C.S.J.M. UNIVERSITY, KANPUR

NEW SYLLABUS (From 2019-20 onwards)

ZOOLOGY

M.Sc. Previous

Paper-I	Non-Chordata	70 marks
Paper-II	Bioinstrumentation & Biotechniques, Bioinformatics and Biotechnology	70 marks
Paper-III	Molecular Biology & Molecular Cytogenetics	70 marks
Paper-IV	Wild Life, Animal Behaviour and Chronobiology	70 marks
Paper-V	Biosystematics, Quantitative Biology and Population Ecology	70 marks
PRACTICAL EXAMINATION		150 marks

I[st] Paper - Non Chordata

Note: Attempt any four questions. All questions carry equal marks.

1. **Organization of Coelom**
   - (i) Acoelomates
   - (ii) Pseudocoelomates
   - (iii) Coelomates, protostomia & Deuterostomia.
2. **Locomotion**
   - (i) Flagella and Ciliary movement in Protozoa
   - (ii) Hydrostatic movement in Coelenterate Annelid and Echinoderm
3. **Nutrition & digestion**
   - (i) Patterns of feeding and digestion in Lower metazoan.
   - (ii) Filter feeding in Polychaeta, Molluscs and Echinoderm

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4. **Respiration**

(i) Organs of respiration, Gills, Lungs and Trachea.

(ii) Respiratory pigments

(iii) Mechanism of Respiration

5. **Excretion**

(i) Organs of excretion, coelom, coelomoducts, nephridia and Malpighian tubules.

(ii) Mechanism of Excretion

(iii) Excretion and Osmoregulation

6. **Nervous System**

(i) Primitive nervous system; Coelenterate and Echinodermata.

(ii) Advanced nervous system: Annelids, Arthropods (crustaceans and insects) and Molluscs (Cephalopod)

(iii) Trends in neural evolution

7. **Invertebrate Larvae**

(i) Larval forms of free living invertebrates

(ii) Larval forms of parasites

(iii) Strategies and evolutionary significance of larval forms.

Recommended Books:

Hyman, L.H. The invertebrates. Vol. I Protozoa through ctenophora, McGraw Hill Book Co. New York.

The invertebrates. Vols. II, V and VIII. McGraw Hill Book Co. New York.

Barrington, E.J.W. Invertebrate structure and function, Thomas Nelson and Sons Ltd. London

Jargenstein, G. Evolution of metazoan life cycle. Academic Press, New York and London.

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Barnes, R.D., Invertebrate Zoology, III edition, W.B. Saunders Co., Philadelphia.

Russel- Hunter, W.D. A biology of higher invertebrates, MacMillan Co. Ltd., London

Read, C.P. Animal Parasitism, Prentice Hall

Parker, T.J. and Haswell, W.A. Text Book of Zoology, Vol. I

Paper - II

Bioinstrumentation & Biotechniques, Bioinformatics and Biotechnology

Unit-I : Bioinstrumentation and Biotechniques

Note: Attempt four questions in all, two questions from each section; each question carries equal marks.

1. Principle of spectrophotometers, both UV and visible (Beer- Lambert Law), pH meter and GM counter.
2. Microscopy: Light, Phase contrast, transmission and scanning electron microscope, fluorescence microscopy.
3. Histological techniques- Fixation, tissue processing, various embedding techniques, Microtomes and their application in routine wax section cutting principle and practice of double and triple staining.
4. Photomicrography, its application and utility in biological research.
5. Cryotechniques- Principle of Cryopreservation
6. Separation techniques: High speed and ultra centrifugation.
   - Analytical and preparative centrifugation.
   - Chromatography- Ion exchange, gel filtration, affinity chromatography
   - Electrophoresis
   - Flow cytometry.
7. Autoradiography, liquid scintillation counter, RIA, ELISA.

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Unit - II

Biotechnology & Bioinformatics

1. Scope and Importance of biotechnology.
2. Tools of genetic engineering in health and medicine.
3. Hybrodoma technology
4. DNA recombination and expression in bacterial cell cloning, finger prints.
5. Cell and tissue culture in animals - cell line, primary culture, cell colonies.
6. Microbiology- General precautions in preparation of microbiologic media; inoculation and growth curve of bacteria; Biological mutants and their significance.

Bioinformatics

1. Basics of computers: (CPU, I/O units), operating systems, computer networking.
2. Concept of homepages and website.
3. URLs, using search engines.
4. Databases: nucleic acids, genomes, protein sequences and structures, SNP db, Finding scientific articles, Information retrieval from biological databases, Entrez system, SRS.
5. Sequence Analysis (Homology): pairwise and multiple sequence alignments- BLAST, CLUSTALW, Phylogenetic analysis.
6. Protein structure prediction.... visualizing 3D- structures of proteins.

Books recommended:

John R.W. Masters (ed.) animal cell culture: A practical approach, Ed. IRL Press.

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Robert Braun. Introduction to instrumental analysis. Mac Graw Hill International Edition.

K. Wilson and K.G. Goulding. A biologists guide to principals and techniques of practical biochemistry, ELBS ed.

R.W. Old and S.B. Primrose. Principles of gene manipulation: an introduction to genetic engineering.

R.A. Meyers (Ed.). Molecular biology and biotechnology. VCH Publishers.

Glick, Molecular biotechnology

M.D. Trevan et al. Biotechnology: The biological Principle. Tata MacGraw-Hill Co. Ltd., New Delhi.

