

**Scheme of Examination for M.Sc. Zoology (SEMESTER SYSTEM)
to be implemented from the session 2013-2014 in phased manner
Semester – I**

Paper	Paper Name	Ext. Marks	Int. Marks	Max. Marks	Time Hours
ZOO-I	Cell Biology	75	15	90	3
ZOO-II	Biochemistry and Bio-techniques	75	15	90	3
ZOO-III	Biosystematics & Biostatistics	75	15	90	3
ZOO-IV	Biology of Invertebrates	75	15	90	3
ZOO-V	Practical (Based on Papers ZOO-I & ZOO-II)	Examination to be held annually along with paper ZOO-XI			
ZOO-VI	Practical (Based on Papers ZOO-III & ZOO-IV)	Examination to be held annually along with paper ZOO-XII			
	Seminar / Test (Based on Papers ZOO-I to ZOO-IV)	-	40	40	1
	Total	300	100	400	-
Semester – II					
ZOO-VII	Population and Community Ecology	75	15	90	3
ZOO-VIII	Comparative Physiology	75	15	90	3
ZOO-IX	Population Genetics & Evolution	75	15	90	3
ZOO-X	Biology of Vertebrates	75	15	90	3
ZOO-XI	Practical (Based on Papers ZOO-V, ZOO-VII & ZOO-VIII)	80	20	100	4
ZOO-XII	Practical (Based on Papers ZOO-VI, ZOO-IX & ZOO-X)	80	20	100	4
	Innovation Report/Model/Seminar/Test (Based on papers ZOO-VII to ZOO-X)	-	40	40	1
	Total	460	140	600	-
Semester – III					
ZOO-XIII	Molecular Biology	75	15	90	3
ZOO-XIV	Molecular Endocrinology	75	15	90	3
ZOO-XV	(i) Environmental Biology and Toxicology-I (ii) Applied Zoology-I	75	15	90	3
ZOO-XVI	(i) Molecular Cytogenetics – I (ii) Reproduction and Aging-I (iii) Animal Behaviour & Wildlife Conservation – I (iv) Fish and Fisheries – I (v) Insect Morphology and Physiology – I* (vi) Proteins and Nucleic Acids– I*	75	15	90	3
ZOO-XVII	Practical (Based on Papers ZOO-XIII, ZOO-XIV & ZOO-XV opt. (i) & (ii))	Examination to be held annually along with paper XXIII			
ZOO-XVIII	Practical [Based on papers ZOO-XVI (i/ii/iii/iv/v/vi)]	Examination to be held annually along with paper XXIV			
	Seminar/Test (Based on Papers ZOO-XIII to ZOO-XVI)	-	40	40	1
	Total	300	100	400	-
Semester – IV					
ZOO-XIX	Developmental Biology	75	15	90	3
ZOO-XX	Vertebrate Immunology	75	15	90	3
ZOO-XXI	(i) Environmental Biology and Toxicology-II (ii) Applied Zoology-II	75	15	90	3
ZOO-XXII	(i) Molecular Cytogenetics – II (ii) Reproduction and Aging – II (iii) Animal Behaviour & Wildlife Conservation – II (iv) Fish and Fisheries – II (v) Insect Morphology and Physiology – II* (vi) Proteins and Nucleic Acids – II*	75	15	90	3
ZOO-XXIII	Practical (Based on Papers ZOO-XVII, ZOO-XIX, ZOO-XX and ZOO-XXI opt. (i) & (ii))	80	20	100	4
ZOO-XXIV	Practical [Based on papers ZOO-XVIII & ZOO-XXII(i/ii/iii/iv/v/vi)]	80	20	100	4
	Field / Project Report & Seminar/ Test (Based on papers ZOO-XIX to ZOO-XXII)	-	40	40	1
	Total	460	140	600	-

* Kept in abeyance due to shortage of faculty.

Total Marks : 90
Theory Examination : 75
Internal Assessment : 15
Time: 3 Hours

Note:

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2. Question No. 1, which will be objective/short answer type cover the entire syllabus, will be compulsory. The remaining eight questions will be set section wise selecting four questions from each section (I & II). The candidate will be required to attempt question No. 1 and four more selecting two questions from each section.
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Section – A

1. Biomembranes
 - 1.1 Molecular composition and arrangement, functional consequences.
 - 1.2 Transport – Recapitulation of the plasma membrane; diffusion, active transport and pumps, uniports, symports and antiports.
 - 1.3 Donnan equilibrium; ion movements and cell function: acidification of cell organelles and stomach
 - 1.4 Maintenance of cellular pH; cell excitation; bulk transport; Receptor mediated endocytosis
 - 1.5 Transepithelial transport
2. Cytoskeleton and cell movement
 - 2.1 Structure and organization of actin filaments
 - 2.2 Actin, myosin and cell movements
 - 2.3 Structure and dynamic organizations of microtubules
 - 2.4 Microtubule motors and movement
 - 2.5 Intermediate filaments
 - 2.6 Cilia and flagella
3. The Extra Cellular Matrix and Cell interactions
 - 3.1 Cell walls
 - 3.2 The ECM and cell-matrix interactions
 - 3.3 Cell-cell interactions: adhesion junctions, tight junctions, gap junctions, plasmodesmata
 - 3.4 Ca^{++} dependent and Ca^{++} independent Homophilic cell-cell adhesion
4. Cell matrix adhesion
 - 4.1 Integrins
 - 4.2 Collagen
 - 4.3 Non-collagen components
 - 4.4 Auxin and cell expansion
 - 4.5 Cellulose fibril synthesis and orientation
5. Protein sorting and transport
 - 5.1 Protein uptake into the ER
 - 5.2 Membrane proteins and Golgi sorting
 - 5.3 Mechanism of vesicular transport
 - 5.4 Lysosomes
 - 5.5 Molecular mechanism of secretory pathway

Section – B

- 6 Cell cycle
 - 6.1 The eukaryotic cell cycle
 - 6.2 Regulators of cell cycle progression
 - 6.3 The events of M phase
 - 6.4 Meiosis and fertilization

- 7 Genome organization
 - 7.1 Chromosomal organization of genes and non-coding DNA
 - 7.2 Mobile DNA
 - 7.3 Morphological and functional elements of eukaryotic chromosomes

- 8 Cell – Cell signaling
 - 8.1 Signaling molecules and their receptors
 - 8.2 Function of cell surface receptors
 - 8.3 Pathways of intracellular signal transduction
 - 8.4 Signaling networks

- 9 Cell death and cell renewal
 - 9.1 Programmed cell death
 - 9.2 Stem cells and the maintenance of adult tissues
 - 9.3 Embryonic stem cells and therapeutic cloning

- 10 Biology of Cancer
 - 10.1 The development and causes of cancer
 - 10.2 Oncogenes
 - 10.3 Tumor suppressor genes
 - 10.4 Molecular approaches to cancer treatment

- 11 Biology of Ageing

Suggested Reading Material

- 1. Molecular Cell, Biology, J. Darnell, H. Lodish and D. Baltimore Scientific American Book, Inc., USA.
- 2. Molecular Biology of the Cell, B. Alberts, D. Bray, J. Lewis, M. Raff, K. Roberts and J.D. Watson. Garland Publishing Inc., New York.

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Section – A

- 1.0 General Principles of Biochemistry and chemical composition of life.
- 2.0 Glycolysis, citric acid cycles its regulation and role as metabolic hub.
- 3.0 Hexose monophosphate pathway its regulation and significance.
- 4.0 Cholesterol biosynthesis, its metabolism steroid genesis, Bile acids and their metabolism derrayed cholesterol level.
- 5.0 Saturated and unsaturated fatty acid and their metabolism.
- 6.0 Primary, Secondary, tertiary and quaternary structure of proteins (Domain, Reverse turn of Ramachandran plot).
- 7.0 Enzyme : classification and nomenclature, co-enzymes, induced fit and Molecular Mechanism of Enzyme action, Enzyme feedback mechanism, Isozymes.
- 8.0 DNA, RNA, structure and functions, DNA chroeography.

Section – B

- 9.0 Chemical and Biological assays (*in vitro* and *in vivo* assays)
- 10.0 Principles and uses of analytical instruments: Spectrophotometers, NMR spectrophotometer, ultra centrifuge, Microscopes.
- 11.0 Microbiological Techniques:
 - 11.1 Media preparation and sterilization.
 - 11.2 Inoculation and growth monitoring.
- 12.0 Cell culture techniques:
 - 12.1 Design and functioning of tissue culture laboratory.
 - 12.2 Cell proliferation measurements.
 - 12.3 Cell viability testing.
 - 12.4 Culture media preparation and cell harvesting methods.
- 13.0 Cryotechniques :
 - 13.1 Cryopreservation for cells, tissue, organisms.
 - 13.2 Cryotechniques for microscopy.

- 14.0 Separation techniques in biology.
 - 14.1 Molecular separations by chromatography, electrophoresis, precipitation etc.
 - 14.2 Organelle separation by centrifugation.
 - 14.3 Cell separation by flow cytometry, density gradient centrifugation, unit gravity centrifugation, affinity adsorption, anchorage based techniques etc.

- 15.0 Radioisotope and mass isotope techniques in biology :
 - 15.1 Sample preparation for radioactive counting.
 - 15.2 Autoradiography.
 - 15.3 Metabolic labeling.
 - 15.4 Magnetic resonance Imaging

- 16.0 Biosensors.

Suggested Reading Materials:

1. Animal Cell Culture – A practical approach, Ed. John R.W. Masters, IRL Press.
2. Introduction to Instrumental analysis, Robert Braun, McGraw Hill International editions
3. A Biologists guide to Principles and Techniques of Practical Biochemistry, K. Wilson and K.H. Goulding, ELBS Edn.

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Section – A

- 1.0 Definition and basic concepts of biosystematics and taxonomy.
 - 1.1 Historical resume, Importance and applications of systematics in biology.
- 2.0 Trends in biosystematics – concepts of different conventional and newer aspects
 - 2.1 Chemotaxonomy
 - 2.2 Cytotaxonomy
 - 2.3 Molecular taxonomy
- 3.0 Dimensions of speciation and taxonomic characters
 - 3.1 Species concepts – species category, different species concepts; sub-species and other intra-specific categories.
 - 3.2 Theories of biological classification, hierarchy of categories.
 - 3.3 Taxonomic characters – different kinds, weighing of characters
- 4.0 Methodology
 - 4.1 Taxonomic collections, preservation, curation process and identification.
 - 4.2 Taxonomic keys-different kinds of taxonomic keys, their merits and demerits.
 - 4.3 Systematic publications – different kinds of publications.
 - 4.4 International code of Zoological Nomenclature (ICZN) – its operative principles and interpretation of the following :
Stability, Priority, Concept of availability, formation of names, synonymy, homonymy, the type method, kinds of type specimen, type-designation.
- 5.0 Evaluation of biodiversity indices
 - 5.1 Shannon-Weiner index, dominance index
 - 5.2 Similarity and dissimilarity index
 - 5.3 Association index

Section – B

- 6.0 Measures of central value
Arithmetic mean, mode and median Definition, calculation and its properties.
- 7.0 Measures of Dispersion:
 - 7.1 Range, Interquartile range, Quartile deviation.
 - 7.2 Mean deviation and standard deviation.

- 8.0 Correlation:
Methods studying correlation – Scatter diagram method, Graphic method, Karl Pearson coefficient of correlation, Rank correlation.
- 9.0 Regression analysis (Regression lines and regression equation.)
- 10.0 Concept of sampling and sampling methods:
Definition and law of sampling, judgment sampling, Random sampling, stratified sampling, systematic sampling, multi-stages sampling and quota sampling.
- 11.0 Test of significance for large samples and small samples.
- 12.0 Chi-square analysis
- 13.0 Analysis of variance
- 14.0 Probability and law of probability, Theoretical probability distribution: Binomial distribution, Poison distribution, Normal distribution.
- 15.0 Computer in Biometrics
15.1 Components of computers
15.2 Statistical softwares in Biology

Suggested Reading Material :

1. M. Kato. The Biology of Biodiversity, Springer.
2. E.O. Wilson, Biodiversity, Academic Press, Washington.
3. G.G. Simpson, Principle of animal taxonomy, Oxford ISH Publishing Company.
4. E. Mayer, Elements of Taxonomy.
5. E.O. Wilson, The Diversity of Life (The College Edition), W.W. Northerm & Co.
6. S.K. Tikadar, Threatened Animals of India, ZSI Publication, Calcutta.
7. Batschelet, E. Introduction to mathematics for life scientists, Springer-Verlag, Berling.
8. Jorgensen, S.E. Fundamentals of ecological modeling. Elsevier, New York.
9. Swartzman, G.L. and S.P.O. Kaluzny. Ecological simulation primer, Macmillan, New York.
10. Lendren, D. Modeling in behavioral ecology. Chapman and Hal, London, UK.
11. Sokal, R.R. and F.J. Rohlf. Biometry. Freeman, San Francisco.
12. Snedecor, G.W. and W.G. Cochran, Statistical methods. Affiliated East-West Pres, New Delhi (Indian ed.).
13. Murray, J.D. Mathematical biology. Springer-Verlag, Berlin.
14. Pielou, E.C. the Interpretation of ecological data:A primer on classification and ordination.

