VIDYASAGAR UNIVERSITY

ZOOLOGY

(Honours & General)

Under Graduate Syllabus

(3 Tier Examination Pattern)

w.e.f. 2014-2015

REVISED

Vidyasagar University

Midnapore 721 102

West Bengal

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Syllabus for Three-Year Degree-Course
Zoology (Hons.)

Part-I

Paper- I : Theory	100 marks (90+ 10)
Gr. - A: Non-Chordata	50 marks
Gr. - B: Chordata	50 marks
Paper-II : Theory	100 marks (90+ 10)
Gr. - A: Cell biology, Cytogenetics & Developmental Biology	50 marks
Gr. - B: Bio-systematics, Adaptation & Evolution	50 marks

Part-II

Paper- III: Theory	100 marks (90 + 10)
Gr.-A: Ecology, Ethology, Environmental Biology & Environmental Management	50 marks
Gr. - B: Parasitology, Immunology, Biodiversity & Economic Zoology	50 marks
Paper- IV: Theory	100 marks (90 + 10)
Gr. - A: Microbiology, Biostatistics, Computer Application & Bioinformatics	50 marks
Gr. - B: Histology, Histochemistry, Endocrinology & Bioinstrumentation	50 marks
Paper – V: Practical	100 marks
Unit - A : Dissection, Computer Application	
Unit - B : Cytogenetics, Histology, Histochemistry & Developmental Biology	

Part- III

Paper- VI : Theory	100 marks (90 + 10)
Gr. - A: Molecular Biology & Biotechnology	50 marks
Gr. - B: Animal Physiology, Biochemistry &	50 marks

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Biophysics	
Paper- VII: Practical	100 marks
Unit - A : Parasitology, Immunobiology & Microbiology	40 marks
Unit - B : Animal Physiology, Biochemistry & Biophysics	40 marks
Unit - C : Laboratory Note Book and Viva Voce	20 marks
Paper- VIII :Practical	100 marks
Unit - I : Experiments on Ecology & Environmental Management	25 marks
Unit II: Identification	40
Project work	10
Unit - III : Field report, Laboratory Note Book and Viva Voce	25 marks

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Zoology Honours Syllabus
Part - I
Paper – I : Theory (University Exam -90, Assignment -10)
F. M. : 100 Marks

Group - A : Non-chordata **F. M. : 50 Marks**

1.	Distinguishing characters & classification of Protozoa (upto Phyla)	2
2.	Structural organisation of *Paramoecium* sp.	2
3.	Amoeboid movement and nutrition in Protozoa.	2
4.	Distinguishing characters and classification of Porifera (upto sub-class).	2
5.	Skeletal elements and canal system of Porifera.	2
6.	Distinguishing characters and classification of Cnidaria (upto sub-class).	2
7.	Polymorphism of Cnidaria.	2
8.	Coral reefs (types, formation, distribution and conservation).	2
9.	Structural organisation of *Hormiphora* sp and its systematic position.	2
10.	Distinguishing characters and classification of Platyhelminthes (up to sub-class).	2
11.	Structural organisation of *Fasciola* sp. and its life-cycle.	2
12.	Distinguishing characters and classification of Nematoda (upto sub-class).	2
13,	Structural organisation of *Ascaris* sp. and its life-cycle.	2
14.	Distinguishing characters and classification of Annelida (upto subclass),	2
15.	Structural organisation of *Pheretima* sp.	2
16.	Distinguishing characters and classification of Arthropoda (upto class).	2
17.	Structural organisation of *Periplaneta* sp.	2
18.	Respiration in Arthropoda.	2
19.	Distinguishing characters and classification of Mollusca (upto stub-class).	2

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20.	Structural organisation of *Pila* sp.	2
21.	Torsion in Mollusca.	2
22.	Distinguishing characters and classification of Echinodermata (upto sub-class).	2
23.	Structural organisation of *Asterias* sp.	2
24.	Systematic position of *Peripatus sp*.	2
25.	Systematic position of *Balanoglossus sp*.	2

(Classification as per Levine et al., 1980 for Protozoa; Ruppart-Barnes, 1994, Porifera to Annelida ; Parker & Haswell, 1972 for Arthropoda to Echinodermata)

