZH103: Chordates (35)

1. Chordate Classifications : (up to orders with salient features and examples, except for birds and mammals only names and examples of the orders)

2. Chordates: special topics reflecting diversity of adaptations
2.1 Feeding in Cephalochordates and Urochordates
2.2 Larval form and metamorphosis in Ascidians
2.3 Experimental analysis of function of a vertebrate structure: study of feeding strike of a venomous snake
2.4 Biting, venom delivery and feeding in snakes
2.5 General features of vertebrate integument and its specialization with reference to exoskeletons
2.6 Evolution of aortic arches in vertebrates
2.7 Evolutionary trend in vertebrate brains
2.8 Tripartite concept of kidney organization
2.9 Ruminant stomachs- Digestive tract specializations as fermentation chambers in herbivore mammals
2.10 Dentitions in vertebrates
2.11 Vertebrae: different types

Module ZH104: Animal Behaviour (20)

1. Tinbergen's four questions on studying animal behaviour;
2. Definitions and examples of– habituation, instinctive behaviour, FAP, imprinting and other programmed learning, cultural transmission
3. Social animals- advantages and disadvantages of living in a group, examples of social animals and outline of their social structures
4. Definition and examples of altruism, eusociality, units of selection (just preliminary ideas)

Paper 02: Evolution and Preliminary Knowledge for Quantification in biology Theory (Full Marks 50)

Module ZH201: Evolution (35)

1. Rise of evolutionary theories: the historical outline- conflict between creationists' idea and evolutionary theories, Lamark's theory, Theories proposed by Darwin and Wallace, modern form of Darwinian theory including modern synthehesis

2. H-W theorem and its significance in evolutionary theory, calculating gene frequencies for H-W and non-H-W populations (very simple problems only), Variations in natural populations.
3. Nature and actions of natural selection – evolution of industrial melanism in *Biston betularia* as example,
4. Genetic Drift, Gene Flow and Mutation Rate (only definitions and outlines of these processes, details of nature of actions by each, mathematical models not necessary)

5. Critical concepts (only preliminary and brief discussions)-
5.1 Application of the concept of adaptation- precise definition of adaptation in evolutionary sense, critique of `adaptationist program'
5.2 Trends in the evolution of modern horses- outlines only
5.3 Measurement of rates of evolution – with the example of equine teeth including allometry
5.4 Punctuationist vs. gradualist mode of evolutionary changes
5.5 Heterochrony – as a process of macroevolution, just definitions of the heterochronic processes and examples, including Neoteny and Progenesis
5.6 Process of speciation: concept of reproductively isolated species and models of speciation- Allopatric, Sympatric and Parapatric models

5.7 Recent knowledge about hominid evolution: a brief outline

Module ZH202: Preliminary knowledge for quantification in biology (15)

1. Logarithm, Matrices, Permutation and Combination, Probabilities (just preliminary concepts and very simple problems to be worked out)

2. Graphical representation of data- bar chart, histograms, scatter plots, pie charts; Discrete and Continuous variables- examples, Normal distribution (only primary characteristics and examples, detailed mathematical characterizations not required); Mean, Mode and Median, Standard deviation, Variance and Standard error; Simple Correlations; concept of Hypothesis Testing, Tests for goodness of fit- Chi-square, Student t-test for comparing means of two small samples from normal populations.

Paper-03: Practicals

(Full Marks 50)

Module ZH301: Morpho-anatomical studies (23)

Study of distinctive characters in the external morphologies of (5) -
Crab, Prawn, *Achatina* , *Pila*, *Lamellidens*, Honeybee, Spider, Leech, Sea Star, Dogfish, Flatfish, Rohu, *Mystus*, Toad, Frog, House lizard, Garden lizard, Checkered keelback snake, Russel's viper, Pigeon, Bat

Study of exoskeletons (3): fish scales (ctenoid, placoid and cycloid), feathers (different types found in a pigeon

Study of skeleton and identification of skulls (5):
Skeleton of a guinea-pig,
Skulls of- toad, garden lizard, venomous and non-venomous snakes, bird, dog.

Dissecting the body to reveal anatomical peculiarities (10): in cockroach: digestive system, nervous system, male and female reproductive systems; in *Tilapia*/*Oreochromis* (urino-genital system, brain and vagus distribution, pituitary gland)

Module ZH302: Identifying important and common animals (12)

Mention the systematic position, specimen name and specimen characters only for the following animals: *Paramoecium*, Sponge (*Scypha* and common freshwater sponge), Jelly fish, *Obelia* colony, *Taenia solium*, Liver fluke, *Ascaris*, *Nereis*, *Limnea*, *Bellamya*, Octopus, Cuttle fish, *Daphnia*, *Scylla*, *Ocypode*, *Penaeus*, Scorpion, Cerambycid beetle, Water scorpion, Preying mantis, Aphid, Earwig, Bumble bee, Potter wasp, *Polystes* wasp (common yellow wasp), Sea-star, Sea cucumber, Sea-urchin, Sea-lily, *Balanoglossus*, *Ascidia*, Amphioxus, *Petromyzon*, Myxine, Sting Ray, Flying fish, *Monopterus cuchia*, Caecilian, Tree frog, Salamander, Axolotl larva, Skink, *Varanus*, *Ptyas*, *Naja*, Russel's viper, Bandicoot, *Mus musculus*, Flying fox, Pippistrel bat

Module 303: Outdoor animal watching (5)

Field trips to any locations suitable for watching animals in their natural habitats and natural mood as much intensively as possible (for example, watching surface swimming insects in a stream or pond, the inter-tidal fauna in estuary or coast, bird watching, butterfly watching, etc.) and noting down own observations in a field diary.