John E. Smith. Biotechnology. III ed. Cambridge University Press.

Bioinformatics Basics by Hooman Rashid, Lukas K. Buehler, Published by - CRC Press/Taylor & Fransis Group ISBN-0849312833.

Introduction to Bioinformatics: A theoretical and practical approach. By-Stephan A. Krawetz, David D. Wombli, Published by Human Press.

Introduction to Bioinformatics by Teresa K. Altwood, David Perry-Smith. Publisher- Pearson Education.

Bioinformatics: Genomica and Proteomics Publisher- S. Chand.

Bioinformatics: Concept and Skills. S.C. Rastogi, Mendiratta and Parag Rastogi. Publisher- Rastogi Publication.

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Paper - III

Molecular Biology & Molecular Cytogenetics

Note: Attempt four questions in all, two questions from each section; each question carries equal marks.

Unit-I (Molecular Biology)

1. Structure of DNA- A, B and Z DNA.
2. 3-D Structure of tRNA
3. DNA replication, emphasizing on role of various enzymes involved, in prokaryotic cells and its differences from eukaryotic cells; plasmids.
4. Prokaryotic transcription with special reference to lac operon
5. Post transcriptional modifications- 5' capping, 3-polyadenylation, splicing
6. Genetic code and Wobble's hypothesis
7. Mechanism of initiation, elongation and termination of transcription.
8. Translation in prokaryotes and translational machinery.
9. Post transcriptional modification, molecular chaperones.
10. DNA damage and repair, xeroderma pigmentosum, mismatch repair and base excision repair.

Unit - II (Molecular Cytogenetics)

11. Organisation of DNA in chromosome, chromatin organization, solenoid organization.
12. Structure of metaphase chromosome with special reference to importance of kinetochore and telomere
13. Heterochromatin- facultative and constitutive
14. Euchromatin and C-value paradox
15. Polytene chromosomes and lamp u brush chromosomes and their significance.

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16. Sex determination in insects and mammals, dosage compensation.
17. Human chromosome karyotype
18. Banding in chromosomes u G, C, Q, R banding
19. Structural and numerical aberrations and their significance- nullisomy, trisomy, polyploidy and related syndromes.
20. Heritable diseases in humans viz. haemophilia, colour blindness, albinism etc.
21. Human genome project and formation of genomic DNA library.
22. Impact of ionizing and non-ionising radiation on genes and chromosomes
23. Linkage, two point test cross
24. Cancer protoncogenes and oncogenes

Books Recommended

Atherly, A.G., J.R. Girlton, J.F. MacDonald. The science of Genetics. Saunders College Publishing Harcourt Brace College Publishers, New York.

Brooker, R.J. Genetics: Analysis and Principles, Benjamin/Cummings, Longman, Inc.

Gardener, E.J., M.J. Simmons and D.P. Snustad, Principles of genetics. John Wiley and Sons, New York.

Lewin, B. Genes VI. Oxford University Press, Oxford, New York, Tokyo.

Watson J.D. et al. Molecular Biology of genes. The Benjamin/Cummings Publishing Co. Inc., Tokyo.

J.Darnell, H. Lodish and D. Baltimore. Molecular Cell Biology. Scientific American Books, W.H. Freeman, N.Y.

Benjamin Lewin. Genes VI, Oxford University Press, New York.

P.D. Dabre. Introduction to Practical Molecular Biology. John Wiley and Sons Ltd. New York.

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Paper - IV

Wild Life, Animal Behaviour and Chronobiology

Unit-I : Wild Life

1. Wild life as a resource.
2. Wild life action plan and its implementation
3. Wild life conservation- In situ and ex-situ
4. Protected area- classification (National parks, sanctuaries) and management.
5. Management of endangered species
   - 5.1 Project Tiger
   - 5.2 Project Elephant
   - 5.3 Project crocodile
   - 5.4 Rhinoceros
6. Conservation strategies

   IUCN- Criteria and technology

   CITES; IBWL; WWF; WII
7. Wild life (Protection) Act 1972
   - 7.1 Salient features
   - 7.2 Short comings of the Act
   - 7.3 Amendments 1991
8. Administrative framework
   - 8.1 Wild life advisory board
   - 8.2 Chief wild life warden and power
   - 8.3 Central zoo authority

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Unit - II : Animal Behaviour

1. Ethology as a branch of biology, innate behaviour.
2. Perception of the environment- Mechanical, Electrical, Chemical of factory, auditory and visual.
3. Neural and hormonal control of behavior.
4. Genetic and environmental components of behavior
5. Communication- chemical, visual, light, audio, species, specificity of songs, evolution of language (Primates).
6. Ecological aspects of behavior
   - 6.1 Habitat selection, food selection, optimal foraging theory anti predator defenses.
   - 6.2 Aggression, homing, territoriality, dispersal most parasite relations.
7. Social behavior
   - 7.1 Aggregations- Schooling in fishes, stocking in birds, lending in mammals.
   - 7.2 Group selection, kin selection, altruism and inclusive fitness
   - 7.3 Social organization in insects and primates.
8. Reproductive behavior- Courtship, sexual selection parental care.
9. Biological rhythms
   - 9.1 Circadian and circannual rhythms
   - 9.2 Orientation and navigation
   - 9.3 Migration of fish, turtles and birds
10. Learning and memory: Conditioning, habituation, insight learning, association learning, reasoning.