Group- B : Chordata **F. M. : 50 Marks**

1.	Classification of Chordata (upto order).	7
2.	Structural organisation & life-history of *Ascidia sp.*	2
3.	Structural organisation of *Petromyzon* and Ammocoetes larva	2
4.	Anatomical peculiarities and systematic position of Dipnoi.	2
5.	Accessory respiratory structures in fishes.	2
6,	Axolotl larva and its importance.	2
7.	Anatomical peculiarities and systematic position of *Sphenodon sp*.	2
8.	Poison apparatus and biting mechanism of snakes.	2
9,	Aerodynamics in the flight mechanism of birds.	2
10.	Anatomical peculiarities of Monotremata	2
11.	Structural organisation of *Cavia porcellus*.	6
12.	Exoskeletal, structures of birds & Mammals.	5
13.	Echolocation in Mammals.	2
14.	Comparative study of (i) Heart & aortic arches in vertebrates, (ii) Kidney in invertebrates, (iii) Brain in vertebrates.	12

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(Classification as per Young, 1981)

Paper-II Theory

F. M. : 100 Marks (University Exam - 90, Internal Assessment - 10)

Group- A : Cell biology, Cytogenetics & Developmental Biology

F. M.: 50 Marks

1.	Cytological techniques - cell fractionation, homogenization & cell centrifugation.	2
2.	Ultrastructure & function of Plasma Membrane, Mitochondria, Golgi complex, Endoplasmic Reticulum and Lysosome.	9
3.	Nucleic Acids: DNA: Physico-chemical structure, Chromosomes-Nucleosome concept, RNA: types, structure & function. Chromosomal changes during cell division.	9
4.	Allele concept and allelic interaction- multiple allele (ABO blood group).	3
5.	Genetic determination of sex with special reference to *Drosophila* and man.	3
6.	Linkage and Crossing over; Cytological demonstration of crossing. over-Holliday model	2
7.	Gene maping in diploid (three point).	3
8.	Gene as a structural & functional unit- one gene-one polypeptide; sickle cell anaemia; cistron concept.	3
9.	Outline knowledge of gametogenesis. Ultrastructure of sperm & ovum	2
10.	Physical & molecular events in fertilization; Egg types and role of yolk in cleavage.	2
11.	Comparative account of blastula of *Branchiostoma*, Frog & Chick.	2
12.	Morphogenetic movements and fate-map.	2
13.	Process of gastrulation in Frog & Chick.	2
14.	Role of organisers in development; Transplantation experiments of Speeman & Mangold; Chemistry of Organiser.	2
15.	Organogenesis-Development of brain and eye in chick.	2

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16. Formation and fate of extra-embryonic membrane in chick. 1
17. Placenta-types, structure and function in rodents. 1

Group B: Biosystematics, Adaptation & Evolution F. M. : 50 Marks

1. Geological time scale, fossils & dating mechanisms. 4
2. Zoogeographical realms & their characteristic fauna with special reference to oriental region 3
3. Barriers, dispersals & their impact on animal distribution. 3
4. Continental drift mechanism and its impact on faunal distribution. 2
5. Theories on the Origin of Life. 4
6. Modem concept of evolution: i) Variation and sources of variations in a population, ii) Hardy-Weinberg equilibrium; Forces altering Hardy-Weinberg equilibrium (non-random mating, genetic drift & natural selection); Founder effects & Population ~bottleneck 10
7. Adaptive radiation & adaptive convergence in mammals; Desert adaptation in animals; Migration of fish and bird. 4
8. Origin of bird. 3
9. Colouration & mimicry: Adaptive significance. 1
10. Species concept: i) Typological, ii) Nominalistic, iii) Biological. 3
11. Taxonomy& Systematics: Definitions, taxonomic levels, types, brief idea of modem trends in taxonomy. 3
12. Early development: spiral and radial cleavage.
    Protostomes and Deuterostomes
    Body cavities: acoelomates, pseudocoelomates, coelomates (schizo and enterocoelomates).
    Homology and analogy. 4
12. Concept & importance of classification; Principles of zoological nomenclature. 3
13. Modern approach of classification including numerical, DNA hybridization & GC content techniques. 2
13. Modes of speciation: sympatric, allopatric & parapatric processes. 1

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Part-II
Paper- III : Theory
F. M. : 100 Marks (University Exam – 90, Internal Assessment - 10)
Group- A : Ecology, Ethology , Environmental Biology and Environmental Management
F. M. : 50 Marks

1. Introduction, subdivisions & scope of ecology. 2
2. Concept and Components of Ecosystem; Ecological factors: i) Abiotic: light and their effects on animals, ii) Biotic: intra-specific and inter~specific associations. 6
3. Energy flow in an autotroph based ecosystem. 3
4. Population Ecology : Natality & mortality, growth forms, age pyramids, regulation of population density. 5
5. Community Ecology: habitat & niche concept, species diversity. 4
6. Ecological succession. 2
7. Introduction to animal behaviour. 2
8. Innate and learned behavior; fixed action pattern. 6
   Learning and memory.
09. Biological rhythm. 4
10. Communication: Bee's dance language. Auditory signals, chemicals and bioluminescence in communication. 8
11. Environmental toxicology: LC_{50}; LD_{50}, acute & chronic toxicity. 4
12. Environmental degradation: natural & man-made pollution; nature, sources & effects of major pollutants of air, water & soil; noise pollution. 4