Lab note book: 5 (should include actual lab sketches)

Viva voce: 5

***Readings Suggested* :**

Text Books

Pechenik, J.A., Biology of Invertebrates, TMH, 2002

Kardong, K. V., Vertebrates, 3rd ed., TMH ed.2002

Taylor, Green and Stout, Biological Sciences Cambridge LPE

Manning, A. and **M. S. Dawkins, M.S.,** An Introduction to Animal Behaviour, Cambridge Univ. Press, Indian Ed.

Ridley, Mark, Evolution, Blackwell, 2nd Ed., 1999

***Reference books* :**

Rupert, E.E**.,** R.S. **Fox and** R.D. **Barnes**, Invertebrate Zoology: A functional Evolutioanry Approach, Thomson, 7th Ed, 2004

Pough et al., Vertebrate Life, Pearson LPE, 6th ed., 2003

~~**Hildebrand,**~~ **M.,** Analyses of Vertebrate Structure**,** John Wiley & sons, 1995

Meglitsch, Paul A. & Frederick R. Schram, Invertebrate Zoology, OUP, 3rd edition,1991.

Gadagkar, R. Survival Strategies, Universities Press

Chapman, J.L. and **M.J. Reiss,** Ecology: principles and applications**,** Cambridge LPE

Futuyma, D., Evolutionary Biology, Sinauer Associates

And relevant web materials

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ZOOLOGY

B.Sc Part-II (2nd Year) Zoology (Honours)

PART II - 300 Marks

Paper-IV (Theory) : Genetics, Cell and Molecular Biology, Biochemistry and Biophysics (100)

Group A (50) : Genetics, Cell Biology and Molecular Biology

Module 401: Genetics (20)

1. Significance of Mendel's experiments and laws, Concepts and examples of -Test Cross and Back Cross, Incomplete Dominance/Codominance, Multiple Alleles, Epistasis, Polygenic inheritance
2. Chromosomal aberrations, gene mutations and human diseases (Down's, Klienfelter's, Turner's, Cri du Chat, Sickle cell, Haemophilia, Thallassimia, Albinism – only genetical aspects here, details of physiological consequences not required), Sex chromosomes and sex-linked inheritance
3. Linkage and Recombination – Types and outcome, linkage disequilibrium, 3-point cross

Module 402: Cell Biology and Molecular Biology (30)

1. Units of biological measurements and microscopy
2. Plasma membrane : lipid bilayer, membrane proteins and membrane transport - brief outline only
3. Other organelles : introduction to structure and functions of mitochondria, GERL
4. Cell Cycle : preliminary concept
5. Replication : only outline of the mechanisms
6. Transcription : only outline of the mechanisms
7. Translation : only outline of the mechanisms
8. Gene expression-lac operon, trp operon (only introductory outline of the processes)
9. Types of mutations
10. Transposable genetic elements (preliminary introductions)
11. Genetic engineering- preliminary concepts and common examples
12. Introductory principles of common methods used in cellular and molecular biology: PCR, RFLP, DNA fingerprinting, Gene sequencing

Group B : Biochemistry and Biophysics (50)

Module 403: Biochemistry (30)

1. Chemical evolution of biomolecules (outline only)
2. Biological significance of water
3. Structural identities of biomolecules : Carbohydrates, Amino Acids, Peptides, Lipids (preliminary outlines of lipids), nucleic acids
4. Enzymes (major classes of enzymes –mode of actions and examples) and enzyme kinetics
5. Metabolic pathways: Glycolysis, HMP shunt, Kreb's cycle, electron transfer system (outline), Gluconeogenesis, Glycolysis, beta oxidation,

Module 404 : Biophysics (20)

1. Three-dimensional structure of proteins (preliminary concepts only) : peptide bonds, alpha helix, beta conformation, common examples of globular proteins
2. Structure of nucleic acids (preliminary concepts only) : DNA and RNAs
3. Chromosome structure including Nucleosomes (preliminary concepts only)
4. Introductory principles of common methods used in biochemistry and biophysics : Chromatography, Ultracentrifuge, Electrophoresis, X-ray crystallography, Immunoeletrophoresis & Western blotting

Paper V (Theory): Taxonomy, Ecology, Biodiversity & Microbiology, Parasitology, Immunology (100)

Group A (50): Taxonomy and Systematics, Ecology and Biodiversity

Module 501: Taxonomy and Systematics (10)

1. Modern definitions of taxonomy and systematics, philosophy and working of modern taxonomy, Linaean hierarchy,
2. Concept of a species in taxonomic practice
3. ICZN and its important rules,
4. Cladistics: simple introductory concept and examples.

Module 502: Ecology (25)

1. Ecology of populations: survivorship curves, life history tables, age-sex pyramids, population growth models (exponential and logistic models only)
2. Ecology of communities : defining a community, measuring species diversity, species interactions (competition and coexistence, predation, herbivory, mutualism), succession and concept of climaxes, Theory of Island Biogeography (introductory concepts only)
3. Ecosystems ecology: trophic structure, energy flow, nutrient cycling

Module 503 : Biodiversity and Wildlife Conservation (15)

1. Biodiversity: concept of biodiversity, Importance of biodiversity, biodiversity hotspots, India- a megadiversity country, CBD, Indian Biodiversity Act.
2. Wildlife Conservation: Major forest types and their locations in India, Major wildlife of India - their Indian distribution, present status, conservation efforts (PAs- major sanctuaries and national parks, Indian Wildlife Act, IUCN categories, Project tiger as a case study)

Group B (50): Microbiology, Parasitology, Immunology

Module 504: Microbiology (15)