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Section - A

- 1.0 Introduction to invertebrates with their general characters and classification up to class level.
- 2.0 Minor Phyle
 - 2.1 Concept and significance
 - 2.2 Organization and general characters of Acoelomate, Pseudocoelomates and Coelomates minor phyla (with special emphasis on Ctenophora, Rotifera, Endoprocta, Ectoprocta, Phoronida, Sipunculida and Echiuroidea).
- 3.0 Organization of coelom
 - 3.1 Concept and structure of Acoelomate, Pseudocoelomates and Coelomates.
 - 3.2 Protostomia and Deuterostomia
 - 3.3 Metamerism in Annelida, Pseudometamerism.
- 4.0 Locomotion
 - 4.1 Flagella and ciliary movement in Protozoa
 - 4.2 Hydrostatic movement in Coelenterata, Annelida and Echinodermata
- 5.0 Nutrition and Digestion
 - 5.1 Patterns of feeding and digestion in lower metazoa
 - 5.2 Filter-feeding in Polychaeta, Mollusca and Echinodermata
- 6.0 Respiration
 - 6.1 Organs of respiration : Gills, lungs and trachea
 - 6.2 Respiratory pigments
 - 6.3 Mechanism of respiration

Section – B

- 7.0 Excretion
 - 7.1 Organs of excretion: Coelom, coelomoducts, Nephridia and Malpighian tubules.
 - 7.2 Mechanism of excretion and osmoregulation
- 8.0 Nervous system
 - 8.1 Primitive nervous system: Coelenterata and Echinodermata
 - 8.2 Advanced nervous system: Annelida, Arthropoda (Crustacea and Insecta) and Mollusca (Cephalopoda).
 - 8.3 Trends in neural evolution.

- 9.0 Invertebrate larvae
 - 9.1 Larval forms of free living invertebrates
 - 9.2 Strategies and Evolutionary significance of larval forms
 - 9.3 Conservation of invertebrates.

- 10.0 Introduction to insects
 - 10.1 Mouthparts of Insects
 - 10.2 How are insects able to fly?
 - 10.3 Mechanism of insect flight.
 - 10.4 Metamorphosis in insects
 - 10.5 Hormonal control of moulting.

- 11.0 Social life in insects

- 12.0 Integrated pest management

Suggested Reading Materials:

1. Hyman, L.H. The invertebrates, Vol. I. Protozoa through Ctenophora, McGraw Hill Co., New York.
2. Barrington, E.J.W. Invertebrate structure and function. Thomas Nelson and Sons Ltr J. London.
3. Jagerstein, G. Evolution of Metazoan life cycle, Academic Press, New York & London.
4. Hyman, L.H. The Invertebrates. Vol.2. McGraw Hill Co., New York.
5. Hyman, L.H. The Invertebrates. Vol.8. McGraw Hill. Co., New York.
6. Barnes, R.D. Invertebrate Zoology, IIIrd edition. W.B. Saunders Co., Philadelphia.
7. Russel-Hunter, W.D. A Biology of higher invertebrates, the Macmillin Co. Ltd. London.
8. Hyman, L.H. the Invertebrates smaller coelomate groups, Vol. V. McGraw Hill Co., New York
9. Read, C.P. Animal Parasitism. Prentice Hall Inc., New Jersey.
10. Sedgwick, A.A. Student text book of Zoology. Vol. I, II and III Central Book Depot, Allahabad
11. Parker, T.J., Haswell, W.A. Text book of Zoology, McMillan Co., London.

(Examination to be held annually along with Paper: ZOO-XI)

1. Preparation of mitotic and meiotic chromosomes.
2. Calculation of morphometric data and preparations of idiogram.
3. Determination of chiasma frequency and terminalization coefficient.
4. Preparation of polytene chromosomes and mapping.
5. Colorimetry and spectrophotometry, pH and buffers, isolation of sub-cellular organelles (principles).
6. Proteins: isoelectric point in protein (casein): quantitative estimation of proteins by Biuret method and Lowry's method.
7. Carbohydrates: quantitative estimation of total carbohydrates and glucose, glucose tolerance test, different tests of urine glucose.
8. Lipids: iodine number, saponification value, extraction of lipids quantitative estimation of total lipids, total and free cholesterol phospholipids, triglycerides, and glycolipids.
9. Nucleic acids: extraction of nucleic acids, estimation of DNA and RNA.
10. Paper chromatography: amino acids and carbohydrates.
11. Thin layer chromatography: neutral and phospholipids.
12. Tools: demonstration of parts and working of the following tools: PCR, GLC, Spectrophotometers, Fluorimeter, various kinds of microscopes, pH meter, Electrophoresis, Centrifuges, Tissue culture unit, Balance and Distillation units, Incubators, Photographic Equipment.

(Examination to be held annually along with Paper ZOO-XII)

1. Determination of mean and standard deviation coefficient of correlation, graphics.
2. Use of computers Microsoft word and Microsoft office excel, graphs statistics.
3. Slides and Museum specimens:
 - (a) PROTOZOA: *Gregarina, Monocystis, Ceratium, Euplotes, Didinium, Noctiluca, Radiolaria, Stentor, Opalina*.
 - (b) PORIFERA: Sectional view of *Sycon* (T.S., L.S.), *Grantia* (T.S.)
 - (c) CNIDARIA: *Obelia* polyp and Medusa, *Pennaria, Aurelia-Tentaculocysts, Virgularia, Spongodes, Zoanthus, Favia*.
 - (d) ANNELIDA: *Ozobranchus, Glossiphonia, Eunice, Chloea Flava, Polynoe, Terebella, Eurythoe*.
 - (e) ARTHROPODA: *Cyclops, Daphnia, Chelifer*, section of *Peripatus, Balanus, Lepas, Palinurus, Uca, Pyna, Hippa, Gongylus, Bellostoma, Limulus, Squilla, Eupagurus*.
 - (f) MOLLUSCA: Museum specimens of *Dolabella, Pteria, Nertie, Sanguinolaria, Chicoreus, Ficus, Lambis, Tridacna, Onchidium, Olcia, Murex, Turritella, Bulla, Cardium, Area*.
 - (f) ECHINODERMATA: Museum specimen of *Linckia, Echinodiscus, Holothuria, Antedon*.
 - (h) Study of Slides of *Bugula, Plumatella, Cristatella, Pectinatella*
4. Study of mouth parts of different insects.
5. Mounting: Trachea, Crustacean Larva, *Cyclops, Nauplius, Daphnia, Zoea, Mysis, Cercaria*.
6. Dissection of *Loligo/Sepia, Ak-hopper, Prawn, Cockroach, Earthworm* to expose various systems.

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Section - A

- 1.0 Basic Concepts: Definition, Scope and Significance of Ecology, Concept of biosphere, atmosphere, litho sphere and hydrosphere.
- 2.0 Ecological aspects of abiotic, biotic and edaphic factors.
- 3.0 Ecosystem: Concept, Kinds and components.
- 4.0 Ecological energetic and energy flow: Food chains, food webs, trophic structure; concept of productivity primary, secondary, gross and net' Energy flow models.
- 5.0 Population characteristics
 - 5.1 Population density, methods of population density measurement
 - 5.2 Growth rate and growth forms
 - 5.3 Natality, mortality, survivorship curves and life tables
 - 5.4 Biotic potential – Generation time, net reproductive rate reproductive values
 - 5.5 Population and distribution.
 - 5.6 Population dispersion

Section – B

- 6.0 Population regulation
 - 6.1 Extrinsic and intrinsic mechanisms
 - 6.2 Concept of density dependent and density independent factors in population regulation.
- 7.0 Population Interactions
 - 7.1 Concept of intra specific and inter specific population interactions
 - 7.2 Protocooperation, mutualism and commensalisms
- 8.0 Competition and niche theory.
 - 8.1 Intraspecific and inter specific interactions
 - 8.2 History of niche concepts
- 9.0 Predation
 - 9.1 Model of prey – predatory dynamics
 - 9.2 Role of predation in nature
 - 9.3 Parasitism

- 10.0 Community characteristics
 - 10.1 Species diversity
 - 10.2 Ecological Succession
 - 10.3 Ecological dominance
 - 10.4 Ecotones and Edge effect

Suggested Reading Materials

1. Understanding Evolution by Earl. D. Hanson, Oxford University Press, Oxford, New York.
2. Oxford Surveys in Evolutionary Biology Vol. I – Vol. VI, Oxford University Press, Walton, Street, Oxford.
3. Evolution by Theodose H. Eaton (Jr.) Thomes – Nolson & Sona Limited, London.
4. Evolutionary Theory: (The unfinished synthesis) by Robert G.B. Reid: Croom Helm: London & Sydney.
5. Dobzhansky, Th. Genetics and Origin of species. Columbia University Press.

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Section - A

- 1.0 Feeding mechanisms and regulation.
 - 1.1 Comparative physiology of digestion
- 2.0 Respiration: organs and respiratory pigments through different phylogenetic groups. Physiological response to oxygen deficient stress.
- 3.0 Patterns of nitrogen excretion among different animal groups
- 4.0 Osmoregulation in different animal groups
- 5.0 Thermoregulation
 - 5.1 Homeothermic animals
 - 5.2 Poikilotherms
 - 5.3 Hibernation and Aestivation
 - 5.4 Physical, chemical, neural regulation
 - 5.5 Acclimation and acclimatization
- 6.0 Circulation of body fluids and their regulation among different animal groups
- 7.0 Receptor physiology – a comparative study
 - 7.1 Mechanoreception
 - 7.2 Photoreception
 - 7.3 Chemoreception
 - 7.4 Equilibrium reception
- 8.0 Contractile elements, cells and tissues among different phylogenetic groups
 - 8.1 Muscle structure and function-correlation
 - 8.2 Specialized organs (eg: electric organs and tissues)

Section – B

- 9.0 Heterogamy in eukaryotes
- 10.0 Biology of sex determination and sex differentiation a comparative account
- 11.0 Comparative account of differentiation of gonads in vertebrates
- 12.0 Comparative testicular physiology in animals
 - 12.1 Morphology
 - 12.2 Differentiation
 - 12.3 Function and its regulation

- 13.0 Comparative ovarian physiology and differentiation in vertebrates
 - 13.1 Morphology
 - 13.2 Endocrinology
 - 13.3 Oogenesis vitellogenesis

- 14.0 Fertilization
 - 14.1 Pre-fertilization events
 - 14.2 Biochemistry of fertilization
 - 14.3 Post fertilization events

- 15.0 Multiple ovulation and embryo transfer technology (MOET)
 - 15.1 *In vitro* oocyte maturation
 - 15.2 Superovulation
 - 15.3 *In vitro* fertilization

- 16.0 Assisted reproduction technologies
 - 16.1 Embryo sexing and cloning
 - 16.2 Screening for genetic disorders
 - 16.3 ICSI, GIFT etc.
 - 16.4 Cloning of animals by nuclear transfer

- 17.0 Physiological adaptations to different environments.

- 18.0 Concept of Stress and Strain, Stress hormones and stress regulatory mechanisms.

Suggested Reading Material

1. C.L. Prosser. Comparative Animal Physiology. W.B. Saunders & Company.
2. R.Eckert. Animal Physiology: Mechanisms and Adaptation. W.H. Freeman & Company.
3. W.S. Hoar. General and Comparative Animal Physiology
4. Schiemdt-Nielsen. Animal Physiology: Adaptation and Environment. Cambridge.
5. C.L. Prosser. Environment and Metabolic Physiology. Wiley-Liss, New York.