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Unit - III : Chronobiology

1. Introduction, milestone and scope of chronobiology.
2. Geophysical Environment seasons, proximate and ultimate factors.
3. Anatomy and physiology of time keeping system.
4. Peripheral clocks
5. Recording of brain waves, EEG rhythms
6. Sleep neural mechanism of sleep

Books Recommended

Wilson, E.O. Sociobiology: the new synthesis. Harvard University press. Cambridge, Massachusetts, USA

Hinde, R.A. Animal Behaviour: a synthesis of ethology and comparative psychology, McGraw Hill, New York.

Alcock, J. Animal Behaviour: An evolutionary approach. Sinauer Association, Sunderland, Mass, USA

Gadkar, Strategies for survival

Krebs, J.R. and N.B. Davies, Behaviour ecology, Blackwell, Oxford, U.K.

Saharia, Wild life of India

Dasman, Wildlife biology.

\Paper - V

Biosystematics, Quantitative Biology and Population Ecology

Unit-I : Biosystematics

1. Principles of Animal Taxonomy
   (i) Species concept, International code of Zoological nomenclature.
   (ii) Taxonomic procedure new trends of taxonomy
   (iii) Animal collection, handling and preservation.
   (iv)

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Unit-II : Quantitative Biology

1. Definition of population sample, random sample presentation of data in form of graphs, line charts pie-charts, ban-graphs and histograms.
2. Measure of Central Tendencies-Mean, Median and Mode.
3. Measure of dispersion- ranges, mean deviation, variance standard deviation, standard error, coefficient of variation, correlation.
4. Test of significance- T-test, Chi-square test.
5. Probability distribution and their properties
6. Hypothesis testing
7. Analysis of variance
8. Correlation.

Unit-III : Population Ecology

1. Demography- Life tables, generation time, net reproductive rate, reproductive value.
2. Population growth
   - 2.1 Growth of organisms with non-overlapping generations.
   - 2.2 Exponential growth, Verlist- Pearl logistic growth model.
   - 2.3 Stochastic and time lag models of population growth.
3. Predation
   - 3.1 Models of prey-predatory dynamics
   - 3.2 Rate of predation in nature
4. Competition and Niche Theory
   - 4.1 Intraspecific and interespecific competition
   - 4.2 History of niche concepts
   - 4.3 Theory of limiting similarity
5. Mutualism

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5.1 Evolution of mutualism

5.2 Animal-animal interactions

5.3 Basic models

6. Population regulation- Extrinsic and intrinsic mechanism

Books Recommended

Sokal, R.R. and F.J. Rohlf. Biometry, Freeman, San Francisco, USA.

Snedecor, G.W. and W.G. Cochran. Statistical Methods. Affiliated East-West Press, New Delhi.

Began, M. et al. Ecology. Individuals, Populations and Communities. Blackwell Sci. Publi. Oxford U.K.

Elseth, B.D. and K.M. Baumgartner. Population biology, Van Nostrand Co. New York

Krebs, C.J. Ecological methodology. Harper and Row, New York.

M.Sc. Previous Zoology- Syllabus for Practical Examination

Note: The practical examination will be 150 marks and the examination shall be spread over two days, with one session of five hours each day. Each candidate will submit a complete record of his practical work with collection.

Both internal and external examiners will work in mutual consultation and cooperation during evaluation. The division of marks shall be as follows:

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First Day Examination

1.	Dissection	10 marks
2.	Preparation of block of material provided in absolute alcohol/xylene	05 marks
3.	Trinning, section cutting and spreading	10 marks
4.	One permanent mount	05 marks
5.	Ten spots (lower non chordates only) for identification and comments	15 marks
6.	One exercise on genetical problems	05 marks
7.	One bio-statistic problem	05 marks
8.	Viva voce test	10 marks
9.	Project	10 marks
	Total	**75 marks.**

Second Day Examination

1.	Dissection	10 marks
2.	Exercise on ecology/behavior	10 marks
3.	One cytological preparation	05 marks
4.	Staining of first days microtomic slide	05 marks
5.	Ten spots for identification and comments (higher non-chordates only)	15 marks
6.	Specific comments on any two instruments (tools, apparatus)	10 marks
7.	Viva voce test	10 marks
8.	Practical record	10 marks
	Total	**75 marks.**

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Contents:

Dissections- Nervous systems of Mytilus, Sepia, Loligo, Aplysia, Squilla Sea urchin (Aristotle's / Lantern), Holothuria (General anatomy).

Exercises on Methodology-

a. Instructions on and practice of use of common biological instruments such as various light microscopes with sketching techniques, photomicrography, chromatography, electrophoresis. pH meter and colorimeter etc. depending on availability

b. Culture methods

c. Methods of studying biometrics of living animals

d. Preparation of fixatives, stains and other reagents.

Microtomy- Preparation of blocks, section cutting by wax methods and staining vertebrate and invertebrate tissues.

Mounts- Preparation of permanent stained mounts of various preserved mounting materials (to be provided) and also from the material collected by the students.

Spotting- Study of important prepared slides, museum specimens including those prescribed for B.Sc; classification will follow as already taught in B.Sc.

Genetical problems- a. Test cross, b. back cross, ç. dihybrid cross, d. Multiple alleles, e. Sex linked inheritance, f. gene interaction.