1. The study of microbial structure
2. Microbial Nutrition
3. Microbial growth
4. Control of Microorganisms by Physical and Chemical agents
5. Pathogenicity of Microorganisms
6. Human diseases caused by Virus (polio, avine influenza) Bacteria (cholera, tuberculosis), Fungi (ringworm)

Module 505: Parasitology (15)

1. Concept of parasitism
2. Origin and evolution of parasitism, host parasitic interactions,
3. Parasitic adaptation: physiological, bio-chemical, Zoonosis, Myasis
4. Identifying characters, life cycles, mode of infections of important parasites – *Entamoeba*, *Giardia, Fasciola, Taenia, Ascaris*

Module 506: Immunology (20)

1. What is Immunology: a short preview of the development of the subject
2. Innate (Nonspecific) and Acquired (Specific) immunity.
3. Central dogma of Immune system: (a) Cells of Immune system (b) Organs of Immune system- Primary & Secondary lymphoid organs.
4. Concept of Antigen & Antigen Presentation: Antigenic determinant (for ABO and Rh group only)
5. The Major Histocompatibility Complex : Antigen processing & presentation
6. Concept of T Cell-Antigen recognition and activation [Intracellular signal transuding enzymes excluded] : Structure and function of TCR complex, APC-T Cell interaction,
7. Concept of B Cell Activation and Antibody production [Intracellular signal transuding enzymes excluded]: Structure & Function of Immunoglobins [class switching among Immunoglobin gene excluded].Antigenic determinants of Immunoglobins (Isotype, Allotype & Idiotype).
8. Cytokines (source & function of IL-1, IL-2, IL-4, IL-5, IL-6, IL-8, IL-10, IL-12, Interferons, Tumor Necrosis Factors, Tumor Growth Factors, GM-CSF, M-CSF).
9. The Complement System (Basic concepts & Types only)
10. Techniques in Immunology: ELISA, RIA, Immunodiffusion Techniques,

Paper VI: Practicals (100)

Group A : 50

1. Pedigree analyses (8) : simple pedigrees of Mendelian and common sex-linked traits
2. Statistical tests of data and decision making (8) : Chi square test for goodness of fit and student t test for comparing means of two small samples from normal populations (paired/unpaired)
3. Database preparation, analyses and graphical presentation by EXCEL in Microsoft/Open Office (7)
4. Ecological study (12) – Sampling techniques in field ecology- Quadrat, Transects, Pitfall, Measuring species diversity of given sample of a community
5. Documentation of local fauna (5): documentation of different species of wild birds, mammals, butterflies, mollusks, fishes, amphibians, reptiles, any other common group of animals (any one group to be chosen by the college for a year and not to be repeated in succeeding year) found naturally in the localities around the college.
6. Viva voce (5)
7. Lab Note book (5)

Group B : 50

1. Uses of microscope, stages and occular micrometer and camera lucida for cellular study (5)
2. Chromosome preparations : Onion root tip (mitotic stages), Grasshopper testes (meiotic stages) and Drosophila larvae (Polytene chromosome and imaginal disc) (15)
3. Biochemical tests (20)- Qualitative tests for unknown carbohydrates and proteins, colorimetric assay of protein (Lowry's method) and glucose (Nelson and Somogyi method), Preparation of Buffers – PBS, TRIS-Cl,
4. Viva voce (5)
5. Lab Note book (5)

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Text books and references will be prescribed along with the detailed curriculum, soon to be available in this website

Module 401: **Genetics**

Text Book :

Principle of Genetics by Robert H. Tamarin
TMH, 2002
Or
Principles of Genetics by Gardner et al.
8th Ed. Wiley Paper back

References :

Genetics : Analysis of Genes and Genomes by Hartl and Jones; 6th ed., Jones and Bartlett publishers, 2005
Genetics by Strickberger

Compiled by : Suman Debnath
(Bidhannagar Govt College) 2013-16

Module 402: **Cell and Molecular Biology**
Text Book :
Chapters on Cellular structures and Molecular Biology in Integrated Principles of Zoology by Hickman, Roberts and Larson; McGrew Hill
or
Principle of Genetics by Robert H. Tamarin
TMH, 2002
Or
Principles of Genetics by Gardener et al.
8th Ed., Wiley Paperback
References :
Molecular Biology of the Cell by Alberts et al.
Molecular Biology of the gene by Watson et al.
Lehninger Principles of Biochemistry by Nelson and Cox

Module 403: **Biochemistry**
Text Book :
Chapters on Biomolecules and biochemical processes in Integrated Principles of Zoology by Hickman, Roberts and Larson; McGrew Hill
or
Lehninger Principles of Biochemistry by Nelson and Cox
Or
Biochemistry by Stryer
References :
Harper's Illustrated Biochemistry, 28th ed.

Module 404: **Biophysics**
Text Book :
Lehninger Principles of Biochemistry by Nelson and Cox
Or
Biochemistry by Stryer
References :
Standard Internet Sources

Module 501: **Taxonomy and Systematics**
Text Book :
Taxonomy and Systematics by Mayr and Ashlock
References :
Standard internet sources

Module 502: **Ecology**
Text Book :
Ecology : Theory and applications by Peter Stiling, PHI-EEE, 4th edition
References :
Ecology: principles and applications by Chapman and Reiss, Cambridge Low Priced ed.,
Ecology by Charles Krebs

Module 503: **Biodiversity and Wildlife Conservation**
Text Book/ source :

Webpages for Biodiversity, Indian Forests and Wildlife at en.wikipedia.org/wiki
Biodiversity Profile of India in Madhav Gadgil's Home page at
ces.iisc.ernet.in/hpg/cesmg/indiabio.html
Biodiversity and Species category Homepages at www.iucn.org