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Group - B : Parasitology, Immunology, Biodiversity and Economic Zoology **F.M. : 50 Marks**

1. Basic facts related to Parasitology, related terminologies. 2
2. Life cycle, pathogenicity, clinical features, control and zoonotic aspects of i) *Plasmodium vivax and falciparum*, ii) *Entamoeba histolytica* iii) *Wuchereria bancrofti*, iv) *Echinoccous granulosus*. 4
3. Vectors: Bio-ecology of Mosquitoes & Ticks; role in disease transmission and control. 2
4. Cells and organs in Immunity; Outline structure and classification of immunoglobulin; Concept of antigen, hapten, carrier and adjuvant. Antigen-antibody interaction. 2
5. Acquired & innate immune system with special reference to process, types and principle of vaccination. 2
6. Humoral and cell mediated immune system with special reference to T & B Cell co-operation; antibody production and role of T cells, cytokines. 5
7. Immunological techniques (outline only): Gel diffusion; Immunoelectrophoresis; Immunofluoroscence, RIA; ELISA and monoclonal antibody technique. 4
8. Concept of biodiversity : Types of biodiversity; biodiversity & human welfare; Megadiversity countries & Biodiversity Hotspots with special reference to India. 5
9. *In situ* and *ex situ* conservation. Wildlife (protection) Act & Schedules. Conservation of tiger. 4
10. Bioethics and biosafety. 2
11. Aquaculture: resources in India; Induced breeding of carps; ecohatchery (basic concept); polyculture of fin fish; exotic fishes & their role; fish diseases, symptoms & control; freshwater& brackish water prawn culture; fish byproducts & uses. Ornamental fishery, hatching of egg, rearing, and aquarium management. 10

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12. Sericulture : silk varieties in India; mulberry silkworm culture; extraction & reeling of silk; natural enemies & diseases of silkworm and their control. 2
13. Apiculture: species of honey-bees in India; life history of *Apis cerana indica*; apiculture technique; bee products & uses; natural enemies & diseases of honey bees and their control. 2
16. Basic idea of pest control methods & IPM. Life cycle of *Apion* and *Sitophilus* 2
17. Animal husbandry: common poultry breeds (fowl), rearing methods, diseases & control. 2

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Paper - IV: Theory
F. M. : 100 Marks (University Exam – 90, Internal Assessment - 10)
Group - A : Microbiology, Biostatistics, Computer Application & Bio-informatics
F. M. : 50 Marks

1. Elementary knowledge on the organisational diversity of microorganisms with special reference to virus and bacteria. 5
2. Culture and staining of bacteria (Gram's staining and Acid fast staining). Microbial Genetics-. Conjugation, Transformation and transduction. 6
3. Applied Microbiology : i) Dairy-microbiology of milk & milk products; ii) Agriculture-microbes in pest control & pesticides degradation; iii) Common microbes in relation to serious endemic diseases (Cholera, AIDS & Shigella). 3
4. Physical and Chemical Control of Microbes, Sterilization. Types of antibiotics. 3
4. Definition of sample and population in biometry : frequency distribution; histograms; X~Y curves; Pie chart. 5
5. Measures of central tendencies (mean, mode & median); dispersion (SD, SE& variance). 5
6. Analysis of simple correlation, regression & related problems. 5
7. Basic concept of hypothesis testing: Chi-square & Student-test. Related problems. 5
8. Elementary idea of Desktop Computer devices: CPU; VDU; Key board; mouse; FD drive; CDIDVD ROM drive; RAM. 5
9. Concept of Internet & its use in information collection. 3
10. Basic concept of Bioinformatics. Internet based tool for DNA and protein sequence databases. PUBMED, ERRICA. 5

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Group-B : Histology, Histochemistry, Endocrinology & Bioinstrumentation
F. M. : 50 Marks

1. Histology of liver, endocrine pancreas, kidney, thyroid and pituitary 6
2. Histological techniques: Fixation & fixatives, Staining principles; staining with haematoxylene & eosin; outline classification of dyes. 6
3. Basic concept of histochemistry. PAS, Millon's reaction and Sudan Black B. 4
4. Definition of endocrine glands; Hormones in the regulation of the body function with special reference to the carbohydrate and calcium metabolism; Functions of hypothalamus, pituitary, thyroid, parathyroid, adrenal, pancreas, testis & ovary. 7
5. Types, sources & functions of steroid and peptide hormones. 5
6. Endocrinology of Thyroid, Testis & Ovary. 4
7. Mode of action of Insulin. 3
8. Role of Parathhormone in calcium metabolism. 3
9. Local hormones and their functions. 3
10. Basic principle of optical and electron microscopes. TEM,SEM, Phase contrast microscopes. Resolving power, Resolution and Magnification. 5
11. Electrophoresis, chromatography and spectrophotometer 4