Behaviour- Orientation behavior, phototaxis in earthworm and housefly, geotaxis in earthworm, chemotaxis, phototaxis in frog, olfactory behavior in housefly.

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Cytological Preparations u Preparation of chromosomes from onion root tip, pollen mother cells (anther), testes of frog and testes of grasshopper.

Biostatistics (Biometry)- a. Presentation of data in form of frequency table (direct variable continuous variable);

b. Measures of central tendencies (arithmetic mean, median mode, Standard deviation and numerical based on them).

c. Mean deviation, test of significance (t and χ^2 test) and numerical problems based on them and correlation coefficient.

Books, as prescribed for related topics will apply here for assistance in M.Sc. Practical as well.

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NEW SYLLABUS (from 2019-20 onwards)

ZOOLOGY

M.Sc. Final Zoology

PAPER - I	Chordata: Comparative Anatomy of vertebrates (Compulsory)	70 marks
PAPER -II	Animal Physiology, & Immunology (Compulsory)	70 marks
PAPER -III	Biochemistry and Developmental Biology (Compulsory)	70 marks

SPECIAL PAPERS (Optional)

PAPER - IV	Special Paper	70 marks
PAPER - V	Special Paper	70 marks
PRACTICAL EXAMINATION		150 marks

SPECIAL BRANCHES:

A. Ichthyology
B. Entomology
C. Parasitology
D. Cytogenetics
E. Endocrinology
F. Environmental Biology & Applied Ecology.

PAPER - 1: Chordata: Comparative Anatomy of Vertebrates

Note: Attempt four questions in all, two questions from each section; each question carries equal marks.

1. Origin of chordates
   (i) Concept of protochordata
2. Origin and classification of vertebrates.
3. Vertebrate integument and its derivatives.
   (i) Development general structure and function of skin and its derivatives

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(ii) Glands, scales, horns, claws, nails, hoofs, feathers and hair.

4. General plan of circulation in various groups.

(i) Blood (ii) Evolutions of heart (3) Evolution of aortic arches and portal systems. -

5 Respiratory system

(i) Characters of respiratory tissue

(ii) Internal & External respiration

(iii) Comparative account of respiratory organs.

6. Skeletal system:

(i) Form, function, body size and skeletal elements of the body.

(ii) Comparative account of jaw suspensorium, vertebral column.

(iii) Limbs & girdles

7 Evolutions of urinogenital system in vertebrate series

8. Sense organs & function

(i) Simple receptors

(ii) Organs of olfaction and taste

(iii) Lateral line system.

(iv) Electro reception

9. Nervous system

(i) Comparative anatomy of the brain in relation to its functions

(ii) Comparative anatomy of spinal cord.

(iii) Cranial nerves, peripheral & autonomous nervous systems

Books recommended

Alexander, R.M. The Chordata. Cambridge University Press, London

Barrington, E.J.W. The Biology of Hemichordates and Protochordata. Oliver and Boyd, Edinburgh

Kingsley, J.S. Outlines of comparative anatomy of vertebrates. Central Book Depot, Allahabad

Srivastava, MDL. Comparative anatomy of vertebrates, Central Book Depot, Allahabad

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Milton Hilderbrand Analysis of vertebrate structure. IV ed. J.Wiley and Sons, New York.

Romer, A.S. Vertebrate Body. W.B. Saunders Co. Philadelphia.

Young, J.Z. Life of vertebrates, Oxford University Press, London

Young, J Z. Life of Mammals, Oxford University Press, London

Colbert, E.H. Evolution of vertebrates. J.Wiley and Sons, NY

Montagna, W. Comparative at my. J.Wiley aid Sons NY

PAPER - II: Animal physiology & Immunology

Note: Attempt four questions in all, two questions from each, section, each question carries equal marks.

Unit - I, Animal Physiology.

1 Aims and scope of animal physiology

2 Respiratory organs and respiratory pigments.

3 Patterns of nitrogen excretion among different animal groups.

4. Osmoregulation in different animal groups.

5. Thermoregulation
   - (i) Homoeothermic animals.
   - (ii) Poikilotherms
   - (iii) Hibernation.

6. Communication among animals
   - (i) Bioluminescence
   - (ii) Pheromones and other semiochemicals
   - (iii) Audio signals.

7. Contractile elements, cells and tissues.
   - (i) Muscle structure and function.
   - (ii) Movements - amoeboid, ciliary and flagellar

8. Chromatophores and regulation of their function.

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Unit-I : Immunology

- Introduction to Immune system Immunity and its types.
- Monoclonal antibodies.
- Antigen- Antibody interactions.
- Activation and differentiation of B & T cells.
- **Humoral and Cell Mediated immune responses.**
- Cytokines, Complement system
- Hypersensitivty and Autoimmunity
- Immuno deficiencies, vaccines
- Major Histo compatibility complex (MHC) molecules.
- Structure and function of Antibody molecules
- Generation and Regulation of Antibody diversity.

Books recommended

W.B. Saunders, C.L. Prosser. Comparative animal physiology

R. Eckert. W.H. Freeman. Animal Physiology: Mechanisms and adaptation.

W.S. Hoar. General and comparative animal physiology, Prentice Hall, India

Schiemdt - Nielsen. Animal Physiology: Adaptation and Environment. Cambridge

De Robertis and De Robertis. Cell and Molecular biology

Barbara A. Osborne and Janis Kuby. Immunology.

Abul K. Abbas, Andrew H. Lichtman, Basic Immunology: Functions and disorders of the immune system.