Module 504: **Microbiology**
Text Book :
Microbiology by Prescott, Harley & Klein, 5th Edition; 2002
Or
Microbiology by Pelczar et al. Mc Grew Hill, 5th Ed.
References :
Standard internet sources

Module 505: **Parasitology**
Text Book :
Outlines & Highlights For Human Parasitology By Roberts and Janovy, Academic Internet Publishers, 6th Ed.
Or
Parasitology by Bogitsh, Carter and Alteman, Academic Press, Indian Edition, 2006

References :
Outlines & Highlights For Human Parasitology By Bogitsh**,** Academic Internet Publishers

Module 506: **Immunology**
Text Book :
NMS-Immunology by R. Hyde, Williams and Wilkins
Or
Basic Immunology : Functions and disorders by Abbas and Litchman, W. B. Sanders & Co.
References :
Kuby's Immunology by Goldsby, Kindt and Osborn, W.H. Freeman

Background reading: Students are advised to read thoroughly the following text book before reading topics in the text books specified above to develop their fundamental understanding of the subjects.

Integrated Principles of Zoology by Hickman et al., McGrewHill 11th ed. or later editions. (Free downloadable soft copies of the book is also available through internet)

Students are also to be encouraged to use free internet sources including free downloadable softcopies of books on relevant subjects

For achieving good results, students are advised to study prescribed text books and other reading materials thoroughly and thoughtfully instead of mugging readymade notes.

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ZOOLOGY

B.SC Part-III (3rd Year) Zoology (Honours)

Part III – 300 Marks

Paper-VII (Theory): Animal Physiology, Endocrinology and Reproductive biology, Histology (100)

Module 701: Animal Physiology (40)

1. Transport across cell surface membrane. Donnan membrane equilibrium
2. Functions of mammalian blood: Oxygen transport and CO2 transport
3. Neurophysiology: Generation of action potential and propagation of nerve impulse in myelinated and non-myelinated nerve fibers. Synaptic and neuro-muscular junctions: structure and functions
4. Respiration: Gill respiration in fishes, respiration in air-breathing fishes, respiration in Avian lungs
5. General architecture of skeletal (striated) muscles and smooth muscle: Ultrastructure of skeletal muscle sarcomere, molecular structure of actin and myosin. Muscle contraction: sliding filament theory
6. Swim bladder and its function in teleost fishes
7. Water and osmotic regulations: problems in marine cyclostomes, elasmobranchs and teleosts, freshwater teleosts, in hot desert environment (camel) and examples of significant adaptations solving it by different animal groups
8. Urine formation in human kidney
9. Bioluminescence: occurrence, mechanism of production

Module 702: Endocrinology and Reproductive Biology (40)

1. Classification of vertebrate hormones based on chemical nature and mechanism of action (names and examples only)
2. Hormone delivery systems: Endocrine, neuroendocrine, paracrine, neurocrine, autocrine (Definitions and examples only)
3. Feedback control of hormone secretion: negative and positive.
4. Hormone biosynthesis (including sites of synthesis, outlines only): Thyroid hormones (T3, T4), testosterone, estrogen, progesterone, adreno-cortical hormones, Insulin, Adrenal catechol amines
5. Physiologic functions of hormones: Insulin, glucagon, T3 and T4
6. Hormonal control of spermatogenesis
7. Hormonal control of mammalian ovarian cycle, differences between estrous and menstrual cycle
8. Mechanism of hormone actions (outline only): Cytoplasmic receptor, nuclear receptor, membrane receptor, HRE, HSP, cAMP, cGMP, IP3–DAG, tyrosine kinase, calcium- calmodulin

9. Endocrine disorders (symptoms and causes only): Diabetes insipidus; IDDM & NIDDM, Hypothyroidism and Hyperthyroidism, Conn's and Cushing's syndrome

Module 703: **Histology (20)**

1. Basic tissue types: epithelial, connective, cardiac and nervous tissue (typical structure of neuron and types of neuron, glial cells, etc.
2. Membrane specializations of epithelia. (Intercellular surface [cell junctions], luminal surfaces and basal surfaces)
3. Exocrine glands: Types of and discharge of secretory products (merocrine, apocrine, holocrine)
4. Principles of tissue fixation, staining
5. Histology of: stomach, pancreas, testis, ovary, thyroid, lymph node (outline of structures)
6. Histological structure of mammalian nephron and functions of each regions

Paper VIII (Theory): Developmental biology, Environmental Pollutions and Toxicology, Medical Zoology, Economic Zoology (100)

Module 801: **Developmental Biology (30)**

1. Outlines of historical concepts and experience in emergency of developmental biology- Induction, Fate map, Spemann and Mangold's organizer transplant experiments, von Baer's laws
2. Germ layers and its contributions to the development of different tissues in vertebrates
3. Origin of germ cells. Structural features of sperms n eggs in sea urchins and in mammals. Gametogenesis in mammals
4. Fertilization: external fertilization in sea urchins, internal fertilization in mammals (in depth molecular details not required)
5. Cleavage: Types of cleavage found in animals and animals groups that exhibit a type, outlines of cleavage process in *C. elegans*, Zebra fish, *Xenopus* and chick
6. Gastrulation: generalized patterns, brief outlines of the process in *C. elegans*, Zebra fish, *Xenopus* and chick
7. Organogenesis: development of brain in chicken
8. Conceptual outlines (very brief) of – Cell potency and stem cells, sex determination in *Drosophila* & Man, Environmental sex determination in reptiles, HOX genes in development

Module 802: **Environmental Pollutions and Toxicology (20)**

1. Environmental pollutions (nature of sources of pollutants, impact on ecosystems and humans, remedies): water, soil, air and sound pollutions
2. Environmental laws: major ones applicable in West Bengal
3. Toxicology: including its significance as a branch of Science
4. Dose-response relationships
5. In Vivo and In vitro toxicity tests
6. Introduction to the concepts of detoxification mechanisms