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Section – A

- 1.0 Concepts of evolution and theories of organic evolution with an emphasis on Darwinism.
- 2.0 Neo Darwinism
 - 2.1 Hardy-Weinberg law of genetic equilibrium
 - 2.2 A detailed account of destabilizing forces:
 - (i) Natural selection
 - (ii) Mutation
 - (iii) Genetic drift
 - (iv) Migration
 - (v) Meiotic drive
- 3.0 Quantifying genetic variability
 - 3.1 Genetic structure of natural populations
 - 3.2 Phenotypic variation
 - 3.3 Models explaining changes in genetic structure of populations
 - 3.4 Factors affecting human disease frequency
- 4.0 Molecular population genetics
 - 4.1 Patterns of change in nucleotide and amino acid sequences
 - 4.2 Ecological significance of molecular variations
 - 4.3 Emergence of Noe-Darwinism-Neutral Hypothesis
- 5.0 Genetics of quantitative traits in populations
 - 5.1 Analysis of quantitative traits
 - 5.2 Estimation of heritability
 - 5.3 Genotype-environment interactions
 - 5.4 Inbreeding depression and heterosis
 - 5.5 Molecular analysis of quantitative traits
 - 5.6 Phenotypic plasticity

Section – B

- 6.0 Genetics of speciation
 - 6.1 Concept of species
 - 6.2 Patterns and mechanisms of reproductive isolation
 - 6.3 Modes of speciation (Allopatric, sympatric, parapatric, peripatric)

- 7.0 Molecular Evolution
 - 7.1 Gene Evolution
 - 7.2 Evolution of gene families, Molecular drive
 - 7.3 Assessment of molecular variation

- 8.0 Origin of higher categories
 - 8.1 Phylogenetic gradualism and punctuated equilibrium
 - 8.2 Major trends in 'the origin of higher categories
 - 8.3 Micro-and Macro-evolution

- 9.0 Molecular phylogenetics
 - 9.1 Concept of phylogenetic trees.
 - 9.2 Methods of construction of Phylogenetic trees.

- 10.0 Population genetics and ecology
 - 10.1 Metapopulations
 - 10.2 Monitoring Natural Population
 - 10.3 Why small populations become extinct?
 - 10.4 Loss of genetic variations
 - 10.5 Conservation of genetic resources in diverse taxa

Suggested Reading Material

1. Dobzhansky, Th. Genetics and Origin of Species. Columbia University Press.
Dobzhansky, Th., F.J. Ayala, G.L. Stebbins and J.M. Valentine. Evolution. Surjeet Publication, Delhi.
2. Futuyama, D.J. Evolutionary Biology, Suinaer Associates, INC Publishers, Dunderland.
3. Hartl, D.L. A Primer of Population Genetics. Sinauer Associates, Inc, Massachusetts.
4. Jha, A.P. Genes and Evolution. John Publication, New Delhi.
5. King, M. Species Evolution-The role of chromosomal change. The Cambridge University Press, Cambridge.
6. Merrel, D.J. Evolution and Genetics. Holt, Rinehart and Winston, Inc.
7. Smith, J.M. Evolutionary Genetics. Oxford University Press, New York.
8. Strikberger, M.W. Evolution. Jones and Bartlett Publishers, Boston London.

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Internal Assessment: 15
Time: 3 Hours

Note:

1. Nine questions will be set in all.
2. Question No. 1, which will be objective/short answer type cover the entire syllabus, will be compulsory. The remaining eight questions will be set section wise selecting four questions from each section (I & II). The candidate will be required to attempt question No. 1 and four more selecting two questions from each section.
3. As far as possible the questions should be divided into sub-parts and marks indicated part wise.

Section – A

- 1.0 Introduction to Chordates with their general characters.
 - 1.1 Origin of Chordates
 - 1.2 Concept of Protochordata or pre-vertebrates
 - 1.3 Classification of Vertebrates upto orders
- 2.0 Vertebrate integument and its derivatives
 - 2.1 Development, general structure and functions of skin and its derivatives
 - 2.2 Glands, scales, horns, claws, nails, hoofs, feathers and hairs
- 3.0 Skeletal system
 - 3.1 Form, function, body size and skeletal elements of the body
 - 3.2 Comparative account of jaw suspensorium, Vertebral column
 - 3.3 Limbs and girdles
- 4.0 Digestive system: Dentition, Stomach, Digestive Glands
- 5.0 Respiratory system
 - 5.1 Characters of respiratory tissue
 - 5.2 Internal and External Respiration
 - 5.3 Comparative account of respiratory organs

Section – B

- 6.0 General plan of circulation in various groups
 - 6.1 Blood
 - 6.2 Evolution of heart
 - 6.3 Evolution of aortic arches, and Portal systems
- 7.0 Evolution of Urinogenital system in vertebrate series
- 8.0 Nervous system
 - 8.1 Comparative anatomy of the brain in relation to its functions
 - 8.2 Comparative anatomy of spinal cord
 - 8.3 Nerves-Cranial, Peripheral and Autonomous nervous systems
- 9.0 Sense organs
 - 9.1 Simple receptors
 - 9.2 Organs of Olfaction and taste
 - 9.3 Lateral line system
 - 9.4 Electroreception
- 10.0 Adaptations: Levels of morphological adaptation and significance of body size

Suggested Reading Material

1. Barrington, E.J.W. The Biology of Hemichordata and Protochordata. Oliver and Boyd, Edinburgh.
2. Bourne, G.H. The structure and functions of nervous tissue. Academic Press, New York.
3. Carter, G.S. Structure and habit in vertebrate evolution - Sedgwick and Jackson, London.
4. Kingsley, J.S. Outlines of Comparative Anatomy of Vertebrates. Central Book Depot, Allahabad.
5. Kent, C.G. Comparative anatomy of vertebrates.
6. Milton Hilderbrand. Analysis of vertebrate structure. IV. Ed. John Wiley and Sons Inc., New York.
7. Sedgwick, A. A Students Text Book of Zoology, Vol. II.
8. Torrey, T.W. Morphogenesis of vertebrates. John Wiley and Sons Inc., New York and London.
9. Walters, H.E. and Sayles, L.D. Biology of vertebrates. MacMillan & Co., New York.
10. Weichert, C.K. and Presch, W. Elements of chordate anatomy, 4th Edn. McGraw Hall Book Co., New York.
11. Messers, H.M. An introduction of vertebrates anatomy.
12. Montagna, W. Comparative anatomy. John Wiley and Sons Inc.
13. Andrews, S.M. Problems in vertebrate evolution. Academic Press, New York.

(Examination of Papers ZOO-V & ZOO-XI)

Total Marks: 100
Practical Examination : 80
Internal Assessment : 20
Time: 4 Hours

1. Histochemistry: Methods of fixation of different tissues.
2. Preparation of tissues for microtomy and cryostat.
3. Histochemical test:
 - (a) Haemotoxylin-eosin
 - (b) Toluidine Blue
 - (c) Sudan Block-B
 - (d) Mercury bromophenol blue
 - (e) Methyl green-pyronin-Y
 - (f) Periodic acid Schiff's
 - (g) Acid phosphatase
 - (h) Alkaline phosphatase
4. Demonstration of live gametes and their staining procedure.
5. Effect of insulin and epinephrine on blood and urine sugar levels of rat.
6. Determination of optimum pH, temperature and concentration of amylase, trypsin and Lipase enzyme.
7. DLC, TLC, total RBC count of Fish, Frog, Bird and Mammal.
8. Determination of Blood Groups.
9. Identification of blood with non-blood like substances
10. Study of Endocrine glands of vertebrates.
11. Qualitative test of vitamins.
12. Quantification of vitamin A and C.
13. Effect of T4 on tadpole larva.

(Examinations of Papers ZOO-VI & ZOO-XII)

Total Marks : 100
Practical Examination: 80
Internal Assessment : 20
Time: 4 Hours

VERTEBRATE

1. Dissections: Rat/ Lab Mice /Fish. Digestive, Reproductive, Arterial, Venous, systems, Cranial nerves.
2. Museum specimens and slides :
Protochordates – *Salpa* sexual, *Salpa*-sexual, *Botryllus*, *Herdmania*.
Fishes - *Rhinobatus*, *Chimaera*, *Acipenser*, *Amia*, *Periophthalmus*, *Tricanthus*, *Notopterus notopterus*, *Scatophagus*, *Aargus*, *Trichurus*, *Mastacembalus armatus*, *Exocoetus* (flying fish), *Diodon hyterix*, *Echeneis*, *Neucrates*.
Amphibians – *Necturus*, *Siren*, *Ichthyophis*, *Geganophis*, *Rhacophorus*, *Rana tigrina*, *Amblystoma uraetyphlus*, *Cryptobranchus*, *Axolotl* Larvae, *Salamander*, *Amphiuma*, *Trilon*.
Reptiles – *Sirana*, *Chameleon*, *Phrynosoma*, *Chelone mydas*.
Birds – Indian Oriole, Indian Koel (male), India koel (female), Indian tailor birds, Kite, jungle fowl.
Mammals – Indian otter, *Marmoset*, *Loris*, Bat (*Megaderma lyra*), Pangolin, *Echidna*, *Ornithorhynchus*, Hedgehog, Scaly-ant eater, *Porcupine*, *Mongoose*.
3. Skull and lower jaw of *Chelonia*, Crocodile, Bird, Carnivore-mammal (dog), Herbivore mammal (horse).
4. Types of vertebrae of Procoelous, Opisthocoelous, Amphicoelous, Amphiplatian, Heterocoelous, Axis and atlas vertebrae.
5. Comparative Osteology of Vertebrates : Vertebrate, Girdles, Limb-bones

Total Marks : 90
Theory Examination : 75
Internal Assessment : 15
Time: 3 Hours

Note:

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3. As far as possible the questions should be divided into sub-parts and marks indicated part wise.

Section – A

- 1.0 History and Scope of Molecular Biology
- 2.0 DNA replication
 - 2.1 Prokaryotic and eukaryotic DNA replication
 - 2.2 Mechanics of DNA replication
 - 2.3 Enzymes and accessory proteins involved in DNA replication
- 3.0 Transcription
 - 3.1 Prokaryotic transcription
 - 3.2 Eukaryotic transcription
 - 3.3 RNA polymerases
 - 3.4 General and specific transcription factors
 - 3.5 Regulatory elements and mechanisms of transcription regulation
 - 3.6 Transcriptional and post-transcriptional gene silencing.
- 4.0 Post-transcriptional Modifications in RNA
 - 4.1 5'-Cap formation
 - 4.2 Transcription termination
 - 4.3 3'-end processing and polyadenylation
 - 4.4 Splicing, Editing
 - 4.5 Nuclear export of mRNA
 - 4.6 mRNA stability

Section – B

- 5.0 Translation
 - 5.1 Genetic code
 - 5.2 Prokaryotic and eukaryotic translation
 - 5.3 The translational machinery
 - 5.4 Mechanisms of initiation, elongation and termination
 - 5.5 Regulation of translation
 - 5.6 Co- and post-translational modifications of proteins
- 6.0 Antisense and Ribozyme technology
 - 6.1 Molecular mechanisms of antisense molecules
 - 6.2 Inhibition of splicing, polyadenylation and translation
 - 6.3 Disruption of RNA structure and capping
 - 6.4 Biochemistry of ribozyme; hammerhead, hairpin and other ribozymes
 - 6.5 Strategies for designing ribozymes
 - 6.6 Application of antisense and ribozyme technologies

- 7.0 Recombination and repair
 - 7.1 Holiday junction, gene targeting, gene disruption
 - 7.2 Cre/lox recombination
 - 7.3 RecA and other recombinases
 - 7.4 DNA repair mechanisms

- 8.0 Molecular mapping of genome
 - 8.1 Genetic and physical maps
 - 8.2 Physical mapping and map-based cloning
 - 8.3 Southern and fluorescence *in situ* hybridization for genome analysis
 - 8.4 Chromosome micro-dissection and micro-cloning
 - 8.5 Molecular markers in genome analysis RFLP, RAPD and AFLP analysis.
 - 8.6 Molecular markers linked to disease resistance genes
 - 8.7 Application of RFLP in forensic, disease prognosis, genetic counseling, pedigree, etc. analysis, Animal trafficking and poaching; germplasm maintenance and taxonomy.

Suggested Reading Materials

1. Molecular Biology of the Gene, J.D. Watson, N.H. Hopkins, J.W. Roberts, J.A Steitz and A.M. Weiner. The Benjamin/Cummings Pub. Co., Inc., California.
2. Molecular Cell Biology, J. Darnell, H. Lodish and D. Baltimore Scientific American Books, Inc., USA
3. Molecular Biology of the Cell, B. Alberts, D. Bray, J. Lewis, M. Raff, K. Roberts and J.D. Watson. Garland Publishing Inc., New York.
4. Gene VI, Benjamin Lewin, Oxford University Press, U.K.
5. Molecular Biology and Biotechnology. A comprehensive desk reference, R.A Meyers (Ed.), VCH Publishers, Inc., New York.
6. Molecular Cloning: a Laboratory Manual, J. Sambrook, E.F. Fritsch and T. Maniatis, Cold Spring Harbor Laboratory Press, New York.
7. Introduction to Practical Molecular Biology, P.D. Dabre, John Wiley & Sons Ltd., New York.
8. Molecular Biology LabFax, T.A Brown (Ed.), Bios Scientific Publishers Ltd., Oxford.

Total Marks : 90
Theory Examination : 75
Internal Assessment : 15
Time: 3 Hours

Note:

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3. As far as possible the questions should be divided into sub-parts and marks indicated part wise.