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Paper-V: Practical **F. M. : 100 Marks**

Unit – A Dissections and Computer Application (Time- 3h) 50 Marks

Major Dissections: $2 \times 12 = 24$

a) Earthworm : Nervous system & reproductive system.
b) Cockroach : Nervous system& male reproductive system.
c) Rohu: Afferent & Efferent branchial arteries; IXth & Xth Cranial nerves

Minor Dissections: $1 \times 6 = 6$

a) Salivary apparatus of cockroach (hypopharynx to be retained).
b) Mouthparts of cockroach.
c) Female reproductive system of cockroach.
d) Nerve ring of earthworm.
e) Septal nephridia of earthwonn.
f) Brain & pituitary gland of Rohu.

Computer Application: 10

Use of Windows based software (any one) : manipulation of files (in MS Office / Lotus Smart Suit) -file creation& deletion, protection; renaming; editing); handling database (in MS Access / MS Excel or any other) –making tables & charts (Pie, Bar, Polygon etc.).Use of statistical formulas in Excel.

Viva Voce: 5
Laboratory Note Book 5

Unit.; B : Cytology, Histology , Histochemistry & Developmental Biology (TIme:3h) 50 Marks

Unit –I : *15*

a) Study of meiosis from grasshopper.
b) Genetics--Pedigree analysis & Biostatistics- chi square test.

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Unit-II: 15

a) Section cutting, staining of histological tissues and mounting of liver, lungs, stomach, pancreas, thyroid, kidney, ovary & testis.

Unit- III : 10

a) Identification of T. S. of liver, pancreas, thyroid, kidney, ovary & testis, lungs, adrenal, stomach.
b) Identification of whole mount of chick embryo (24h; 48h; 72h, 96h).
c) Identification of cleavage stage (blastula& gastrula of frog).
d) Histochemical detection of carbohydrate, protein& lipid by PAS, Millon's test and Sudan Black B techniques respectively.

Viva Voce: 5

Laboratory Note Book: 5

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Part-III
Paper – VI Theory F. M. : 100 Marks (University Exam - 90, Internal Assesment - 10)
Group - A : Molecular Biology & Biotechnology
F. M. : 50 Marks

1. Genetics of cell cycle, checkpoints. 6
2. Basic steps and process of replication, transcription and translation in prokaryotes, enzymes and proteins associated with these processes 4+4+4
3. Post transcriptional modifications-Splicing, types and basic steps.
3. Molecular basis of Mutation-origin and types. DNA Repair mechanisms. 6
4. Elementary idea of mitochondrial and chloroplast DNA, Centromeric, telomeric, selfish DNA, C value paradox 3
5. Regulation of gene expression: Lac and Tryp operon. 4
7. Concept of Oncogene. 3
8. Elementary idea of animal biotechnology – basic steps of gene cloning, c DNA and genomic library, restriction endonuclease-action and types, steps and use of PCR. Vermitechnology- basic steps. 8
9. Principle of animal cell culture - i) Basic concept
   ii) Media and its types 2

Group B: Animal Physiology, Biochemistry & Biophysics 50 Marks

1. Osmosis; diffusion; Donnan membrane equilibrium; pH; buffers. Importance Physiological buffer system. 3
2. Laws of thermodynamics; fundamentals of energy concepts. Calculation of G^0 2
3. Classification, structure and biological role of carbohydrate, protein (upto quaternary structure) & lipid. 9
4. Carbohydrate metabolism -Glycogenesis; glycogenolysis; gluconeogenesis. 3

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5. Elementary idea of biological oxidation. Oxidative phosphorylation & electron transport chain. 3
6. Protein metabolism-Transamination, deamination and urea cycle. 2
7. Lipid metabolism – oxidation of fatty acid. 3
8. Enzymes, properties, types and enzyme kinetics; Factors affecting enzyme activity. 4
9. Ultra structure of muscle; chemical & physiological basis of skeletal muscle contraction. 4
10. Structure of mammalian nephron; physiology of urine formation; osmoregulators & osmoconformers. 4
11. Nature, origin and propagation of nerve impulse along a neuron; Synaptic & myoneuronal junctions. 4
12. Transport of 0_2 & CO_2 in mammals; Bohr and Haldane Effects; Chloride shift. 3
13. Temperature regulation in mammals. 3
14. Oestrous and menstrous cycle and their regulation. 3