Module 805: **Medical Zoology (15)**

1. Mosquito-borne diseases: Malaria and Filaria - causative agents and their life cycle, mode of infections in man, major modes of treatments, major vector species in India, their ecology and life cycles, control measures
2. Mosquito-borne diseases: Dengue and DHF, Chikungunya - causative virus, symptoms and treatments
3. Visceral Leishmaniasis (Kala Azar) - causative species and vectors in West Bengal
4. Common ticks and mites in human surroundings and diseases caused by them

Module 806: **Economic Zoology (35)**

1. Fishes and fishery: Diversity of indigenous freshwater, estuarine, marine fishes and shell fishes in West Bengal. Invasive and exotic species of fishes in West Bengal. Techniques of modern pisiculture and prawn culture. Problems related to wild prawn seed collections in Sunderbans, fish productivities in India and West Bengal, ecology and degradation of freshwater fish habitats and decrease in wild fish stocks (very brief idea)
2. Sericulture: Silks and Silk worms, sericulture practices – methods, scopes and problems
3. Apiculture: Honey bees and their behaviors in relation to bee-keeping, popular methods of beekeeping, scopes and problems
4. Lac culture: Lac and lac insects, host plants and lac cultivation, scopes and problems
5. Poultry birds: Different breeds, their advantages and disadvantages, importance of indigenous breeds
6. Cattle, goat and lambs: Different breeds, their advantages and disadvantages, importance of indigenous breeds

Paper IX: Practical (100)

Group A: 50

1. Physiology: Blood slide preparations (from goat/rat) to identify and study the characteristic features of different types of WBC, total count of WBC. Determination of hemoglobin content of goat/rat blood by Sahli's haemoglobinometer. Human blood pressure and Pulse measurements, etc. (15)

2. Microtomy: Paraffin section cutting and mounting, H & E staining of histological tissues and identifying the stained slide (name, identifying characters only). [Fixation and paraffin embedding procedure should be demonstrated in the class] (15)

3. Determination of soil and water pH (with pH meter); Quantification of free CO2 and dissolved O2 (Winkler's method) in water sample (10)

4. Viva voce (5)

5. Lab Notebook (must include actual lab notes and sketches) (5)

Group B: 50

1. Developmental Biology: Identification of chick's embryonic stages (at 24, 48, & 96 hours of incubation. Identification of fry stages of carp fish (any cultivated carp species) (10)

2. Morpho-metric studies: Mouth parts and fins of fishes (any major carp, *Mystus,* Tilapia), different aspects of *Acatina, Pila, Bellamya,* Ants (Total length, Head length, Trunk and Petiole length, Gaster length of any size big sized easily identity effectively available ant like *Camponotus, Oecophila,* and *Tetraponera*) (15)

3. Medical entomology: Identification of *Culex, Aedes* and *Anopheles* mosquitoes from whole mount dry specimens. Identification of *Plasmodium, Entamoeba, Giardia, Fasciola, Ascaris, Wuchereria* (15)

4. Viva voce (5)

5. Lab Notebook (must include actual lab notes and sketches) (5)

Typed By : Abhinav Bagchi (Vc College)
Edited By : Suman Debnath (Bidhannagar College)

West Bengal State University

(Barasat, N-24 Parganas, India, Pin Code 700126)

SYLLABUS

For The

B.Sc in Zoology (Hons.)

The following syllabus* (Part II) *has been proposed by the UG-BOS in Zoology of W.B.S.U for being implemented from the year 2011

PART II - 300 Marks

Paper-IV (Theory) : Genetics, Cell and Molecular Biology, Biochemistry and Biophysics (100)

Group A (50) : Genetics, Cell Biology and Molecular Biology

Module 401: Genetics (20)

1. Significance of Mendel's experiments and laws, Concepts and examples of - Test Cross and Back Cross, Incomplete Dominance/Codominance, Multiple Alleles, Epistasis, Polygenic inheritance
2. Chromosomal aberrations, gene mutations and human diseases (Down's, Klienfelter's, Turner's, Cri du Chat, Sickle cell, Haemophilia, Thallassimia, Albinism – only genetical aspects here, details of physiological consequences not required), Sex chromosomes and sex-linked inheritance
3. Linkage and Recombination – Types and outcome, linkage disequilibrium, 3-point cross

Module 402: Cell Biology and Molecular Biology (30)

1. Units of biological measurements and microscopy
2. Plasma membrane : lipid bilayer, membrane proteins, membrane transport-brief outline
3. Other organelles : introduction to structure and functions of mitochondria, GERL
4. Cell Cycle : preliminary concept
5. Replication : outline of the mechanisms
6. Transcription : outline of the mechanisms
7. Translation : outline of the mechanisms
8. Gene expression-lac operon, trp operon
9. Types of mutations

10. Transposable genetic elements
11. Genetic engineering- concept and examples
12. Principles (outline) of common methods used in cellular and molecular biology: PCR, RFLP, DNA fingerprinting, Gene sequencing

Group B : Biochemistry and Biophysics (50)

Module 403: Biochemistry (30)

1. Biological significance of water
2. Structural identities of biomolecules : Carbohydrates, Amino Acids, Peptides and Proteins, Lipids (preliminary outlines of lipids)
3. Enzymes (major classes of enzymes –mode of actions and examples) and enzyme kinetics
4. Metabolic pathways (structure to be included) : Glycolysis, HMP shunt, Kreb's cycle, electron transfer system (outline), Gluconeogenesis, Glycolysis, beta oxidation,

Module 404 : Biophysics (20)

1. Diffusion, Osmosis, Donnan equilibrium,
2. Physico-chemical structure of nucleic acids : DNA and RNAs,
3. Nucleosome concept
4. Principles of common methods used in biochemistry and biophysics : Chromatography, Ultracentrifuge, Electrophoresis, X-crystallography, Immunoeletrophoresis & Western blotting

Paper V (Theory) : Taxonomy, Ecology, Biodiversity & Microbiology, Parasitology, Immunology (100)

Group A (50): Taxonomy and Systematics, Ecology and Biodiversity

Module 501: Taxonomy and Systematics (10)

1. Modern definitions of taxonomy and systematics, philosophy and working of modern taxonomy, Linaean hierarchy,
2. Concept of a species in taxonomic practice
3. ICZN and its important rules,
4. Cladistics: simple introductory concept and examples.