Section – A

1. Basic concept of endocrinology, its scope and role in molecular biology.
2. Chemical nature of hormones;
 - 2.1 Amino-acid derived hormones
 - 2.2 Peptide hormones
 - 2.3 Glyco-protein hormones,
 - 2.4 Steroid hormones and
 - 2.5 Prostaglandin
3. Biosynthesis of peptide hormones, transcriptional and post-transcriptional modifications
4. Network of extra-cellular and intracellular signals. Role of cell structure in intracellular communication.
5. Prostaglandin structure, type, synthesis and biological activities.
6. Mechanism of action of peptide hormones; concept of second messengers, cAMP, cGMP, Ca⁺⁺, calmoduline, IP₃, DAG, NO, signal transduction mechanism, G-proteins.
7. Mechanism of action of steroid hormones; Nuclear receptors, orphan genes and receptors and their role in metabolism and development. Cross talk concept, phosphorylation, Heat shock proteins.

Section – B

8. Hormonal regulation of Metabolism:
 - 8.1 Role of Insulin & Glucagon in regulation of Carbohydrate metabolism
 - 8.2 Metabolic regulatory hormones in Lipid & Protein metabolism
9. Role of Parathyroid Hormone in Ca⁺⁺ & Po₄⁻ regulation
10. Genetic basis of hormonal disorders.
11. Sequence-specific DNA binding proteins, DNA binding receptor proteins and their role in gene transcription, cell differentiation and cell proliferation.
12. Interaction between pathways i.e. cAMP, Ca⁺⁺ pathway, parallel pathway.
13. Role of Hormones and metabolites in morphogenesis & early development.
14. Gastrointestinal hormones and their role in regulation of metabolic activity.

15. Regulatory substances – Erythropoietin, growth factors, Thymus gland & Kinins.
16. Diabetes & Obesity management vis-à-vis life style & Endocrine factors.
17. Hormone therapy in different endocrine disorders.

Suggested Reading Materials

1. Benjamin Lewin, Genes VII, Oxford University Press.
2. Lodish et al. Molecular Cell Biology.
3. Ethan Bier. The Coiled Spring, Cold Spring Harbor Press.
4. L.P. Freedman. Molecular Biology of Steroid and Nuclear Hormone Receptors, Birkhauser.
5. G. Litwack. Biochemical Actions of Hormones, Academic Press.

Note:

1. Nine questions will be set in all.
2. Question No. 1, which will be objective/short answer type cover the entire syllabus, will be compulsory. The remaining eight questions will be set section wise selecting four questions from each section (I & II). The candidate will be required to attempt question No. 1 and four more selecting two questions from each section.
3. As far as possible the questions should be divided into sub-parts and marks indicated part wise.

Section- A

1. Environmental pollution:
 - 1.1. Definition, primary and secondary pollutants.
 - 1.2. Types of pollution: their causes, sources, effect and control management/method
 - 1.2.1. Air pollution
 - 1.2.2. Water pollution
 - 1.2.3. Soil pollution
 - 1.2.4. Noise pollution
 - 1.2.5. Thermal pollution
 - 1.2.6. Radio-active pollution.
2. Green House effect: Definition, global warming, consequences and significance.
3. Ozone layer: Ozone as a friend and a foe; reasons of ozone depletion and its possible effects on plants, animals and man; Measures to check depletion of ozone layer.
4. Concepts of sustainable development, its utility and significance.
5. Environment Impact Assessment: Definition, Introduction, Different phases and significance.
6. Environmental Policy: Economic environmental policy, social environmental policy, legal environmental policy at global and national level.
7. Environmental Audit

Section- B

8. Environmental Toxicology:
 - 8.1. Historical background, Classical toxicology, ecotoxicology and environmental toxicology.
 - 8.2. Classification of toxicants.
9. Toxic agents: Pesticides, metals, solvents Radiation, carcinogens, poisons, Bio-toxins, petrochemicals.
10. Toxicant uptake:
 - 10.1. Route of toxicant uptake/Absorption of toxicant
 - 10.2. Uptake at tissue and cellular level/Distribution and storage of toxicant.
 - 10.3. Biotransformation and elimination of toxicant.
11. Xenobiotics: Definition, types and significance

12. Target organ toxicity:
 - 12.1. Hematototoxicity
 - 12.2. Hepatototoxicity
 - 12.3. Nephrototoxicity
 - 12.4. Neurotoxicity
 - 12.5. Dermototoxicity

Suggested Reading Material

1. Concepts of Ecology by Edward J. Kormondy; Prentice Hall of India (Pvt.) Ltd.
2. Fundamentals of Ecology by W.B. Odum, E.P. Saunders, Toppan Co. Ltd., Tokyo, Japan.
3. Ecology by Paul Colin Vacx: John Wiley & Sons, Inc.
4. Environmental Pollution by H.M Dix., John Wiley Publications, New York.
5. Handbook of Solid Waste Management by Wilson, Van Nostrand, Reinhold.
6. Environmental Studies by D.B. Botkin, & E.A. Keller, Martill Publising Co., Columbs, Toronto, London.
7. Ecology of Natural Resources, Francoid remade, John Wiley & Sons, New York, Singapore.
8. Ecology by Paul Colinvaux; John Wiley & Sons, New York, Chichester, Brisbane, Toronto, Singapore.
9. Applied Ecology and Environmental Management by Edward I. Newman.
10. Principle of Environmental Science by W.P. Cunningham & M.A. Cunningham.
11. Environmental Impact Assessment Methodologies by Y. Anjaneyulu.
12. Bioremediation Technology by Fulekar, M.H.
13. Biotranformation: Bioremediation Technology for Health & Environmental Protection by R. D. Stapleton Jr. and V.P. Singh (Ed), Elsevier.
14. Casarett & Doull's Toxicology: The Basic Science of Poisons by Curtis Klaassen.
15. Applied Ecology and Natural Resource Management by Guy R. McPherson and Stephen DeStefano
16. Essentials of Ecology by C Townsend, M Begon, J L Harper, Scuthwick, C.H.
17. Ecology and the quality of our environment by D. Van Nestrand.
18. Ecotoxicology: The study of pollutants in ecosystems. 3rd Ed. Elsevier by Moriarty, F.
19. Environment concerns and strategies. Ashish Pub. House, NDL by T.N. Khushoo.
20. Environmental biology. Akashdeep Pub. House by R.R. Trevedi Gurdeep Raj.
21. Textbook: A Textbook of Modern Toxicology. Third Edition by E. Hodgson (Ed.). John Wiley & Sons, Inc. (Posted on the D2L content page.)
22. Environmental Health by Monroe T. Morgan
23. Handbook of Environmental Health and Safety – principle and practices by H. Koren; Lewis Publishers
24. Principles of Environmental Toxicology by I. C. Shaw and J. Chadwick; Taylor & Francis ltd.
25. Introduction to Toxicology, 3rd Ed. Taylor & Francis, London by Timbrell, J.

Elective Paper: ZOO-XV (ii)
Applied Zoology- I

Total Marks: 90
Theory Examination: 75
Internal assessment: 15
Time: 3 hours

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Section- A

1. Vertebrate and non vertebrate pests, their harmful status and economic importance (Rodents, Birds, Snails and insects).
2. Pest control practices: Cultural control, Physical control, Mechanical control, Chemical control, Biological control, Herbal control and legal control.
3. Migration, population fluctuation and Ecological factors affecting the population and development of insects.
4. Insects of medical and veterinary importance.
5. Forensic Entomology: Introduction, forensically important insects, collection of data from cadaver site, interpretation of data for predicting time and cause of death.
6. Pheromones- Production and their use in pest surveillance and management.

Section-B

7. Sericulture : Types of silk, species of silk moth (scientific names), Silkworms and their host plants, mulberry silk worm culture, agricultural aspects of mulberry plant cultivation, extraction and reeling of silk, natural enemies and diseases of silkworm and their control.
8. Apiculture : Species of honey bees in India, life history of *Apis cerana indica*, agriculture techniques, bee products and their uses, natural enemies and diseases of honey bee and their control.
9. Lac culture: lac insect (Scientific name), composition of lac, strains of lac insect, cultivation of lac host plants (in brief) processing of lac and uses of lac.
10. Vermiculture, Poultry keeping, piggery and Dairy industry.
11. Prawn culture, Pearl culture.
12. Social forestry, Joint forest managements.
13. Bioresources & uses of Biodiversity

Suggested Reading Material:

1. Insect Pest Management by Dent, D.
2. Agricultural Entomology by Hill, D.S., Timber Press.
3. General and Applied Entomology by David, B. V. & Ananthkrishnan, T. N., Tata McGraw-Hill Publishing.
4. Entomology and Pest Management by Pedigo L. P. Prentice Hall, India.
5. General and Applied Entomology by Nayar K. K. and T. N. Ananthkrishnan and B. V. Davis, Tata McGraw Hill Publications. New Delhi.
6. Agricultural Pests: Biology and Control Measures by B. M. Deoray and T. B. Nikam, Nirali Publication, Pune.
7. Concepts of Insect Control by Ghosh M. R. Wiley Eastern Ltd. New Delhi.
8. Economic Zoology. Shukla Upadhyay, Rastogi Publication, Meerut, India, 1998.

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Time: 3 Hours

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3. As far as possible the questions should be divided into sub-parts and marks indicated part wise.

Section – A

- 1.0 Biology of Chromosomes:
 - 1.1 Molecular anatomy of eukaryotic chromosomes.
 - 1.2 Metaphase chromosomes: Centromere, Kinetochore, Nucleolus organizers and rRNA genes.
 - 1.3 Telomere: Functions, Telomeric DNA structure, telomere synthesis, telomerase cycle, telomere shortening in cell senescence and immortalization.
 - 1.4 Heterochromatin and euchromatin.
- 2.0 Giant Chromosomes:
 - 2.1 Polytene Chromosomes
 - 2.2 Lampbrush Chromosomes
- 3.0 Sex Chromosomes:
 - 3.1 Sex determination and the Y Chromosome
 - 3.2 Dosage compensation in *C. elegans*, *Drosophila* and Humans.
 - 3.3 X inactivation in Mice and Mules.
 - 3.4 The role of the second X Chromosome
 - 3.5 Molecular basis of inactivation.
- 4.0 Genomic Imprinting:
 - 4.1 Uniparental disomy
 - 4.2 Imprinting disorders
 - 4.3 Ovarian teratomas and hydatiform moles.
 - 4.4 Nature and mechanism of genomic imprinting
 - 4.5 X- inactivation and imprinting
 - 4.6 Sex specific imprinting

Section – B

- 5.0 Somatic Cell Genetics:
 - 5.1 Cell fusion and somatic cell hybrids – agents and mechanism of fusion.
 - 5.2 Heterokaryon – Cell lines and selection systems and chromosome segregation.
 - 5.3 Radiation hybrid mapping.
 - 5.4 Gene mapping with somatic cell hybrids
 - 5.6 Hybrid mapping panels.
- 6.0 Genes in Pedigrees:
 - 6.1 Mendelian pedigree pattern.
 - 6.2 Heritable diseases in human.
 - 6.3 Inheritance of mitochondrial diseases
 - 6.4 Complications to the basic pedigree patterns
 - 6.5 Non-Mendelian traits.

- 7.0 Gene Mutations :
 - 7.1 Spontaneous mutations – Base pair substitution and frame shift mutations
 - 7.2 Induced mutations – Radiation, chemical and environmental
 - 7.3 *In –vitro* site specific mutagenesis.
 - 7.4 Detection of mutagens – The Ames test and sister chromatid exchanges.

- 8.0 Genetics of Cell Cycle:
 - 8.1 Genetic regulation of cell division in yeast and eukaryotes.
 - 8.2 Molecular basis of cellular check points.
 - 8.3 Molecular basis of neoplasia.

Suggested Reading Material:

1. Atherly, A.C., J.R. Girton and J.F. McDonald. The Science of Genetics. Saunders College Publishing, Harcourt Brace College Publishers, NY.
2. Brooker, R.J. Genetics : Analysis and Principles. Benjamin/Cummings, Longman Inc.
3. Fairbanks, D.J. and W.R. Anderson. Genetics – The Continuity of Life. Brook/Cole Publishing Company ITP, NY, Toronto.
4. Gardner, E.J., M.J. Simmons and D.P. Snustad. Principles of Genetics. John Wiley and Sons. Inc., NY.
5. Griffiths, A.J.F., J.H. Miller, D.T. Suzuki, R.C. Lewontin and W.M. Gelbart. An introduction to genetic analysis. W.H. Freeman and company, NY.
6. Lewin, B. Genes. VI. Oxford University Press, Oxford, New York, Tokyo.
7. Snustad, D.P. and M.J. Simmons. Principles of Genetics. John Wiley and Sons. Inc., NY.
8. Watson, J.D., N.H. Hopkins, J.W. Roberts, J.A. Steitz and A.M. Weiner. Molecular Biology of Genes. The Benjamin/Cummings Publishing Company Inc., Tokyo.
9. Tom Strachan & Read, A.P. Human Molecular Genetics 3rd edition, Garland Publishing 2004, London.