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Part-III

Paper – VII Practical **100 marks**

Unit-A: **35 marks**

Parasitology, Immunobiology & Microbiology

1. Parasitology (set any one) : preparation of gut content of cockroach, fowl and seminal vesicle smear from earthworm for observation on endoparasites. 15
2. Immunobiology (set anyone) : isolation of lymphocyte from blood/spleen; identification of lymphoid cells from prepared slides (spleen, lymph gland, bursafabriceous); determination of blood group (ABO & Rh) 5
   Demonstration of ELISA/ Immunofluroscence technique/blotting. 5
3. Microbiology (set any one) : Preparation of culture media; culture of microorganisms; staining of microbes (Gramstain). 10

Unit - B **45 marks**

Biochemistry, Animal Physiology, Biochemistry, Biophysics

1. Biochemistry (set any one) :

a. Qualitative tests for carbohydrate (glucose, fructose, Lactose/Maltose, Sucrose, Starch, Dextrin), Protein (albumin/globulin, gelatine, peptone).

b. Quantitative test- colorimetric analysis (Lowry's method) of protein; 30

2. Animal physiology & biochemistry (set any three; 10+10+5-25); Estimation of Hb; differential count; total count; determination of CT, BT & ESR (for white rat); Tests of ammonia, uric acid and urea in the urine offish (aquarium water) / toad, bird guano and cow respectively);
3. Biophysics-use of pH meter & estimation of pH of solutions. 10
   Demonstration to students on the use of digital balance, homogeniser, colorimeter/spectrophotometer, Electrophoresis and centrifuge machine. 5

Unit C : Laboratory note book & Viva-Voce **20 Marks**

1. Viva Voce 10
2. Laboratory Note Book 10

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Part-III

Paper – VIII : Practical **100 marks**

Unit A: Ecology and Environmental Management **25 Marks**

1. Determination of dissolved O_2, free CO_2, alkalinity & hardness.
2. Determination of LC_{50} & LD_{50} of a pollutant.
3. Qualitative and Quantitative Study of Zooplankton and soil fauna.

Unit B: Identification **40 Marks**

Identification (upto sub-class for non chordates and order for chordates)

1. Non-chordates: *Elphidium, Scypha (= Sycon), Neptune's cup, Aurelia, Pennatula, Physalia; Sea-anemone, Madripora, Beroe, Nereis, Chaetopterus, Aphrodite, Squilla, Hippa, Eupagurus, Tachypleus or Carcinoscorpius, Peripatus, Belostoma, Chiton, Patella, Aplysia, Mytilus, Sepia, Loligo, Octopus, Asterias, Astropecten, Sea-urchin, sea-lily*, Hemichordate.
2. Chordates; *Branchiostoma, Ascidia, Petromyzon, Myxine, Torpedo, Sphyrnma, Exocoetus, Hippocampus,Echinus ,lchthyophis, Trilototriton, Axolotl larva, Cryptobranchus, Hyla, Chameleon, Gekko, Vipera, Naja, Hydrophis, Passer, Ploceus,Pycnonotus, Halcyon, Dinopium, Pteropus.*
3. Bones: appendicular bones of *Columba and Cavia; vertebrae of snake, Columba and Cavia; skull of Bufo, Rana, Chelonia,* venomous snake, *Columba, Cavia and Canis.*
4. Applied Zoology : *Entamoeba, Giardia, Trypanosoma, Plasmodium, Leishmania, Ascaris (male & female), Wuchereria bancrofti, Sitophilus, Tribolium, Tryporyza, Hispa, Apion, Leucinodes, skil worm life history stages, honey bee, lac insect, Culex, Anopheles, Aedes, Phlebotomus, Paeneus,Macrobrachium,Labeo rohita, L. bata, Cirhinus mrigala, Catla catla, Mugi/parsia, Lates calcarifer, Harpodon neherias.*

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Unit- C : Project work, Field report, Laboratory Note book and Viva voce	**35 marks**
1. Project/review work	10
1. Field report: study of any ecosystem & its biodiversity	10
2. Viva Voce	05
3. Laboratory Note book	10

Note: Number at the end of each topic denotes number of classes required.