Module 502: Ecology (25)

1. Ecology of populations: survivorship curves, age-sex pyramids, population growth models (exponential and logistic models only)
2. Ecology of communities : defining a community, measuring species diversity, species interactions (competition and coexistence, predation, herbivory, mutualism), succession and concept of climaxes, Theory of Island Biogeography (introductory concepts only)
3. Ecosystems ecology: trophic structure, energy flow, nutrient cycling

Module 503 : Biodiversity and Wildlife Conservation (15)

1. Biodiversity: concept of biodiversity, Importance of biodiversity, biodiversity hotspots, India- a megadiversity country, CBD, Indian Biodiversity Act.
2. Wildlife Conservation: Major forest types and their locations, Major wildlife of India - their Indian distribution, present status, conservation efforts (PAs- major sanctuaries and national parks, Indian Wildlife Act, IUCN categories, Project tiger as a case study)

Group B (50): Microbiology, Parasitology, Immunology

Module 504: Microbiology (15)

1. The study of microbial structure
2. Microbial Nutrition
3. Microbial growth
4. Control of Microorganisms by Physical and Chemical agents
5. Pathogenicity of Microorganisms
6. Human diseases caused by Virus, Bacteria, Fungi and Protozoa (only major diseases caused by each)

Module 505: Parasitology (15)

1. Concept of parasitism, origin and evolution of parasitism, host parasitic interactions, parasitic adaptation: physiological, bio-chemical, Zoonosis, Myasis
2. Identifying characters, life cycles, mode of infections of important parasites – *Entamoeba*, *Giardia, Trypanosoma, Fasciola, Taenia, Ascaris*

Module 506: Immunology (20)

1. Overview & Concept of Immunology: Preview of development of this subject; Innate (Nonspecific) and Acquired (Specific) immunity.

2. Central dogma of Immune system: (a) Cells of Immune system and its know-how- Phagocytes and APCs (Dendritic Cell, Macrophage, Monocyte, Neutrophil, Basophil, Eosinophil), Mast Cell, T lymphocytes (Th1, Th2, Cytotoxic T cells, Tr and Tm), NK Cells, B Cells & Plasma Cells, Hematopoetic bone marrow cells. (b) Organs of Immune system- Primary & Secondary lymphoid organs.
3. Concept of Antigen & Antigen Presentation: Antigenic determinant, Change of antigenic determinant in ABO Blood group antigen, Rh Factor, The Major Histocompatibility Complex and its involvement in Antigen processing & Presentation, Structure of MHC molecules,
4. Concept of T Cell-Antigen recognition and activation [Intracellular signal transuding enzymes excluded] : Structure and function of TCR complex, APC-T Cell interaction, T Cell maturation in Thymus, Differentiation and function of T Cells (Th1, Th2, Cytotoxic T cells), Involvement of Physical & Chemical Co-stimulation (Co-stimulatory molecules, Cytokine & Chemokine).
5. Concept of B Cell Activation and Antibody production [Intracellular signal transuding enzymes excluded]: Structure & Function of Immunoglobins [class switching among Immunoglobin gene excluded].Antigenic determinants of Immunoglobins (Isotype, Allotype & Idiotype).
6. Cytokines (source & function of IL-1, IL-2, IL-4, IL-5, IL-6, IL-8, IL-10, IL-12, Interferons, Tumor Necrosis Factors, Tumor Growth Factors, GM-CSF, M-CSF).
7. The Complement System (Basic concepts & Types only), Hypersensitive Reactions (Basic concepts & Types only)
8. Techniques in Immunology: ELISA, RIA, Immunodiffusion Techniques,

Paper VI: Practicals (100)

<u>Group A</u> : 50

1. Pedigree analyses (10) : simple pedigrees of Mendelian and common sex-linked traits
2. Statistical tests of data and decision making (10) : Chi square test for goodness of fit and student t test for comparing means of two small samples from normal populations (paired/unpaired)
3. Database preparation, analyses and graphical presentation by EXCEL in Microsoft/Open Office (10)
4. Ecological study (15) – Sampling techniques in field ecology- Quadrat, Transects, Pitfall, Measuring species diversity of given sample of a community
5. Documentation of local fauna (5): documentation of different species of wild birds, mammals, butterflies, mollusks, fishes, amphibians, reptiles, any other common group of animals (any one group to be chosen by the college for a year and not to be repeated in succeeding year) found naturally in the localities around the college.

Group B : 50

1. Uses of microscope, stages and occular micrometer and camera lucida for cellular study (5)
2. Chromosome preparations : Onion root tip (mitotic stages), Grasshopper testes (meiotic stages) and chironomid larva (lampbrush chromosome) (20)
3. Biochemical tests (25)- Qualitative tests for unknown carbohydrates and proteins, colorimetric assay of protein (Lowry's method) and glucose (Nelson and Somogyi method), Preparation of Buffers – PBS, TRIS-Cl, Ringer's solution.