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3. As far as possible the questions should be divided into sub-parts and marks indicated part wise.

Section – A

- 1.0 Central nervous system, Hypothalamus-pituitary axis:- Hypothalamus nuclei (anatomy) , Vascularity, endocrine functions, Neurosecretions, Neurohormones and Hormones, Pituitary and non-pituitary gonadotrophins and their biological significance.
- 2.0 Germline-soma interactions during early development.
- 3.0 Sertoli cell-germ cell interactions and regulation of testicular activity both *in vivo* and *in vitro*.
- 4.0 Physiology, biochemistry and molecular biology of follicular growth.
- 5.0 Induced and spontaneous ovulators; Theories of ovulation.
- 6.0 Follicular atresia; causes, regulation and significance with special reference to fertility regulation.

Section – B

- 7.0 Molecular, cellular and functional changes during ageing, life span, chronological and biological age, Relationship between reproduction and ageing. Importance of diet, diseases, exercise, stress and yoga.
- 8.0 Chromatin changes; structural and functional impairment; Acetylation, methylation, changes in histones and packing proteins during ageing.
- 9.0 Enzyme changes during ageing; Isoenzyme patterns, induction of enzymes and molecular properties.
- 10.0 Collagen changes during ageing; structure, types and cross linking groups and functional changes.
- 11.0 Hormonal changes during ageing; age-reversal effects of hormones and growth factors.
- 12.0 Theories of ageing: somatic mutation theory; error theory; codon restriction theory; gene regulation theory; free radical theory ; telomerase theory.

Suggested Reading Materials:

1. Guraya S.S. (1998). Cellular and Molecular Biology of General development and Maturation in mammals Narosa Publishing House, New Delhi.
2. Hafez E.S.E.(1994). "Reproduction in farm animals". Lea Febighiese.
3. Mc Donald L.E. (1988). Veterinary Endocrinology & Reproduction. Varghese Co., Bombay
4. Degrodt L.I.(1995). Endocrinology Vol. I, II, III Saunders.
5. Gurays S.S. (2000). Comparative Cellular and Molecular Biology of Ovary in mammals. I.B.H., New Delhi.

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Section – A

1. Concept of Animal behaviour; Mile-Stones in the history of animal behaviour and scope.
2. Anthropomorphism and subjectivity vs. Ethology : Various methods to overcome these problems in the study of animal behaviour.
3. Stereotyped and acquired behaviour patterns : Tropisms, Taxes, Reflexes, Instincts, learning & reasoning; Change in major modes of adaptive behaviour in phylogeny.
4. Perception of the environment : Mechanical, Electrical, chemical, olfactory, auditory, visual
5. Biological rhythms and concept of biological clock.
6. Motivation: Introduction, goal oriented behaviour, biological drives – Primary and Secondary drives.
7. Concept of learning: law of learning, types of learning – Habitation, trial & error learning, latent learning, Insight, Imprinting, Classical conditioning & Instrumental learning.

Section – B

8. Wildlife: Definition, significance and wildlife zones of the world and India, Wildlife Map of the world, Wildlife map of India;
9. Protected Area Systems: Concept, Historical background, categories and management objectives of protected areas, world growth of protected areas, and Present status of National PA-Systems.
10. Theory and Practice of Biosphere Reserves of the world: Biosphere Reserves of India.
11. Natural Heritage Sites of the world, Natural Heritage sites in India. Important National Park and Wildlife Sanctuaries of India
12. Wildlife and livelihood; Wildlife and illegal trade & control;
13. Wildlife conservation techniques, role of WWF, IUCN, UNEP, Red Data Book; Categories of Endangered Wildlife Species.
14. A brief analysis of Avian and Mammalian fauna of the Indian Subcontinent and World.

Suggested Reading Materials:

1. Techniques for wildlife Census in India by W.A. Rogers (A field manual); Wildlife Institute of India, Dehradun.
2. Wildlife Wealth of India by T.C. Majupuria; Tecpress Services, L.P., 487/42-SOL-Wattenslip, Pratunam Bangkok, 10400, Thailand
3. Ali, S. Ripley S.D. Handbook of Birds of India, Pakistan 10-Vols. Oxford University Press, Bombay.
4. The Book of Indian Animals by S.H. Prater, BNHS-Publication, Bombay.
5. Wildlife in India by V.B. Saharia Natraj Publishers, Dehradun.
6. E.P. Gee, The Wildlife of India.

Total Marks : 90
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Section – A

- 1.0 Definition of Fish, Fisheries and aquaculture.
- 2.0 Classification of fishes with distinguishing characters and examples of each group.
- 3.0 Indian fisheries production, utilization and demand.
- 4.0 Estuarine, Marine, Riverine and wetland fisheries: characteristic species and their exploitation.
- 5.0 Culture fisheries
 - 5.1 Cultivable organisms for aquaculture.
 - 5.2 Criteria of selection of cultivable fishes
- 6.0 Design, construction and maintenance of fish culture ponds.
- 7.0 Ecology of fish pond ecosystem
 - 7.1 Physico chemical conditions of ponds water and soil
 - 7.2 Biological conditions of waters
 - 7.3 Weeds and their control
 - 7.4 Productivity of fish pond
 - 7.5 Classification of water bodies on the basis of productivity.
- 8.0 Water pollution its causes and remedy
- 9.0 Aquaculture Ranching and Rational fishery.

Section – B

- 10.0 Fish integument : Exoskeleton and colouration
- 11.0 Fins : origin, types and functions
- 12.0 Food and feeding habits of fishes, Digestion in fishes
- 13.0 Respiratory system Gill structure and functions, Accessory respiratory organs swim bladder and webberian ossicles
- 14.0 Osmoregulation in fishes

- 15.0 Receptors in fishes
 - 15.1 Chemoreceptors
 - 15.2 Lateral line organs
 - 15.3 Eye Ear
 - 15.4 Pineal organ

- 16.0 Hormones and reproduction : Induced breeding in carps and catfishes.

- 17.0 Identification of different maturity stages of fishes.

- 18.0 Migration in fishes

- 19.0 Fish diseases and their control

- 20.0 Age and growth studies

Total Marks : 90
Theory Examination: 75
Internal Assessment : 15
Time: 3 Hours

Note:

1. Nine questions will be set in all.
2. Question No. 1, which will be objective/short answer type cover the entire syllabus, will be compulsory. The remaining eight questions will be set section wise selecting four questions from each section (I & II). The candidate will be required to attempt question No. 1 and four more selecting two questions from each section.
3. As far as possible the questions should be divided into sub-parts and marks indicated part wise.

Section – A

- 1.0 Classification and diagnostic features of insects.
- 2.0 Distinctive characters and interrelationship of various insect orders.
- 3.0 Classification of Orthoptera, Hemiptera and Coleoptera up to families (important ones only)
- 4.0 Evolution of wings.
- 5.0 Insect and Plants
 - 5.1 Phytophagy
 - 5.2 Pollination and Myrmacochory
- 6.0 Insect Predation and parasitism
- 7.0 Insect societies: Subsociality in insect; Eusociality in insect (Colony and Castes in Hymenoptera and Isoptera); Evolution of eusociality.
- 8.0 Insect defense.

Section – B

- 9.0 Integument, its derivatives, and colour production.
- 10.0 Segmentation and tagmosis.
- 11.0 Head and its appendages.
- 12.0 Thorax and its appendages.
- 13.0 Wings and its variation.
- 14.0 Abdomen and its appendages.
- 15.0 External Genitalia and its modifications.
- 16.0 Metamorphosis.
- 17.0 Diapause.
- 18.0 Mounting.

Suggested reading material

1. The Insect-Structure and Function. - by R.F. Chapman.
2. Imm's General Text Book of Entomology –by O.W. Richards and R.G. Davies.
3. The Insect an outline of Entomology- by P.G. Gullan and P.S. Cranston.

Total Marks : 90
Theory Examination: 75
Internal Assessment : 15
Time: 3 Hours

Note:

1. Nine questions will be set in all.
2. Question No. 1, which will be objective/short answer type cover the entire syllabus, will be compulsory. The remaining eight questions will be set section wise selecting four questions from each section (I & II). The candidate will be required to attempt question No. 1 and four more selecting two questions from each section.
3. As far as possible the questions should be divided into sub-parts and marks indicated part wise.

Section – A

- 1.0 Covalent properties of proteins.
 - 1.1 Structure and chemistry of amino acids.
 - 1.2 Protein sequencing
 - 1.3 Peptide synthesis
 - 1.4 Covalent modification
 - 1.5 Protein size and composition
 - 1.6 Protein splicing
- 2.0 Protein secondary structure
 - 2.1 Protein tertiary structure and folding patterns
 - 2.2 Common tertiary structural motifs
 - 2.3 Role of packing constraints in tertiary structure patterns
 - 2.4 Divergent vs. convergent evolution of similar structural motifs
- 3.0 Globular and Fibrous Proteins
 - 3.1 Water and the hydrophobic effect
 - 3.2 Tertiary and quaternary effect
 - 3.3 Motifs in globular proteins
 - 3.4 Properties of protein interiors and surfaces
 - 3.5 Fibrous proteins
 - 3.6 Structure of bone
- 4.0 Protein folding and thermodynamics
 - 4.1 Protein folding and dynamics
 - 4.2 Folding overview: the Levinthal paradox
 - 4.3 Condensation and molten globules
 - 4.4 Ramachandran plots and amino acid propensities
 - 4.5 Catalysis and assistance
 - 4.6 Amino acid sequence variation and membrane protein folding
 - 4.7 Chaperonin-assisted protein folding

Section-B

- 5.0 Large macromolecular assemblies
 - 5.1 Principles of protein-protein interaction
 - 5.2 Control of assembly
 - 5.3 Viruses,
 - 5.4 Muscle assemblies

- 6.0 Use of sequence comparisons of study evolution.
- 7.0 Allostery (Hemoglobin), Myoglobin structure and oxygen binding
 - 7.1 Hemoglobin subunits cooperativity, the Hill coefficient
 - 7.2 Quaternary structure changes Sickle cell and other molecular diseases
- 8.0 Methods of Study Protein-Protein purification and analysis, Electrophoresis, Dialysis, Column chromatography, Ultracentrifugation, Mass spectrometry, Affinity chromatography, Optical spectroscopy, X-ray crystallography, NMR, High resolution electron microscopy. Peptide chemistry-sequencing and synthesis.

Suggested Reading Materials

1. G.M. Blackburn and M. Gait. Nucleic Acids in Chemistry and Biology. Oxford University Press.
2. W. Saenger. Principles of Nucleic Acid Structure. Springer Verlage, New York.
3. T.E. Creighton. Proteins: Structure and Molecular Properties. W.H. Freeman, New York.

(Examination to be held annually along with paper XXIII)

1. Preparation of microscopic slide with specific staining – Blood smears – for detection of any Parasitic forms intra cellular (e.g. malarial parasite) or extra cellular (Trypanosomes). Avian blood could be tried, Fish blood.
2. Raising of larval stages – again in respect of mosquitoes: - *Culex*; *Anopheles*, *Aedes*, marking out the basic structural differences at larval level.
3. Preparation of permanent mounts of *Culex* and *Aedes* and *Anopheles* adults – highlight differences, if any, between basic these important vectors.
4. Preparation of stained mounts of *Dicrocoelium dendriticum* (as are example of Trematode Parasite) from sheep liver, Acetocarmine stain.
5. Study of Nematodes in glycerin. The material could be had from frogs cloacal region of the frog and lizards.
6. Making acetocarmine squashes of nematode eggs for their chromosomal pattern.
7. Scanning of frog cloacal scrappings in glycerin on a glass slide for sharing any evidence of monogenetic trematodes like Diplozoon or *Polystoarella*.
8. Study of parasitic load in a host species in different region : no. of parasites per host specimen or region of the specimen.
9. Non-protein nitrogenous substances: qualitative estimation of serum Bilirubin serum and urine creatinine.
10. Estimation of Acid and alkaline phosphates.
11. Demonstration of SDS and non-SDS electrophoresis
12. Microbiological media preparation, sterilization, dilution, inoculation and standard plant count.
13. Practical of paper XV opt. (i) & (ii) will be based on theory curriculum.

[Examination to be held annually along with paper ZOO-XXIV(i)]

1. Making karyological preparations from testicular material of suitable insects by squash and air drying techniques to study the structure and behaviour of chromosomes during mitosis and meiosis.
2. Study of chiasma frequency and terminalisation co-efficient.
3. Study of mitosis from hepatic caecae of suitable insects and preparation of karyotype and idiogram.
4. Demonstration of banding techniques (C, G and T).
5. Study of NORs in insect chromosomes.
6. Making preparations from salivary glands of *Chironomus* larvae / *Drosophila* larvae to study polytene chromosomes.
7. Effect of temperature on polytene chromosomes.
8. Preparation of human buccal smear to study sex chromatin.
9. Nuclear sexing from polymorphonuclear leucocytes.
10. Identification of meiotic and mitotic stages from permanent slides.
11. Gel electrophoresis : Practical demonstration.
12. Isolation of genomic DNA.
13. PCR : Introduction and practical demonstration.