Paper III Biochemistry and Developmental Biology

Paper-III

Unit - I : Biochemistry

1 Thermodynamics principles and steady - state conditions of living organisms.

2. Degradation of glucose, palmitic acid and amino acids.

3. Energy metabolism and high-energy compounds

   (i) Redox potentials

   (ii) Mitochondrial electron transport chain

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(iii) Oxidative phosphorylation

4. Biosynthesis of urea. aspartic acid. glucose, glycogen and prostaglandins.
5. Nature of Enzymes:
   (i) Classification and nomenclature of enzymes.
   (ii) Kinetic analysis of enzyme catalyzed reactions.
   (iii) Regulation of enzyme activity by non-genetic mechanisms.
   (iv) Half of enzymes intracellular degradation of proteins.
6. Biosynthesis of proteins nucleic acids.
7. Site directed mutagenesis and enzyme engineering
8 Immobilized enzymes and their application.
9 Fertilization
   1. Pro-fertilization events.
   2. Biochemistry of fertilization
   3 . Post-fertilization events.
10. Collection and cryopreservation of gametes and embryos
11 Ovarian follicular growth and differentiation
   1. Morphology
   2. Endocrinology
   3. Molecular Biology
   4 Oogenesis and Vitellogenesis
   5. Ovulation and ovum transport in mammals.

Unit II Developmental Biology

1. Standard techniques and methods of experimental embryology namely Vital dying, extirpation, isolation, transplantation and grafting. .
2. Gastrulation, Fate maps
3. Cell-cell communication-Multicellularity aggregation, differentiation, cell movement, contact inhibition, cell adhesives.

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4. Cleavage, polarity, determination ingredients; cleavage and nuclear activity. organizers- properties and physiology, embryonic induction, primary and secondary, competence, heterogeneous inductions.

5. Metamorphosis, hormones and genes morphogenesis of vertebrates (the cyto differentiation with example of eye and limb) Differential gene expression.

Books recommended

Austen, C.R. and Short, R.V. Reproduction in animals.

Schatten and Schatten. Molecular biology of fertilization.

F.T. Longo. Fertilization. Chapman and Hall.

R.G.Edwards. Human Reproduction

Balinsky. An Introduction to Embryology, CBS College Publishen

Gilbert. Developmental Biology, Sinauer

Berril, N.J. Developmental Biology. TMH, India.

D. Voet and J.G. Voet. Biochemistry. J. Wiley and Sons.

M.Sc. Final

Zoology Practical Examination

Note: The practical examination shall carry 150 marks; 75 marks for first day (general examination) and 75 marks for second day (special paper) The examination shall be spread over two day.

Each student shall submit a brief report on excursion, one special general paper (in the second day examination) along with the complete record of his / her practical work with collections, slides, and other preparations. Each student has to deliver at least one seminar lecture.

Both internal and external examiners shall work with mutual consultation and cooperation, during evaluation.

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First day

1	Major dissection	10 marks
2	Minor dissection	05 marks
3	Preparation of permanent mount	05 marks
4	Ten spots for identification and comments	15 marks
5	One physiology experiment	05 marks
6	Comments in details on two embryological slides/models/specimens	05 marks
7	One histological preparation/exercise	05 marks
8	Viva voce test	10 marks
9	Practical record, collection, slides and other preparations	05 marks
10	Project	10 marks
	Total	**75 marks**

The second day practical will be held as per schedule provided for the concerned syllabi for special papers.

Contents of the Practical Exercises.

Major Dissections- a. Fish: Cranial nerves of flat fish and Stingray, b. Mammal- Blood vascular system, cranial neck nerves.

Minor dissections — a. Fish: electric organs; b Internal ear of Scoliodon, c. Reproductive organs of a mammal.

Mounts - WM of Salpa, Oikopluera, Squamous epithelium and ciliated- epithelium of frog, filoplume of bird. WM preparation of bird embryos.

Osteology - Endosskeleton of bony fish, reptiles, birds and mammals.

Palate in birds

Jaw suspension in vertebrates

Embryology- Study of various stages of embryos of representatives of different classes of vertebrates. Study of different types of placentae (may be replaced by models) including their histological section.

Section of tadpole larvae through different region of different stages.

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Sections of various regions and stages of chick embryo and also their whole mounts

Histology- Comparative histology of vertebrates organs including endocrine glands.

Museum Specimens- Models of extinct reptiles, human evolution, archaeopteryx, and other preserved specimens of chordates including those prescribed for B.Sc.

Physiology Experiments- a Measurement of buffer action; b. Determination of osmotic concentration of fish farming, To demonstrate the principle espirometer; g. Comparison of pulmonary and cutaneous respiration in frog; h. any other modification of above exercises or additional one depending on facilities available.

M.Sc. Final Zoology

SPECIAL PAPER - Ichthyology and fisheries

Paper IV (A) (Ichthyology)

Note Attempt four questions in all; each question carries equal marks.

1. Classification - Evolutionary classification (Classification prepared by Berg and that by Romer), merits and demerits of Borg's classification. Cladistic classification (Modern approach); Ostracoderms, placoderms.
2. Origin and evolution of fishes (Elasmobranchs and bony fishes)
3. Identification - Technique, identification of local fish fauna.
4. Zoogeography - Spatial distribution of ' fishes; discontinuous distribution;
5. Local Fish fauna - Food fishes, forage fishes, predatory fishes and insectivorous fishes, wood fishes.
6. Migration - Type of migratory fishes; physiologic and applied aspects of migration, influencing factors, associated problems; migrations of eels, migration of Salmon, migration of Hilsa.