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Text books and references will be prescribed along with the detailed curriculum, soon to be available in this website

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Question patterns :

Questions of 1, 3 and 5 marks totalling the assigned marks for the module from each module in all paper.

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Please note that the marks and paper distribution for three years / parts of B.Sc. in Zoology (Hons) would be following. The syllabus and marks distribution for Part I remain as it is now ongoing (implemented for the first year of 2010-2011). *Any previously prescribed pattern of syllabus and marks distribution for the Part II and Part III for B.Sc. in Zoology (Hons) is to be ignored*.

PART-II : 300 Marks

Paper-04 (Theory): 100 marks

Group A: Genetic & Cell and Molecular Biology
Module 401: Genetics (20)
Module 402: Cell and Molecular Biology (30)

Group B: Biochemistry and Biophysics
Module 403: Biochemistry (30)
Module 404: Biophysics (20)

Paper 05 (Theory) : 100 marks

Group A : Taxonomy and Systematics, Ecology, Biodiversity and Wildlife Conservation (50)
Module 501: Taxonomy and Systematics (10)
Module 502: Ecology (25)
Module 503: Biodiversity and Wildlife Conservation (15)

Group B : Microbiology, Parasitogy and Immunology (50)
Module 504: Microbiology (15)
Module 505: Parasitology (15)
Module 506: Immunology (20)

Paper 06 (Practicals): 100 marks

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PART-III : 300 Marks

Paper-07 (Theory) : 100 marks

Module 701: Animal Physiology (40)
Module 702: Histology and Histopathology (20)
Module 702: Endocrinology and Reproductive Biology (40)

Paper-08 (Theory) : 100 marks

Module 801: Developmental Biology (35)
Module 803: Environmental Biology and Toxicology (20)
Module 804: Medical Zoology (10)
Module 805: Economic and Applied Zoology (35)

Paper 09: Practicals (100)

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West Bengal State University

(Barasat, N-24 Parganas, India, Pin Code 700126)

SYLLABUS

For The

B.Sc in Zoology (Hons.)

PART-III-300 Marks

***DRAFT SYLLABUS* (June 2012)**

Paper-VII: Theory (100)

Module 701: **Animal Physiology (40)**

1. Transport across cell surface membrane, Donnan membrane equilibrium
2. Functions of mammalian blood: Oxygen transport and CO_2 transport
3. Neurophysiology: Generation of action potential and propagation of nerve impulse in myelinated and non-myelinated nerve fibers. Synaptic and neuro-mascular junctions : structure and functions
4. Respiration: gill respirations in fishes, respiration in air-breathing fishes, respiration in avian lungs
5. General architecture of skeletal (striated) muscle and smooth muscle; Ultrastructure of skeletal muscle sarcomere, molecular structure of actin and myosin, Muscle contraction: sliding filament theory
6. Swim bladder and its functions in teleost fishes
7. Water and osmotic regulations : problems in marine cyclostomes, elasmobranchs and teleosts, freshwater teleosts, in hot desert environments(camel) and examples of significant adaptations solving it by different animal groups
8. Urine formation in human kidney
9. Bioluminescence: occurrence, mechanism of production

Text Book:
Animal Physiology by Kurt Neilsen-Schmidt, Cambridge Univ. Press, New Delhi, 2002 Indian Ed.
References:
Textbook of Medical Physiology by A.C. Guyton & J.E. Hall

Module 702: **Endocrinology and Reproductive biology (40)**

1. Classification of vertebrate hormones based on chemical nature and mechanism of action (names and examples only).
2. Hormone delivery systems: Endocrine, neuroendocrine, paracrine, neurocrine, autocrine (Definitions and examples only)

3. Feed back control of hormone secretion: negative and positive.
4. Hormone biosynthesis (including sites of synthesis, outlines only): Thyroid hormones (T_3, T4), testosterone, estrogen, progesterone, adreno-cortical hormones, Insulin, Adrenal catecholamines.
5. Physiologic functions of hormones: Insulin, glucagon, T3 and T4.
6. Hormonal control of spermatogenesis
7. Hormonal control of mammalian ovarian cycle, differences between estrous and menstrual cycle.
8. Mechanism of hormone actions (outlines only): cytoplasmic receptor, nuclear receptor, membrane receptor, HRE, HSP, cAMP, cGMP, IP3—DAG, tyrosine kinase, calcium-calmodulin
9. Endocrine disorders (*symptoms and causes only*): Diabetes insipidus; IDDM & NIDDM, Hypothyroidism and hyperthyroidism, Conn's and Cushing's syndrome.

Text Book :
Endocrinology by Turner and Baxter
References:
Textbook of Medical Physiology by A.C. Guyton & J.E. Hall

Module 703: **Histology (20)**

1. Basic tissue types: epithelial, connective, cardiac and nervous tissue(typical structure of neuron and types of neuron, glial cells etc)
2. Membrane specializations of epithelia. (Intercellular surface [cell junctions], luminal surfaces and basal surfaces.).
3. Exocrine glands: Types and discharge of secretory products (merocrine, apocrine, holocrine).
4. Principles of tissue fixation, staining,
5. Histology of: stomach, pancreas, testis, ovary, thyroid, lymph node. (Outline of structures).
6. Histological structure of mammalian nephron and functions of each regions.