[Examination to be held annually along with paper ZOO-XXIV(ii)]

1. Dissection of brain, spinal cord and associated nerves and male and female reproductive systems of earthworm, cockroach, grass hopper, and rat.
2. Perfusion techniques and fixation method for histological studies.
3. Processing of nervous and reproductive tissues for microanatomy and histochemistry.
4. Study of permanent slides on mammalian reproductive and nervous tissues.
5. Study of folliculogenesis and atresia in rat ovary.
6. Study of apoptosis in nervous tissues and gonads.
7. Extraction and estimation of macromolecules such as proteins, carbohydrates, lipids, and nucleic acids.
8. Histochemical and biochemical analysis of age pigments.
9. Study of vitellogenesis in different animals.
10. Oocyte collection; aspiration and slicing method.
11. Oocyte maturation *in vitro*.
12. Sperm morphology, capacitation, sperm count, and sperm motility.
13. *In vitro* fertilization.

[Examination to be held annually along with paper ZOO-XXIV(iii)]

1. Designing of experiments, observations, techniques of data analysis, presentation of results and writing of laboratory report.
2. To demonstrate locomotive, explorative withdrawal and habituation behaviours in earthworm.
3. To demonstrate response of earthworm to light.
4. To demonstrate antennal grooming behaviour in cockroach.
5. Demonstration of food preferences in *Tribolium/ Rhizopertha/ Callosbruchus*.
6. Investigation of habituation of diving response of mosquito larvae.
7. To study the effect of temperature on heartbeat of cockroach.
8. Field study of nesting behaviour of common available avian fauna of the region.
9. To prepare charts of wildlife zones of India and the world
10. (a) Estimation of insect-population using sweep net method.
(b) Estimation of population of soil arthropods by transect method.
11. To study mobbing response of birds.

[Examination to be held annually along with paper ZOO-XXIV(iv)]

1. Study of Anatomy and Morphology of important group of fishes.
2. Taxonomic study of common families, genera and species of fishes
3. Study of fishes of Haryana
4. Survey of fish fauna of a specific fishing spot by each student
5. Examination of skeleton of cartilaginous and bony fishes
6. Study of histological and microscopic structure in fishes
7. Analysis of physical and chemical properties of water
8. Qualitative and quantitative examination of phyto- and Zooplankton in a water body.
9. Study of Aquatic weeds and aquatic insects

[Examination to be held annually along with paper ZOO-XXIV(v)]

1. Dissection of the below mentioned insects (to show their stomatogastric sympathetic nervous system and central nervous system, alimentary canal and reproductive organs): mylabris, Cockroach, Ak-hopper, *Gryllus*, wasp.
2. Permanent slide preparation of whole mounts and various modifications of different morphological parts of insect (antennae, legs, wings, mouthparts, genitalia etc.).
3. Fixation, section cutting and staining (double) of suitable insect tissues.
4. Insect collection and preservation.

[Examination to be held annually along with paper ZOO-XXIV(vi)]

1. Separation of macromolecules by Chromatographic techniques.
2. Isolation of genome DNA.
3. Southern blotting
4. RFLP analysis.
5. Isolation of RNA

Total Marks : 90
Theory Examination: 75
Internal Assessment : 15
Time: 3 Hours

Note:

1. Nine questions will be set in all.
2. Question No. 1, which will be objective/short answer type cover the entire syllabus, will be compulsory. The remaining eight questions will be set section wise selecting four questions from each section (I & II). The candidate will be required to attempt question No. 1 and four more selecting two questions from each section.
3. As far as possible the questions should be divided into sub-parts and marks indicated part wise.

Section – A

- 1.0 Introduction to animal development
 - 1.1 Problems of developmental biology
 - 1.2 Developmental patterns in metazoans
 - 1.3 Development in unicellular eukaryotes
- 2.0 Creating multicellularity
 - 2.3 Cleavage types
 - 2.4 Comparative account of gastrulation
- 3.0 Early vertebrate development
 - 3.1 Neurulation and ectoderm
 - 3.2 Mesoderm and endoderm
- 4.0 Cytoplasmic determinants and autonomous cell specification
 - 4.1 Cell commitment and differentiation
 - 4.2 Cell specification in nematodes
 - 4.3 Germ cell determinants
 - 4.4 Germ cell migration
 - 4.5 Progressive cell - Cell interaction and cell specification fate
- 5.0 Body Axes
 - 5.1 Establishment of Body axes in mammals and birds
 - 5.2 Proximate tissue interactions
 - 5.3 Genetics of axis specification in *Drosophila*
- 6.0 Homeobox concept in different phylogenetic groups

Section – B

- 7.0 Tetrapod limb development
- 8.0 Hormones as mediators of development
 - 8.1 Amphibian metamorphosis
 - 8.2 Insect metamorphosis
 - 8.3 Ovarian luteinization and mammary gland differentiation.
- 9.0 Environmental evolution and animal development
 - 9.1 Environmental cues and effects
 - 9.2 Malformations and disruptions
 - 9.3 Changing evolution through development modularity
 - 9.4 Developmental constraints
 - 9.5 Creating new cell types - basic evolutionary mystery

- 10.0 Biology of sex determination
 - 10.1 Chromosomal sex determination - mammals and *Drosophila*
 - 10.2 Testis determining genes
 - 10.3 Ovarian development
 - 10.4 Secondary sex determination in mammals
 - 10.5 Environmental sex determination.

- 11.0 Cell diversification in early animal embryo
 - 11.1 *Xenopus* blastomeres
 - 11.2 Morphogen gradients
 - 11.3 Totipotency & Pluripotency
 - 11.4 Embryonic stem cells
 - 11.5 Renewal by stem cells - epidermis
 - 11.6 Skeletal muscle regeneration
 - 11.7 Connective tissue cell family

- 12.0 Hemopoietic stem cells
 - 12.1 Stem cell disorders
 - 12.2 Blood cells formation
 - 12.3 Bone marrow transplants
 - 12.4 Gene therapy

Suggested Reading Material

1. S.F. Gilbert. *Developmental Biology*. Sinauer Associates Inc., Massachusetts.
2. Ethan Bier. 'The Cold Spring'. Cold Spring Harbor Laboratory Press, New York.

Total Marks : 90
Theory Examination: 75
Internal Assessment : 15
Time: 3 Hours

Note:

1. Nine questions will be set in all.
2. Question No. 1, which will be objective/short answer type cover the entire syllabus, will be compulsory. The remaining eight questions will be set section wise selecting four questions from each section (I & II). The candidate will be required to attempt question No. 1 and four more selecting two questions from each section.
3. As far as possible the questions should be divided into sub-parts and marks indicated part wise.

Section – A

- 1.0 Innate and Acquired Immunity
- 2.0 Phylogeny and Ontogeny of immune system
 - 2.1 Organization and structure of lymphoid organs
 - 2.2 Cells of the immune system and their differentiation
 - 2.3 Lymphocyte traffic
- 3.0 Nature of immune response
- 4.0 Nature of antigens and superantigens
 - 4.1 Antigenicity and immunogenicity
 - 4.2 Factors influencing immunogenicity
 - 4.3 Epitopes and haptens
- 5.0 Structure and Functions of Antibodies
 - 5.1 Classes and subclasses
 - 5.2 Gross and Fine structure
 - 5.3 Antibody mediated effector functions
- 6.0 Antigen-Ab interactions *in vitro* and *in vivo*.
- 7.0 Complement System
- 8.0 Major Histocompatibility Complex in mouse and HLA system in human
 - 8.1 MHC haplotypes
 - 8.2 Class I and class II molecules
 - 8.3 Cellular distribution
 - 8.4 Peptide binding
 - 8.5 Expression and diversity
 - 8.6 Disease susceptibility and MHC/HLA

Section – B

- 9.0 Organization and expression of Ig genes
 - 9.1 Models for Ig gene structure
 - 9.2 Multigene organization of Ig genes
 - 9.3 DNA rearrangements and mechanisms
 - 9.4 Generation of antibody diversity
 - 9.5 Differential expression of Ig genes.

- 10.0 T-cell receptors
 - 10.1 Isolation, molecular components and structure
 - 10.2 T-cell maturation and thymus
 - 10.3 T H-cell activation mechanism
 - 10.4 T-cell differentiation
 - 10.4 Cell death and T-cell population

- 11.0 B-cell generation, activation and differentiation
 - 11.1 B-cell receptors
 - 11.2 Selection of immature self-reactive B-cells
 - 11.3 B-cell activation and proliferation
 - 11.4 T H-B-Cell interactions
 - 11.5 Humoral immune response-kinetics

- 12.0 Cytokines
 - 12.1 Structures and functions
 - 12.2 Cytokine receptors
 - 12.3 Cytokines and Immune response

- 13.0 Cell-mediated effector functions
 - 13.1 Cell adhesion molecules
 - 13.2 Effector cells and molecules
 - 13.3 CTL and NK cells-mechanisms of action
 - 13.4 Delayed type hypersensitivity

- 14.0 Hyper sensitivity and auto-immunity

- 15.0 Immunological tolerance and vaccines.

Suggested Reading Material

1. Kuby. Immunology, W.H. Freeman, USA.
2. W. Paul. Fundamentals of Immunology.
3. I.M. Roitt. Essential Immunology, ELBS Edition.

Note:

1. Nine questions will be set in all.
2. Question No. 1, which will be objective/short answer type cover the entire syllabus, will be compulsory. The remaining eight questions will be set section wise selecting four questions from each section (I & II). The candidate will be required to attempt question No. 1 and four more selecting two questions from each section.
3. As far as possible the questions should be divided into sub-parts and marks indicated part wise.

Section- A

1. Biogeography:
 - 1.1. Major terrestrial and aquatic biomes.
 - 1.2. Major forest types of India.
 - 1.3. Zonoecotones, Orobiomes and Pedobiomes.
2. Natural resources and their conservation:
 - 2.1. Concept and classification of resources.
 - 2.2. Renewable and non-renewable resources.
 - 2.3. Resource degradation, Conservation and resource management.
 - 2.4. Human impact on natural resources.
3. Biodiversity – assessment, conservation and management, biodiversity act and related international conventions.
4. Remote sensing and geographic information system: Basic concepts, procedure and Applications.
5. Ecological restoration:
 - 5.1. Definition, brief history and recent development.
 - 5.2. Restoration and its strategies.
 - 5.3. Restoration of terrestrial and aquatic ecosystems.
 - 5.4. Eutrophication and restoration of Indian lakes.

Section-B

6. Environmental Toxicology: Food additives, air, water and soil pollutants.
7. Effect of pollutant on ecosystem with case study of important Organo-phosphorous and Organo-chlorine pesticides, Nitrates, Polychlorinated biphenyls, Clenbutarol.
8. Solid waste management: Primary waste products-Solid waste, toxic biological and hospital landfills, incineration, source reduction and recycling.
9. Bioremediation, its role and significance.
10. Toxicological risk assessment and management.
11. Principles and significance of systematic toxicology.
 - 11.1. Definition, introduction and discussion of Genotoxicology.
 - 11.2. Applications of toxicology anthropogenic activities and environment.
 - 11.3. Human toxicology and medicinal ethics.

Suggested Reading Material:

26. Concepts of Ecology by Edward J. Kormondy; Prentice Hall of India (Pvt.) Ltd.
27. Fundamentals of Ecology by W.B. Odum, E.P. Saunders, Toppan Co. Ltd., Tokyo, Japan.
28. Ecology by Paul Colin Vacx: John Wiley & Sons, Inc.
29. Environmental Pollution by H.M Dix., John Wiley Publications, New York.
30. Handbook of Solid Waste Management by Wilson, Van Nostrand, Reinhold.
31. Environmental Studies by D.B. Botkin, & E.A. Keller, Martill Publising Co., Columbs, Toronto, London.
32. Ecology of Natural Resources, Francoid remade, John Wiley & Sons, New York, Singapore.
33. Ecology by Paul Colinvaux; John Wiley & Sons, New York, Chichester, Brisbane, Toronto, Singapore.
34. Applied Ecology and Environmental Management by Edward I. Newman.
35. Principle of Environmental Science by W.P. Cunningham & M.A. Cunningham.
36. Environmental Impact Assessment Methodologies by Y. Anjaneyulu.
37. Bioremediation Technology by Fulekar, M.H.
38. Biotranformation: Bioremediation Technology for Health & Environmental Protection by R. D. Stapleton Jr. and V.P. Singh (Ed), Elsevier.
39. Casarett & Doull's Toxicology: The Basic Science of Poisons by Curtis Klaassen.
40. Applied Ecology and Natural Resource Management by Guy R. McPherson and Stephen DeStefano
41. Essentials of Ecology by C Townsend, M Begon, J L Harper, Scuthwick, C.H.
42. Ecology and the quality of our environment by D. Van Nestrand.
43. Ecotoxicology: The study of pollutants in ecosystems. 3rd Ed. Elsevier by Moriarty, F.
44. Environment concerns and strategies. Ashish Pub. House, NDL by T.N. Khushoo.
45. Environmental biology. Akashdeep Pub. House by R.R. Trevedi Gurdeep Raj.
46. Textbook: A Textbook of Modern Toxicology. Third Edition by E. Hodgson (Ed.). John Wiley & Sons, Inc. (Posted on the D2L content page.)
47. Environmental Health by Monroe T. Morgan
48. Handbook of Environmental Health and Safety – principle and practices by H. Koren; Lewis Publishers
49. Principles of Environmental Toxicology by I. C. Shaw and J. Chadwick; Taylor & Francis ltd.
50. Introduction to Toxicology, 3rd Ed. Taylor & Francis, London by Timbrell, J.