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Syllabus for Three-Year Degree Course
in
Zoology General Course

Part – I

Paper – I : Theory	100 marks (90 + 10)
Gr. – A : Non-Chordata	30 marks
Gr. – B : Texonomy, Evolution, Adaptation & Distribution	30 marks
Gr. – C : Developmental Biology	20 marks
Gr. – D : Ecology, Ethology & Wildlife	20 marks

Part – II

Paper – II : Theory	100 marks (90 + 10)
Gr. – A : Chordata	30 marks
Gr. – B : Cell Biology, Genetics & Molecular Biology	30 marks
Gr. – C : Physiology & Biochemistry	20 marks
Gr. – D : Parasitology, Histology & Endocrinology	20 marks
Paper – III : Practical	100 marks

Part – III

Paper – IV : Applied Zoology (Theoretical & Practical)	100 marks
Gr. – A : Applied Zoology Theory	70 marks
(Univ. Exam. – 63; Int. Assessment – 07)	
Gr. – B : Applied Zoology Practical	30 marks

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Detailed Syllabus

Part – I

Paper – I : Theory (University Exam. – 90, Int. Assessment – 10)

F.M. : 100 Marks **F.M. : 30 Marks**

Group – A : Non-chordata

1. Classification with distinctive features and suitable examples of Sub Kingdom Protozoa (upto Phylum) and Phylum Porifera, Cnidaria, Platyhelminthes, Nemathelminthes, Annelida, Arthropoda, Mollusca & Echinodermata (upto Sub Class) 9
2. General structure & function / processes of the following with reference to the specimens mentioned.
   - I) **Locomotion :** (i) Microfibrils (*Amoeba*), (ii) Flagella (*Euglena*), (ii) Cilia (*Paramoceium*), (iv) Parapodia (*Neanthes*) 3
   - II) **Feeding & Digestion :** (i) Microphagy (*Amoeba*), Macrophagy (*Periplaneta*), Canal system (*Sycon*) 3
   - III) **Respiration :** (i) Respiratory pigments (haemoglobin & hemocyanin), (ii) Ctenidium & Pulmonary sac (*Pila*), Gills, Trachea & book-lung (Prawn, Cockroach, Scorpion); 3
   - IV) **Excretion :** (i) Flame cells (*Taenia*), (ii) Nephridia (Earthworm), Malpighian Tubules (Cockroach), Green gland (Prawn) 3
   - V) **Circulation :** (i) Open circulation (cockroach), (ii) Closed circulation (earthworm), (iii) Haemal circulation (starfish) 3
   - VI) **Neural integration :** (i) Integration – simple & complex nerve nets, (ii) Nervous system cockroach, apple snail) 2
   - VII) **Reproduction & Life cycle :** (i) Fission (*Amoeba*), (ii) Conjugation (Paramoecium), (iii) Budding (*Hydra*), (iv) Metagenesis (*Obelia*), (v) Sexual reproduction (Earthworm & cockroach), (iv) Metamorphosis in insects (Mention only types) 4

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Group B : Taxonomy, Evolution, Adaptation & Distribution : 30 marks

1. Definition of systematics & taxonomy. 1
2. Species as unit of evolution (definition & types : biological, sibling & polytypic) 5
3. Chemical basis of origin of life. 3
4. Darwinism & synthetic theory of evolution. 3
5. Hardy-Weinberg equilibrium in relation to natural selection – a brief idea. 2
6. Anatomical & physiological adaptations: aquatic, desert & Volant animals. 9
7. Zoogeographical realms & their subdivisions with characteristics fauna. 4
8. Schematic representation of geological time scale indicating time of origin of major animal groups. 3

Group C : Developmental Biology 20 marks

1. Spermatogenesis & Oogenesis. 5
2. Fertilization in sea-urchin. 2
3. Types of eggs & cleavage, process of cleavage in frog & chick 6
4. Gastrulation in frog & chick. 4
5. Placentation in mammals. (Rabbit) 2
6. Organiser concept 1

Group D : Ecology, Ethology & Wildlife 20 marks

1. *Ecology & Ecosystem* – definition, components, energy flow, food chain, food web, ecological pyramids. 6
2. Population – definition & growth types (logistic & exponential) 1
3. Community – definition & types. (major & minor community) 1
4. Pollution – air, water & noise. 6
5. Social behaviour of honey-bee. 2
6. Echolocation in bat. 2
7. Conservation of wildlife – purpose & methods; Concept of wild life sanctuary, National Park & Biosphere Reserve. 2

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Part – II

Paper – II : Theory Full Marks 100

(Univ. Exam 90 & Internal Assessment – 10)