Text Books :
Basic Histology: Text & Atlas by Luiz Carlos Junqueira et al. Macgrew-Hill (also visit-http://www.freeebook4u.net/2011/03/basic-histology-text-atlas-11th-edition.html)
References:
1. Histology: A Text and Atlas by Ross & Reith. Lippincott williams
2. Histology & Cell Biology by Kurt E. Johnson; Harwal Publishing Company
3. A Text book of Histology: practical guide by J.P. Gunashekharan, 2nd Ed. Elsivier India

Paper VIII: Theory (100)

Module 801: **Developmental Biology (30)**

1. Outlines of historical concepts and experiments in the emergence of developmental

biology- Induction, Fate map, Spemann and Mangold's organizer transplant experiments, von Baer's laws.
2. Germ layers and its contributions to the development of different tissues in vertebrates.
3. Origin of germ cells, Structural features of sperms and eggs in sea urchins and in mammals, Gametogenesis in mammals,
4. Fertilization: external fertilization in sea urchins, internal fertilization in mammals (in depth molecular details not required)
5. Cleavage : Types of cleavage found in animals and animal groups that exhibit a type, outlines of cleavage process in *C. elegans*, Zebra fish and *Xenopus* and chick
6. Gastrulation: generalized patterns, brief outlines of the process in *C. elegans*, Zebra fish, *Xenopus* and chick
7. Organogenesis : development of brain in chicken
8. Conceptual outlines (very brief) of – Cell potency and Stem Cells, Sex determination in *Drosophila* and Man, Environmental sex determination in reptiles. HOX genes in development

Text Books :
Principles of Development : by Lewis Wolpert, Jim Smith, Tom Jessell, Peter Lawrence (3rd Ed. OUP, India)
References :
Developmental Biology by Scott Gilbert

Module 802: **Environmental Pollutions and Toxicology (20)**

1. Environmental pollutions (nature and sources of pollutants, impacts on ecosystems and humans, remedies): water, soil, air and sound pollutions
2. Environmental laws: major ones applicable in West Bengal
3. Toxicology: including its significance as a branch of Science
4. Dose-response relationships
5. In vivo and In vitro toxicity tests
6. Introduction to the concepts of detoxication mechanisms

Text Books:
1. Rana, S. V.: Environmental Pollution - Health and Toxicology
2. Curtis D Klaassen: Casarett and Doull's Toxicology

Module 805: **Medical Zoology (15)**

1. Mosquito-borne diseases: Malaria and Filaria- causative agents, their life cycle, modes of infections in man, major modes of treatments, major vector species in India, their ecology and life cycles, control measures
2. Mosquito-borne diseases: Dengue and DHF, Chikungunya- causative virus, symptoms and treatments

3. Visceral Leishmaniasis (Kala-azar)- causative species and vectors in West Bengal
4. Common ticks and mites in human surroundings and diseases caused by them

Text Book:
Hati, A. K., Medical Entomology, Allied Publishers

Module 006: **Economic Zoology (35)**

1. Fishes and fishery: diversity of indigenous freshwater, estuarine, marine fishes and shell fishes in West Bengal. Invasive and exotic species of fishes in West Bengal. Techniques of modern pisciculture and prawn culture. Problems related to wild prawn seed collections in Sunderbans, fish productivities in India and West Bengal, ecology and degradation of freshwater fish habitats and decrease in wild fish stocks (very brief idea)

2. Sericulture: silks and silk worms, sericulture practices- methods, scopes and problems

3. Apiculture: Honey bees and their behaviours in relation to bee-keeping, popular methods of bee keeping, scopes and problems

4. Lac culture: Lac and lac insects, host plants and lac cultivation, scopes and problems

5. Poultry birds: different breeds, their advantages and disadvantages, importance of indigenous breeds

6. Cattle, goats and lambs: different breeds, their advantages and disadvantages, importance of indigenous breeds

Text Books:
Economic Zoology- Shukla and Upadhyaya. Rastogi Pub., 2nd Ed, 2005
References :

- Fish and Fisheries of India by Jhingran. Hindustan Publishing
- Encyclopedia of Economic Zoology. 2 vols. By Khan, A. A. (Editor), 2007. Anmol Publications. 2007
- Freshwater Aquaculture by Santhanam *et al.*
- Aquaculture by T. V. R. Pilley
- Animal Husbandry by G. C. Banerjee
- Sericulture & Silk Industry by D. C. Sarkar
- Lac Culture by N. Ghorai
- Bee keeping in India by ICAR
- Livestock & Poultry Production by Singh and Moore

Paper IX: Practical (100)

GROUP A : Full Marks 50

1. Physiology: Blood slide preparations (from goat/rat) to identify and study the characteristic features of different types of WBC, total count of WBC. Determination of haemoglobin content of goat/rat blood by Sahli's haemoglobinometer. Human B.P. and pulse measurements etc. (15)

2. Microtomy: Paraffin section cutting and mounting, H&E staining of histological tissues and identifying the stained slide (name, identifying characters only). [fixation and paraffin embedding procedure should be demonstrated in the class] (15)

3. Determination of soil and water pH (With pH meter); Quantification of free CO_2 and dissolved O_2 (Winkler's Method) in water sample (10)

4. Viva voce (5)

5. Lab Note Book (must include actual lab notes and sketches) (5)

Group B : Full Marks 50

1. Developmental Biology: Identification of chick's embryonic stages (at 24, 48 & 96 hrs. of incubation. Identification of fry stages of a carp fish (any cultivated carp species) (10)

2. Morpho-metric studies: mouth parts and fins of fishes (any major Carp, *Mystus*, Tilapia), different aspects of shells of *Acatina*, *Pila*, *Bellamya*, Ants (Total length, Head length, Trunk and Petiole length, Gaster length of any big sized easily available ant like *Camponotus*, *Oecophila, Tetraponera*) (15)

3. Medical entomology: Identifications of *Culex, Aedes* and *Anopheles* mosquitoes from whole mount dry specimens. Identification of *Plasmodium, Entamoeba, Giardia, Fasciola, Ascaris, Wuchereria* (15)

4. Viva voce (5)

5. Lab Note Book (must include actual lab notes and sketches) (5)