Elective Paper: ZOO-XXI (ii)
Applied Zoology - II

Total Marks: 90
Theory Examination: 75
Internal assessment: 15
Time: 3 hours

Note:

1. Nine questions will be set in all.
2. Question No. 1, which will be objective/short answer type cover the entire syllabus, will be compulsory. The remaining eight questions will be set section wise selecting four questions from each section (I & II). The candidate will be required to attempt question No. 1 and four more selecting two questions from each section.
3. As far as possible the questions should be divided into sub-parts and marks indicated part wise.

Section - A

1. Parasites, hosts, parasitism and parasitic adaptations, Parasitoids.
2. Host parasite specificity and interaction, Isolation of parasitic populations, infection and growth vectors.
3. Immune response and self-defense mechanisms, immune evasion and biochemical adaptations of parasites; parasites of veterinary importance.
4. Parasites of insects and their significance.
5. Introduction to vector biology, economic importance and control of fleas, lice, bugs, mosquitoes, flies and parasitoids.
6. Vector-parasite interaction; host-pathogen interaction, control of insect vector.

Section - B

7. Zoonosis:
 - 7.1. Viral-Rabies,
 - 7.2. Japanese encephalitis;
 - 7.3. Bacterial- Brucellosis, Plague;
 - 7.4. Rickettsial- Rickettial zoonosis, Q fever, Scrub typhus.
 - 7.5. Protozoan, Helminth and Nematode diseases in humans.
8. Insect Morphology: external features and their articulation, Comparative study of head-antennae, thorax – legs, wings; abdominal appendages, genitalia. Group of social insects and their social life; evolution of sociality.
9. House Hold Insects: Cockroach, Ants, Moths, Beetles, Silver Fish, Book louse, Wasp, Mites & ticks and their control.
10. Edible fresh water fishes, Snakes and snake Venom, Economic importance of mammals.
11. Wool and fur industry, leather industry.
12. Pharmaceuticals from animals.

Suggested Reading Material:

1. Asa C. Chandler, Clark P. Read, Introduction to Parasitology, John Wiley and Sons., Inc., New York.
2. Thomas W.M. Cameron, Parasites and Parasitism, Billing and Sons Ltd. London,
3. Elmer R. Noble, Glenn A. Noble; Parasitology: The Biology of Animal Parasites, Lea and Febiger, Washington.
4. R.P. Hall, Protozoology, Prentice-Hall, Inc. Englewood Cliffs. N.J. Charles E. Tuttle Company, Tokyo
5. J.L. Soulsby, Biology of Parasites, Academic Press, New York.

6. **Paper : ZOO-XXII (i) Semester – IV**
Molecular Cytogenetics – II

Total Marks : 90
Theory Examination: 75
Internal Assessment : 15
Time: 3 Hours

Note:

1. Nine questions will be set in all.
2. Question No. 1, which will be objective/short answer type cover the entire syllabus, will be compulsory. The remaining eight questions will be set section wise selecting four questions from each section (I & II). The candidate will be required to attempt question No. 1 and four more selecting two questions from each section.
3. As far as possible the questions should be divided into sub-parts and marks indicated part wise.

Section – A

- 1.0 Human Cytogenetics:
 - 1.1 Human karyotype.
 - 1.2 Nomenclature for normal chromosomes (ISCN)
 - 1.3 Variable chromosome features
 - 1.4 Nomenclature for acquired chromosome aberrations
 - 1.5 Nomenclature for meiotic chromosomes
 - 1.6 Species codes.
- 2.0 Chromosome Banding Techniques and their Applications:
 - 2.1 Q-banding
 - 2.2 C-banding
 - 2.3 G-banding and R-banding
 - 2.4 T-banding
 - 2.5 High-Resolution and Replication banding
 - 2.6 Nuclease banding
 - 2.7 Molecular correlates of chromosome bands.
 - 2.8 Functional significance of chromosome bands.
- 3.0 Numerical and Structural Abnormalities of Human Chromosomes –Syndromes:
 - 3.1 Autosomal syndromes – cat-cry syndrome, Wolf-Hirschhorn syndrome, Trisomy 13, Trisomy 18, Trisomy 21.
 - 3.2 Sex chromosomal syndromes – Turner syndrome, Klinefelter syndrome, XYY, True and Pseudohermaphroditism.
 - 3.3 Chromosomal abnormalities and dermatoglyphics.
 - 3.4 Fragile sites and fragile X syndrome.
- 4.0 Cytogenetic Implications and Consequences of Structural Changes and Numerical Alterations of Chromosomes:
 - 4.1 Aberrations of chromosome number – Polyploidy, aneuploidy
 - 4.2 Aberrations of chromosome structures – Duplications, deletions, inversions, translocations.

Section – B

- 5.0 rDNA Technology:
 - 5.1 Gene-cloning
 - 5.2 Vectors
 - 5.3 cDNA and genomic libraries
 - 5.4 Blotting techniques
 - 5.5 Chromosome walking
 - 5.6 Application of rDNA technology

- 6.0 Molecular Cytogenetic Techniques:
 - 6.1 FISH
 - 6.2 Chromosome painting
 - 6.3 Automated karyotyping
 - 6.4 Flow cytometry
 - 6.5 DNA fingerprinting

- 7.0 Molecular Markers in Genome Analysis:
 - 7.1 RFLP
 - 7.2 RAPD
 - 7.3 AFLP
 - 7.4 PCR and its applications in genome analysis
 - 7.5 Microarrays – bases expression analysis.

- 8.0 Genome Projects:
 - 8.1 Human genome project – history, organization, goals and value of the project.
 - 8.2 Genetic mapping of the human genome
 - 8.3 Physical mapping of the human genome
 - 8.4 Human genome diversity project
 - 8.5 Model organisms and other genome projects.
 - 8.6 Life in the post genomic era.

Suggested Reading Material

1. Atherly, A.C., J.R. Girton and J.F. McDonald. The Science of Genetics. Saunders College Publishing, Harcourt Brace College Publishers, NY.
2. Brooker, R.J. Genetics : Analysis and Principles. Benjamin/Cummings, Longman Inc.
3. Fairbanks, D.J. and W.R. Anderson. Genetics – The Continuity of Life. Brook/Cole Publishing Company ITP, NY, Toronto.
4. Gardner, E.J., M.J. Simmons and D.P. Snustad. Principles of Genetics. John Wiley and Sons. Inc., NY.
5. Griffiths, A.J.F., J.H. Miller, D.T. Suzuki, R.C. Lewontin and W.M. Gelbart. An introduction to genetic analysis. W.H. Freeman and company, NY.
6. Lewin, B. Genes. VI. Oxford University Press, Oxford, New York, Tokyo.
7. Snustad, D.P. and M.J. Simmons. Principles of Genetics. John Wiley and Sons. Inc., NY.
8. Watson, J.D., N.H. Hopkins, J.W. Roberts, J.A. Steitz and A.M. Weiner. Molecular Biology of Genes. The Benjamin/Cummings Publishing Company Inc., Tokyo.
9. Tom Strachan & Read, A.P. Human Molecular Genetics 3rd edition, Garland Publishing 2004, London

Total Marks : 90
Theory Examination: 75
Internal Assessment : 15
Time: 3 Hours

Note:

1. Nine questions will be set in all.
2. Question No. 1, which will be objective/short answer type cover the entire syllabus, will be compulsory. The remaining eight questions will be set section wise selecting four questions from each section (I & II). The candidate will be required to attempt question No. 1 and four more selecting two questions from each section.
3. As far as possible the questions should be divided into sub-parts and marks indicated part wise.

Section – A

- 1.0 Biology of oocyte maturation and its regulations.
- 2.0 Molecular basis of fertilization; Capacitation, Acrosome reaction, Cortical granules exocytosis & egg activation. *In vitro* and *in vivo* fertilization, sexing, stem cells, cloning and future prospectives.
- 3.0 Corpus luteum, structure and functions. Control of luteal functions including luteolytic & luteotrophic factors, Pseudopregnancy and gestation periods.
- 4.0 Hormonal regulation of implantation, pregnancy, parturition, placenta and its hormones. Artificial wombs, Immunocontraception; Mammary glands and physiology of lactation.
- 5.0 *In vitro* fertilization and embryo transfer technology with special reference to wildlife conservation.
- 6.0 Environmental factors influencing Reproduction; Pheromones and Reproduction.
- 7.0 Influence of age on reproductive performance.

Section – B

- 8.0 Structure and classification of neurons and glial cells. Neuronal elements, basis of circuit, synaptic action, dendritic properties and functional operation of spinal cord, membrane conductance, Brain stem, Autonomic nervous system.
- 9.0 Principles of synaptic transmission; Ca²⁺ and transmitter release; post synaptic transmission mechanism; diversity of neurotransmitters: acetylcholine, catecholamine, serotonin, GABA, glycine, histamine, peptides, NO, and opioids.
- 10.0 Denervation and regeneration of synaptic connections in vertebrate central nervous system
- 11.0 Apoptosis its molecular mechanism regulation, and significance.
- 12.0 Neuropsychiatric disorders; Neuropathy, Diseases involving myelin; Ischemia and hypoxia; Epileptic seizures; Alzheimer disease; Prion disease; Progeria, Parkinson's disease.
- 13.0 Dietary requirements of the aged, psychological and social problems of the aged.

Suggested Reading Materials:

1. Guraya S.S. (1998). Cellular and Molecular Biology of General development and Maturation in mammals Narosa Publishing House, New Delhi.
2. Hafez E.S.E.(1994).”Reproduction in farm animals”. Lea Febighiese.
3. Mc Donald L.E. (1988). Veterinary Endocrinology & Reproduction. Varghese Co., Bombay
4. Degrodt L.I.(1995). Endocrinology Vol. I,II,III Saunders.
5. Gurays S.S. (2000). Comparative Cellular and Molecular Biology of Ovary in mammals. I.B.H., New Delhi.

Total Marks : 90
Theory Examination: 75
Internal Assessment : 15
Time: 3 Hours

Note:

1. Nine questions will be set in all.
2. Question No. 1, which will be objective/short answer type cover the entire syllabus, will be compulsory. The remaining eight questions will be set section wise selecting four questions from each section (I & II). The candidate will be required to attempt question No. 1 and four more selecting two questions from each section.
3. As far as possible the questions should be divided into sub-parts and marks indicated part wise.

Section – A

- 1.0 Social behaviour:
 - 1.1 Aggregations and society;
 - 1.2 Advantages of group living;
 - 1.3 Types of social organization in animals
 - 1.4 Group selection, kin selection, altruism, reciprocal altruism.
 - 1.5 Territoriality and parental care.
- 2.0 Social behaviour of termites, ants and primates.
- 3.0 Various means of communication in animals: Chemical, Visual, auditory, touch etc.
- 4.0 Hormones and animal Behaviour: Hormones important to behavioural regulation;
- 5.0 Aggressive behaviour; sexual attraction and sexual behaviour.
- 6.0 Pheromones and animal behaviour: types of pheromones, role of pheromones in animal behaviour; pheromones of social insects.

Section – B

- 7.0 Wildlife Census: Planning a wildlife census, understanding sample counts, Block counts, Road side counts, Dung counts, Pugmark census, Water-hole census, Presentation of India. Key industrial animals.
- 8.0 Study of signs and symptoms: A practice of recording field observations.
- 9.0 Bio-telemetry, Ageing and Sexing techniques.
- 10.0 Wildlife Damage, its nature and definition, electric fences for wildlife damage control, Basic electric fence design, Trench design, line trapping, Mist netting, Rocket netting
Chemical capture: Equipment, Drugs, Plan of operation.
- 11.0 Wildlife Tourism: Definition scope and range; Popular Wildlife Tourist Sports of the world, Popular Wildlife spots in India, Sustainable use of wildlife spots, Education methods.
- 12.0 Poaching: Its definition and implications, conducting anti-poaching operations, Evidence in poaching cases.
- 13.0 National Projects: Project Tiger, Project elephant, Project Rhinoceros, Project Crocodiles, Project Hangul, Manipur Brow Antlered Deer.