Group – A : Chordata **30 Marks**

1. Classification of Phylum Chordata with distinctive features and suitable example – upto living Orders (Amphibia, Reptilia & Mammalia); upto living Sub Class (Fishes & Aves) 6
2. Functional anatomy in relation to Filter feeding (*Branchiostoma*) 2
3. Structure & functions of the followings :
   (i) Integument – general structure & function; integumentary derivatives (scales in fishes; horny scales & plates in reptilian; feathers of birds; hairs of mammals) 3
   (ii) Digestive system – pharynx (*Ascidia*); stomach (*Columba & Bos*). 3
   (iii) Respiratory system – gills (fishes), accessory respiratory organs (fish), lungs, (*Bufo, Cohlumba* and *Cavia*) 4
   (iv) Excretory system – pro-, meso-, meta-nephric kidneys; modification of urinary ducts in vertebrates; Loop of Henle. 4
   (v) Circulatory system – single circuit heart (fish), double circuit heart (amphibian, bird and mammals); modification of aortic arches in vertebrates. 4
   (vi) Nervous system – Brain in *Bufo* & Man; origin & distribution of cranial nerves in *Bufo* and Man. 4

Group B : **30 Marks**

Cell Biology, Genetics & Molecular Biology

1. Ultrastructure & function of plasmamembrane, GERL system & ribosome. 4
2. Chromosome structure – nucleosome model. 2

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3. Cell cycle, oncogene & cancer (basic idea). 3
4. Physico-chemical properties of DNA & RNA. 2
5. Nucleic acids as genetic materials. 2
6. Basic idea of replication, transcription in *Escherichia coli*. 4
7. Modes of inheritance of autosomal & sex-linked genes in man; Thalassemia & Haemophilia. 4
8. Linkage & recombination. 2
9. Point mutation and changes in chromosome number & structure with referene to Sickle-cell and anaemia, Down syndrome, Klinefelter syndrome & Turner syndrome. 4
10. Sex determination in *Drosophila.* 3

Physiology & Biochemistry

Group – C **20 marks**

1. Formed elements in vertebrate blood; clotting & coagulation; ABO blood group & Rh factor. 3
2. Enzyme classification & characteristics. 2
3. Classification of carbohydrate, protein & lipid; Concept of glycolysis, glycogenesis, neoglucogenesis (aerobic, anaerobic & fermentation). 5
4. Vitamins – chemical names, sources & deficiency disorders for Vit. A, B complex, C & E. 4
5. Physiology of nerve impulse & synaptic transmission. 3
6. Osmoconformers & Osmoregulators; Osmoregulation in fishes. 3

Parasitology, Histology & Endocrinology

Group – D **20 marks**

1. Parasitism (definition & different types) and other interspecific (symbiosis, commensalisms & mutualism) interactions. 3
2. Life history, pathogenicity and clinical features of (i) *Entamoeba histolytica*, (ii) *P. falciparum,*(iii) *Ascaris,* (iv) *Fasciola hepatica*.

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3. Host-parasite interaction; Immune response, T & B lymphocytes. 4
4. Histology of pituitary, thyroid & pancreas and their hormonal functions in mammals. 5

Practical

Paper – III **100 marks**

1. Dissection : (two major dissections – one invertebrate & one vertebrate). 30 marks
   Earthworm – digestive & nervous systems.
   Apple snail – digestive & nervous systems.
   Cockroach – digestive, nervous & female reproductive system.
   Rohu/ Lata – afferent & efferent, urinogenital system, brain, cranial nerves (IXth & Xth origin & distribution).
2. Mounting & preparations (Two) 15 marks
   (a) Mouth parts of cockroach & mosquito.
   (b) Radula & osphradium of *Pila*.
   (c) Setae of earthworm.
   (d) Mounting of mosquito larva.
   (e) Cycloid, ctenoid & placoid scales.
   (f) Blood film of rat and haemolymph of cockroach (Leishman/ Giemsa stain).
   (g) Seminal vesicle of earthworm for Monocystid gregarines (Ehrlich hematoxylene).
   (h) Gut contents of cockroach for protozoa.
   (i) Whole mount of aquatic micro-arthropods.
   (j) Epithelial cells from buccal semears.
3. Identification with reasons : (one from bones, one from histological slides, two from non-chordates and two from chordate specimens; systematic position upto taxon as mentioned in the theory) 30 marks
   (a) Bones : Skull, vertebrae, limb & girdle bones of *Columba & Cavia*.
   (b) Histological slides : T.S. of mammalian stomach, duodenum, ileum, lung, liver, pancreas, testis, ovary, kidney, thyroid.

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(c) Non-chordate specimens : *Amoeba, Plasmodium vivax, Paramoceium, Scypha, Obelia,* Sea-anaemone, *Ascaris Ancylostoma, Hirudinaria,* Centiped, Milliped, Scorpion, *Bombyx mori, Lamellidens, Achatina, Loligo,* Star fish, *Balanoglossus*.

(d) Chordate specimens : *Achatina, Branchiostoma, Petromyzon, Scoliodon, Lates, Anabas, Racophorus,* Axolotl larva, *Tylototriton, Gekko, Hemidactylus, Mabuia,* Turtle, *Naja,* Chiroptera.