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8. Food and feeding habits - basic food, secondary food, incidental food. obligatory food and supplementary food. Plankton feeders, herbivorous, carnivorous, omnivorous, monophagic and stenophagic fishes, euryphagic fishes. Surface feeders column feeders, bottom fenders, grazers, strainers,

9 Reproduction and development - Seasonality; Prolific breeders; Oviparity and viviparity; fecundity (methods of enumeration of eggs); endocrinal regulation; embyrogenesis of any carp; parental care in fishes.

10. Abiotic and their influences on fish.

11. Maintenance and working freshwater and marine aquaria.

Paper V(A) - (Applied Fisheries)

Note: Attempt four questions in all; each question carries equal marks.

1. Type of fisheries - Marine fisheries (Coastal fisheries, deep sea fisheries, off shore fisheries); Riverine fisheries (Major rivers systems of North India and their fisheries), reservoir fisheries; Laurtrine fisheries; estuarine fisheries estuary types, ecologic features, principal estuaries and their fisheries).

2. Prawn Fisheries- Fishing methods, culture method, future of prawn fishery in India; pollution and prawn fishery and processing of prawns.

3. Fishing Methods- Sea water (crafts of east and west coast, tackles, other methods– electric fishing, light fishing, echo sounders); in in-land waters (fishing crafts and tackles).

4. Pond Culture (fish farming)- Types of fish farming, planning and construction fish farms, physiochemical and biological characteristic of fish farms; maintenance and improvement of fish farm.

5 Principal cultivable fishes - Brief account of indigenous and exotic species Procurement of seed; collection, identification and transport of seed,

6. Induced breeding - Stripping, hypophysation technique, bund fisheries (dry and wet), indoor hatcheries and hapa techniques.

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7. Other techniques of fish culture - Composite fish culture; fish culture in paddy fields; sewage fed fisheries.
8. Fish diseases and their control - fungal diseases, bacterial diseases, protozoan diseases, helminthes infections, and diseases induced by pollutants; prophylactic measures.
9. Fish decomposition and rigor mortis.
10. Fish preservation and processing - Causes of spoilage, methods of preservation and demerits of prevalent trivial methods.
11. Fish by-products
12. Age and growth, length and weight relationship.
13. Tagging of fishes and population enumeration-.
14 Transport of fish and marketing

Syllabus for Practical examination to be held on second day

Note : The principal examination on second day will also extend for five hours, each student will maintain a record of the excursion and submit it at the time of this examination along with his collection and preparations. The division of marks for practical examination on second day is as follows:

1	Major Dissection	10 Marks
2.	Minor dissection	05 Marks
3.	Excursion report	10 Marks
4.	Ten spots for identification and comments	15 Marks
5.	Two local fresh water species for taxonomic identification with reasons up to species	05 Marks
6.	Comments on adaptive features of two fish species/two specimens for pathology/two models from applied fisheries.	10 Marks
7.	Viva voce test (on special paper only)	10 Marks
8.	Practical record, collections, slides and models.	10 Marks
	TOTAL	**75 marks**

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Syllabus for dissection: and mounting: -

Major dissections -	Cranial nerves of fresh water fish- Wallago attu, Mystus species
	Weberian ossicles of fresh water fish
	Exposure of pituitary of a fresh water fish
Minor dissections-	Electric organs- Torpedo (Electric-ray)
	Accessory respiratory organs- Heteropneutus
	Anabus, Opheocaplalous
	Eye and eye muscles
	Scroll valves
Mountings-	Different types of scales
	Ampullae of Lorenzini
	Hand section of olfactory organs
	Nerve fibre
	Blood film
	Eggs

Books recommended for Special Papers (Ichthyology & Fisheries)

Lagler	Ichthyology
Norman	History of fishes
Berg, L.S.	Classification of fishes.
Francis Day	Fishes of India vol. I & II
K.C. Jayaram	The freshwater fishes of India, ZSI Calcutta
P.K. Talwar	Commercial Marine fishes of India, ZSI Calcutta
K.S. Misra	Fauna of India, Vol. I, II, III Rec. of Indian Museum
V.G. Jhingeran	Fish and Fisheries on India
Parihar	Fish and Fisheries
Chandy ,M.	Fish and fisheries. NBT, New Delhi Wealth of India Vol. III
C.V.Kurian and	Prawns and Prawn Fisheries of India

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V.O.Sebestian	Hindustan Publishing House, New Delhi
C.L.Chunder	Breeding of Indian Major Carps, Rashtriya Art Printers, Agra
Lal	Nets and gears
Khanna S.S.	Fishes
Grover	Fishes
C.B.L Srivastava	Biology of Fishes
Santosh Kumar	Anatomy and physiology of Fishes, Vikas Publication, N.Delhi .

M.Sc. Final Zoology
Special paper - (IV B) - Entomology

Paper - IV (B) Morphology, Anatomy, Physiology, Ecology and Embryology of insect

Note: Attempt four questions in all; each question carries equal marks.

1. Morphology of head thorax and abdomen, structure of the digestive, respiratory, circulatory, excretory, nervous receptor organs including second and light producing organs and reproductive system.
2. Physiology of the digestive, respiratory, circulatory, excretory, nervous receptors organs including sound and light producing organs
3. Metamorphosis, role of hormones in development.