Suggested Reading Materials:

1. Techniques for wildlife Census in India by W.A. Rogers (A field manual); Wildlife Institute of India, Dehradun.
2. Wildlife Wealth of India by T.C. Majupuria; Tecpress Services, L.P., 487/42-SOL-Wattenslip, Pratunam Bangkok, 10400, Thailand
3. Ali, S. Ripley S.D. Handbook of Birds of India, Pakistan 10-Vols. Oxford University Press, Bombay.
4. The Book of Indian Animals by S.H. Prater, BNHS-Publication, Bombay.
5. Wildlife in India by V.B. Saharia Natraj Publishers, Dehradun.
6. E.P. Gee, The Wildlife of India.

Total Marks : 90
Theory Examination: 75
Internal Assessment : 15
Time: 3 Hours

Note:

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2. Question No. 1, which will be objective/short answer type cover the entire syllabus, will be compulsory. The remaining eight questions will be set section wise selecting four questions from each section (I & II). The candidate will be required to attempt question No. 1 and four more selecting two questions from each section.
3. As far as possible the questions should be divided into sub-parts and marks indicated part wise.

Section – A

- 1.0 Introduction to fish biotechnology and methods of fish stock improvement.
- 2.0 Selection and hybridization
- 3.0 Androgenesis and Gynogenesis – natural and induced
- 4.0 Polyploidy induced
- 5.0 Sex reversal and sterility
- 6.0 Transgenesis, transgenes and application
- 7.0 Cryopreservation of gametes and embryo
- 8.0 Fish-by products
- 9.0 Fish preservation process
- 10.0 Nutritive aspect of fish meat and oil.

Section – B

- 11.0 Different systems for aquaculture: pond culture, cage culture, raceway culture.
- 12.0 Culture of important fish species (Mayer carps, common carps, Chinese carps, cat fish culture and Tilapia culture).
- 13.0 Integrated Aquaculture and waste water aquaculture
- 14.0 Pearl Culture
- 15.0 Frog culture
- 16.0 Prawn culture-Fresh and brackish water
- 17.0 Impact of Aquaculture on Environment
- 18.0 Methods of Fishing : Crafts and gear technology
- 19.0 Nutrition in Aquaculture
 - 19.1 Nutrient and non-nutrient diet components
 - 19.2 Preparation and processing of feed, feed formulae,
 - 19.3 Natural and supplementary feed and their utilization

Total Marks : 90
Theory Examination: 75
Internal Assessment : 15
Time: 3 Hours

Note:

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3. As far as possible the questions should be divided into sub-parts and marks indicated part wise.

Section – A

- 1.0 Digestive system: Alimentary canal: Digestion (Including unusual food materials); Absorption; Nutrition.
- 2.0 Circulatory system: Circulatory organs; Haemolymph; circulation of blood; Immune system
- 3.0 Respiratory system: Tracheal system, Spiracles; Gaseous exchange; Respiration in aquatic and endoparasitic insects.
- 4.0 Excretory system: Malpighian tubules; Nitrogenous excretion; Urine production; fat body and other haemocoelic tissues.

Section – B

- 5.0 Reproductive system : male and female reproductive organs; Spermatozoa and sperm transfer; ovulation and fertilization; types of reproduction.
- 6.0 Nervous system: Central nervous system (brain in brief); sympathetic nervous system; Controlling behaviour.
- 7.0 Endocrine system: Endocrine glands; Major hormones; Regulation of hormone titer; Mode of action of hormones.
- 8.0 Sensory system and behaviour: Mechanical stimuli; Sound reception and sound production; Chemical stimuli; Semiochemicals-Pheromones, Kairomones allomones and synomones: Insect vision.

Suggested reading material

1. The Insect-Structure and Function. - by R.F. Chapman.
2. Imm's General Text Book of Entomology –by O.W. Richards and R.G. Davies.
3. The Insect an outline of Entomology- by P.G. Gullan and P.S. Cranston.

Total Marks : 90
Theory Examination: 75
Internal Assessment : 15
Time: 3 Hours

Note:

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2. Question No. 1, which will be objective/short answer type cover the entire syllabus, will be compulsory. The remaining eight questions will be set section wise selecting four questions from each section (I & II). The candidate will be required to attempt question No. 1 and four more selecting two questions from each section.
3. As far as possible the questions should be divided into sub-parts and marks indicated part wise.

Section – A

- 1.0 Covalent properties of nucleic acids
 - 1.1 Modified nucleosides.
 - 1.2 Properties of polynucleotides.
 - 1.3 Secondary and tertiary structure.
- 2.0 Chemistry of nucleic acid polymerization. Enzymatic and acid phase methods.
- 3.0 Nucleic acid structure I. Duplex stability, hybridization. RNA structure, hairpin and pseudoknot structures, tRNA.
- 4.0 Nucleic acid structure II. DNA and RNA helical geometries (A-Z), bending, deformation, triplexes, quadruplexes. Chromatin structure. Structure of the nucleosome core; organization of nucleosomes into solenoids; topological consideration.
- 5.0 Nucleic acid analysis. DNA and RNA sequencing, determination of modified nucleotides, analysis of nucleic acid secondary structure.
- 6.0 Interactions of nucleic acids with small molecules.
- 7.0 Proteins-nucleic acid interactions I.
- 8.0 Proteins-nucleic acid interactions II.

Section – B

- 9.0 Principles of enzyme catalysis.
- 10.0 RNA catalysis
 - 10.1 Chemistry and structure of ribozymes
 - 10.2 Evolutionary implications
 - 10.3 RNA splicing
 - 10.4 RNA-and spliceosome-mediated reactions
- 11.0 Nucleoside analogs. Incorporation of analogs into DNA/RNA and properties of polynucleotides (thionucleotides, fluorophores, biotinylated nucleosides).
- 12.0 Enzyme mechanisms. Proteases, polymerases, other examples.

- 13.0 Gene and genome analysis
 - 13.1 Bioinformatics
 - 13.2 Genome maps
 - 13.3 Microarray-based expression analysis
 - 13.4 Genomics-based drug discovery.

- 14.0 Extremophiles
 - 14.1 Life at 105⁰C or pH 1 or at 5M KCl
 - 14.2 Protein stability
 - 14.3 Protein-nucleic acid interactions.

Suggested Reading Materials

1. G.M. Blackburn and M.Gait. Nucleic Acids in Chemistry and Biology. Oxford University Press.
2. W. Saenger. Principles of Nucleic Acid Structure. Springer Verlage, New York.
3. T.E. Creighton. Proteins: Structure and Molecular Properties. W.H. Freeman, New York.

(Examination of Papers ZOO-XVII & ZOO-XXIII)

Total Marks : 100

Practical Examination: 80

Internal Assessment : 20

Time: 4 Hours

General

1. Antigen-antibody interaction *in vitro*.
2. ELISA.
3. Isolation of B-lymphocytes.
4. Phagocytosis *in vitro*.
5. Blood film preparation and identification of cells.
6. Histology of lymphoid organs.
7. Immunological diagnosis of pregnancy/infection/cancer.
8. Studies on vaginal smears during different stages of estrous cycle.
9. Studies of different types of eggs with reference to their yolk contents.
10. Studies of normal development with reference to normal tables of developmental stages of frog/toad chick.
11. Preparation of whole mounts of embryo and larvae when present.
12. Bioassay to demonstrate toxicological effect.
13. Study of various components of pond ecosystem.
14. Determination of Water quality characteristics viz: Dissolved oxygen, pH, free carbon dioxide, Salinity, transparency, alkalinity and hardness.
15. Determination of phosphate, ammonia and nitrate in water.
16. Determination of sediment chemistry
 - Moisture
 - Carbonate
 - Nitrate
 - pH
 - Phosphate
 - Texture
 - Organic Carbon
17. Practical of paper XXI opt. (i) & (ii) will be based on theory curriculum.

Paper : ZOO-XXIV (i) Semester – IV
Practical [Based on Paper ZOO-XVIII & ZOO-XXII(i)]

[Examination of Papers ZOO-XVIII(i) & ZOO-XXIV(i)]

Total Marks : 100
Practical Examination: 80
Internal Assessment : 20
Time: 4 Hours

1. Making karyological preparations from bone marrow of a rodent for making somatic karyotypes.
2. Making karyological preparations from bone marrow and other tissues of fishes/amphibians/birds for making karyotypes.
3. Study of meiosis in testicular material of suitable vertebrates.
4. Short term lymphocyte culture of human peripheral blood for preparing karyotype.
5. Banding techniques in the chromosomes of vertebrates/human.
6. Nucleolus organizer regions in the chromosomes of Human/Rat/Mice/Bird/Fish.
7. Sister chromatid differential staining of chromosomes.
8. A survey for the study of :
 - (i) ABO and Rh blood groups
 - (ii) Some morphogenetic and behavioural traits.
 - (iii) Some biochemical traits.
9. Preparation of pedigrees and pedigree analysis.
10. Submission of a Survey/Project report.

[Examination of Papers ZOO-XVIII(ii) & ZOO-XXIV(ii)]

Total Marks : 100
Practical Examination: 80
Internal Assessment : 20
Time: 4 Hours

1. Effects of pesticides, drugs, and xenobiotics on granulosa cells *in vitro*.
2. Effects of pesticides, oxidants, and free radicals on testicular tissue *in vitro*.
3. Morphological changes during spermeogenesis.
4. Localization of steroidogenic enzymes.
5. Estimation of catalase from nervous and reproductive tissue
6. Determination of Glutathione peroxides, glutathione reductase during aging.
7. Lipid peroxidation by MDA method.
8. Impact of Vitamin C & E on lipid peroxidation *in vitro*.
9. Fluorescence studies on age pigment.
10. Age related changes in sperm characteristics.

[Examination of Papers ZOO-XVIII(iii) & ZOO-XXIV(iii)]

Total Marks : 100
Practical Examination: 80
Internal Assessment : 20
Time: 4 Hours

- 1 To study the effect of temperature on gill movement in fishes.
- 2 Laboratory study of mechanism of flight in grasshopper.
- 3 Study of response of flour beetle (*Triblium* sp.) to angles of substrate.
- 4 To study nesting behaviour of squirrels in different habitats vis., urban environment, grain-market-area, roadside plantations, orchards gardens etc.
- 5 Field study of burrowing behaviour of common available rodent fauna of the region.
- 6 Preparation of field diary on the basis of observations regarding habitat, habits of common available avian and rodent fauna of the region.
- 7 Study of morphological changes in common avian species during breeding season.
- 8 Demonstration of different stages of reproductive cycle in rat/mouse.
- 9 Field visit to a zoo or wildlife part/sanctuary and preparation of field report.
- 10 Preparation of charts of endangered amphibians, reptiles and mammals with ecological remarks.
- 11 Animal behaviour patterns using Photostat sheets.
- 12 Analysis of standard pug marks of large sized wild mammals.

[Examination of Papers ZOO-XVIII(iv) & ZOO-XXIV(iv)]

Total Marks : 100
Practical Examination: 80
Internal Assessment : 20
Time: 4 Hours

1. Fish Feed formulation and processing.
2. Proximate analysis of fish feed (Determination of moisture, protein, fat, ash carbohydrate, fiber and energy).
3. Taking out of pituitary gland, preservation and preparation of extract.
4. Determination of length weight relationship.
5. Determination of age of fish using hard parts
6. Analysis of fecundity, Gonado somatic index (GSI), Hepatosomatic index (HIS) in some fishes.
7. Study of crafts and gear and method of operation
8. Visit to fish farm and fish market
9. Project Report

Total Marks : 100

Practical Examination: 80

Internal Assessment : 20

Time: 4 Hours

1. Identification upto families, by following suitable keys, of the specimens belonging to any of the following orders: Coleoptera, Orthoptera, Odonata, Hemiptera, Hymenoptera.
2. To study amino acids of insect blood by paper chromatography, or any other suitable exercise in insect physiology.
3. Identification and classification of common insects (museum specimens).
4. Studies of whole mounts and other permanent slides.

Paper : ZOO-XXIV (vi)
Practical [Based on Paper ZOO-XVIII & ZOO-XXII(vi)]

Semester – IV

[Examination of Papers ZOO-XVIII(vi) & ZOO-XXIV(vi)]

Total Marks : 100
Practical Examination: 80
Internal Assessment : 20
Time: 4 Hours

1. Northern blotting
2. Restriction digestion of DNA
3. PCR
4. Agarose gel electrophoresis.
5. Elucidation of structure of biomolecules by spectrophotometry.