4. Report on field study tours : 10 marks
   Any two sites of zoological importance : (Zoogarden, Museum, Sericultre centre, Apiculture centre, Fisheries, Agriculture farm & Coastal region.
5. *Viva voce.* 10 marks
6. Laboratory Note Book 5 marks

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Part – III

Paper – IV **Full Marks 100**

Applied Zoology (Theoretical & Practical)

70 marks (University Exam. 63, Int. Ass. 7)

Group – A : Applied Zoology Theory

1. **Sericulture :** Characteristics of sericulture industry and its scope; kinds of silkworm, host plants and improvement of their variety. Life history and raring of *Bombyx mori,* harvesting & processing of cocoon, reeling & extracton of silk, pest on mulberry plants and diseases of *Bombyx mori* and control measures. Research & development of sericulture in India. 12
2. **Aquaculture :** Principles, definition & scope. Fisheries resources of India (Inland & off-shore) and their important inchthyofauna. Exotic fishes and their merits demerits. Fish breeding and their application. Basic principles of different aquaculture systems (polyculture, waste water recycling, Integrated farming). Marine pearl culture and culture of prawn and shrimps. 12
3. **Pest & Pest management :**
   (A) Definition and types of pest with examples. Life history, behaviour, ecology, damage and control of the following pests : (a) Paddy-Scirpophaga (syn. Tryporzya) incertulas (b) Stored grain Sitophilus oryzae (c) Wheat pest-(*Tanymecus inducus*) (d) Brinjal pest (Leucinodes orbinalis) (e) Jute pest-(*Anomis sabulifera*) (g) Mammal pest-(*Bandicoota bengalensis*). 12
   (B) Integrated pest management.
4. **Apiculture :** Development of Apiary in India, Types of honey bee, modern methods of apiary management, products and its uses. Problems and prospects. 6
5. **Lac culture :** Lac incets, Composition of Lac, strains of lac insects, cultivation of lac, Lac host plants (names only), processing of lac and its uses.

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6. **Poultry :** Duck and fowl-Types of breeds, rearing and disease management.
7. Environment, Wildlife & Biodiversity : Basic idea of ecotoxicology & xenobiotics; concept of EIA; importance & strategies of wildlife conservation. Conservation act and application. Basic concept of biodiversity; biodiversity hotspots. Scheduled endangered Indian mammals. Animal cruelty (prevention) Act. 10
8. Biotechnology & Immunology : Basic concept of genetic engineering & cloning : Basic principles & techniques of gene manipulation; basic idea of vectors – plasmids, cosmid & bacteriophage; techniques & application of ELISA & RIA (basic idea); outline structure and classification of immunoglobulin; antigen-antibody reaction; basic principle of vaccination. 10

Group B : Applied Zoology Practical **30 marks**

1. Experimental works : 10 marks
   i. Estimation of dissolved O_2 content of water.
   ii. Estimation of salinity of water.
   iii. Pedegree analysis : sex-linked recessive, autosomal recessive & dominant.
   iv. Determination of ABO blood group & rh factor in man.
   v. Differential count of human blood.
   vi. LD_{50} dose determination for any toxicant on any model.
   vii. Measurement of water & soil pH handling pH meter.
   viii. Sampling of zooplankton & extraction of soil micro-arthropods.
   ix. Narcotisation of earthworm and *Achatina* using suitable techniques.
   x. Tests for food colours/ adulteration : mustard oil, red chilli powder, turmeric powder, toxic colours in vegetables/sweets.

2. Field training: (submit report of field training at any two places from below) 10 marks

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i. Estuarine bheri/freshwater fish farm
ii. Poultry centre.
iii. Apiary.
iv. Sericulture centre.
v. Places of wildlife interest (Sanctuary, national park, biosphere reserves etc.)
vi. Agricultural farms for pest study & have idea of IPM practices.
vii. Species diversity studies in forest ecosystem/ coastal regions.

3. Identification : (write specimen characters & applied importance)

10 marks

*Plasmodium vivax, P. falciparum,*microfilaria of *Wucherria bancrofti, Taenia solium, Scirpophaga incertulus, Sitophilus oryzae, Tanymecus indicus, Leucinodes orbonalis, Anomis sabulifera, Lepisma, Termite, Bandicoota bengalensis, Labeo rohita, L bata, L. calbasu, Catla catla, Cirrhinus nirigala, Hypophthalmichthyes molitrix, Cyprinus carpio, Ctenopharyngodon idella, Ilsa ilisha, Penaeus monodon, Macrobrachium rosenbergi.*

Note : Number at the end of each topic denotes number of classes required.

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