Paper - V - (B) Insect taxonomy, Economic Entomology, and Social Insects

Note: Attempt four questions in all; each question carries equal marks.

(1) Taxonomy: Detailed knowledge of the following orders and particularly of the families mentioned below-

1. Thynanure 2. Collembola 3. Orthoptera 4. Blatteria 5. Phasmida 6 Mantoidea 7. Dermaplera 8. Isoptera 9. Embioptera 10. Corredenia 11. Mallphage 12. Anopleura 13. Ephemerida 14. Onnats 15. Thysanoptera 16.

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Némoptera 17. Lecoptera. 18. Heteroptera- Pentotomidae, Cordeae, Lygaeidae Hydrumetridae. Beostomatidae. 19. Homopters- Fulgorisde, Oicadıdae Cercopidae, jassıdate, Altyrodae, Aphidiae. 20. Coleptera- Dytisciae, Lampyrıdae, Cantharıdae, Dermemade, Coccibellate, Scarwbacidac, Cerrmbycidae, Curcullonidae, 21. Lopidoptera. Pyralidiate, Nocurit, Spobgidae, Geometridac, Bombucıdae, Saturnidae, Papilionadar, Nymphaldae. 22. Strepsiptgera 23. Hymenoptera - Teuthrednae, Evanıdae Ichne, umoidae, Chalici fade, Formicidae, Vespodne, Ecmeniade, Aniade. 24. Dipters Mycroplidae, Tipulidae, Psychodiae, Culcidae, Chtrononade, Asilidae, Syphidae, Muciade, Tuchiniade Hippobosedae 25. Siphoupera

(2) Economic entomology economic importance of the weevil, locust, honey bee, lac insect, pests of stored grains, cotton paddy, sugar cane, cattle, men, forest plants and fruits their life history Nutrit of dosage and various types of control measures employed with special emphasis on insecticides.

(3) Social insects - their organization adaptations and behaviour.

(4) Soil insects and plant protection.

Books recommended.

Evig , D..: College Entomology.

Imm. A.D. Text book of Entomology (9th ed. revised by Richard an Davis).

Icocot, A.D. : Recent Advances in Entomology.

Packward, A.S.: Text Book of Entomology.

Practical

Note The practical examination on second day will also extend for five hours Each student will maintain a record of the excursion and submit it at the time of this examination alongwith his/her practical record, collection and preparation.

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The division of marks is as follows:

1.	Major dissection	10 marks.
2.	Minor dissection	05 marks
3.	Ten spots for identification and comments	15 marks
4	Identification of two legal insects upto species level	05 marks.
5.	One biostatistical problem	10 marks.
6.	Excursion report	10 Marks
7.	Viva voce test	10 marks.
8.	Record, collection, and preparations.	10 marks.
	TOTAL -	**75 marks.**

Syllabus for M.Sc. (Final) Zoology (Entomology special paper) practical examination.

Major dissection:

Expose any one of the following systems and associated parts of any of the insects

Nervous system, Alimentary canal, Reproductive system and Respiratory system of Grasshopper, Dysdercus (Red cotton bug), Danus (Plain tiger butter fly), Acherontia (Hawk moth) Musca (Housefly) Apis (Honey bee), Vespa (Wasp) and Mylabris (Blister beetle).

Minor dissection:

Tentorium, Tympanum of Grasshopper, Spiracle of Grasshopper, Endocrine system of the Cockroach, Heart and blood vessels of Cockroach Johnston's organ of Male mosquito, aristate antenna and modified hind wing (Haltere) of housefly, Sting apparatus of Honey bee and Wasp, Genitalia of Male and Female

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Study of the following prepared slides:

Types of Antenna, Mouth parts, Legs, Wings, Wing coupling apparatus, Eggs and Overioles. W.H. of Lepisma, Springtails, Pediculus, Climax, Aphid, Xenopsylla, Bird louse, Culex Male and Female, Anopheles male and female, Aedes male and female, Thrip, larva of Culex and Anopheles, Pupa of Culex and Anopheles. T.S. Gizzard and Proventriculus of Cockroach, T.S. of fors gut, mid gut and hind gut alongwith cloaca, T.S. of Filter chamber, T.S of Rectum, T.S. of Compound eye, T S. of Flight muscle fibres, T.S. of Testis, Ovary, T.S. through an early embryo, T.S. of abdominal ganglia, L.S of Spiracle alongwith trachea, L.S of Brain, L.S. of the fore gut of Cockroach, MV.S. of the heart of a Cicada, Gills of aquatic insects.

Study of the following museum specimens:

Mantis, Phyllium, Stick insect, Earwig, Queen termite, Belostoma, Cicada Male & Female, Nepa, Rhinoceros beetle, Types of Larvae and Pupae, Life History of Silk worm, Sand fly, Butterfly. Lac insect, Honey bee.

Study of the Specimens selected from the Orders of insects as per theory course for the purpose of identification.

Record of the exercises on growth and development of insects with the help of following biostatistical calculations; Dyar's law, Chi-square test, Growth index and Howe's index values, Critical difference, Standard error, Standard deviation, Transformed and Angular transformed values.

Histological preparations of the Grasshopper viscera exposed to easily available insecticides.

At least one Life History of a crop pest is to be included in the collection.

Books recommended for special paper

D.P. Tombhare: Insect, morphology, and physiology, S.Chand & Co.

H. Bursell: Insect physiology, Academic Press, NY

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A. Kumar and P.M. Nigam - Economic and applied entomology, Emkay Publishers, Delhi - 51

Nigam, P.M. and A.Kumar U Agricultural entomology, ----do-----

Kumar, A and P.N. Nigam- Crop pests of India ----do-----

M.Sc. Final Zoology

Special Paper - IV (C) - Parasitology

IV. General Parasitology

Note: Attempt four questions in all; each question carries equal marks

(1) Morphology and systematics (including ultrastructure) of protozoans, trematodes, cestodes and nematodes in relation to man & domestic animals.

(2) Life cycle of the following:

Entameoba histolytica, Trypanosoma, Leishmania, Schistosoma, Paragonimus westermani, Dicrocoelium, dendrificum, Echinococcus granulosus, Diphyllobothrium latum, Dipylidium canimu. Hymenol'epis nana, Wuchereria bancrofti, Brugia malayi, Dracunclus medinensis, Trichinella, spiralis, Strongyloides stercorali.

(3) Different types of larvae of trematodes cestodes and nematodes.

(4) General account of parasitism, evolution and parasitic adaptation.

(5) Arthopods as vectors.

Paper V (C) - Applied Parasitology

Note: Attempt four questions in all; each question carries equal marks.

1. Causes, symptoms, diagnosis, treatment and prevention of important prasitic protozona's trematodoes, cestodes and nematodes of man and domestic animals.
2. Physiology of nutrition, excretion and respiration of parasites.
3. Ecology of parasities.

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4. Immunology, immunity disorders immunoprophylaxis.
5. Reproduction.
6. Egg shell formation.

Practical

1.	Permanent preparation of rectal ciliates, Monocystis, Blood film of man for plasmodium	- 15 marks
2.	Permanent stained preparation of trematodes & cestodes from the animal provided.	- 05 marks
3.	Preparation of the material provided (Arthopods)	- 05 marks
4.	Identify and comment upon spots 1-10	- 15 marks
5.	Two specimens for taxonomic identification upto species level	- 05 marks
6.	Project	- 10 marks
7.	Viva-voce	- 10 marks
8.	Practical record & collection	- 10 marks
	TOTAL	- 75 marks

Books Recommended

Read, C.P. Animal Parasitism, Prentice Hall, Inglewood, New Jersey, USA

Baker, J.R. The Parasitic Protozoa. Hutchinson, London

Cheng, T.C. The Biology of Animal Parasites, W.B. Saunders an Co. Philadelphia and London.

Chandler, A.C. Introduction to Parasitology, J.Wiley and Sons

Cobb, N.A. Nematodes and their relationships, Year Book , U.S.Deptt. of Agriculture, 1914: pp 457 -490.

Corfton, H.B. Nematodes, Hutchinson University Library, London.

Dawes, B. The Trematoda. Cambridge University Press

Hyman, L.H. The Invertebrates Vol. II and III, McGraw Hill, N.Y.

Smyth, J .D. The Physiology of Trematodes, W.H.Freeman and Co.

Smyth. The Animal Parasitology, Cambridge University Press.

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M.Sc. Final Zoology
Special Paper - (D) - Animal Cytology and Cytogenetics

Paper IV - (D) - GENERAL ANIMAL CYTOLOGY

Note: Attempt four questions in all; each question carries equal marks

1. Cell cycle - cell divisions; mitosis and meiosis.
2. Chromosomes - Giant chromosomes, isochromosomes, heterochromatin, euchromatin, chromosome proteins, arrangement of chromatin in chromosomes Nomenclature of mammalian chromosomes; C G banding and karyotypes
3. Chromosomal aberrations - Deletion, duplication, translocation and numerical abberation.
4. Sex determination - Primary and secondary sex characters; sex chromosome structure and mechanisms of sex determination, sex chromatin and Y body
5. Protoplasm -Chemical and physical nature.
6. Cell metabolism - Energy metabolism and biosynthesis of carbohydrates, proteins; lipids, nucleic acids, and their catabolism
7. Cell Membrane - modifications and physiology.
8. Nucleus - Ultrastructure, chemical composition and its significance.
9. Cell organelles - Detailed structure and functions different organelles including lysosomes, centrosome and plasmids
10. Cilia, flagella, basal bodies and Parthenogenesis

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Paper V (D) - Clinical Cytogenetics

Note: Attempt four questions in all: each question carries equal marks.

1. Linkage, and crossing over - types of linkage, linkage maps and groups, detection of linkage; cytologic basis of crossing over, crossing over between, three linked genes, gene conversion.
2. Chromosomal compliments in human - nomenclature, morphology, karyotype and chemical composition; types of chromatin of different regions of the chromosomes. DV Praw model of human chromosome structure.
3. Lethal heriditary diseases in man - Sickle cell anemia, Phenyl - ketonuria, Hutington's chorea albinism and Galactosemica.
4. Sex chromosomes and abnormalities, Klinfelter's syndrome, Turner's and Dom syndrome, testicular feminisation and aged eggs.
5. Genetic and clinical aspect of Rh disease, A,B, O, incompatibility and control, effect of IQ score and phenocopy.
6. Effect of environment on development of characters -external, internal environment.
7. Population genetics - Factors affecting genen, gene frequencies, migration, mutations, selection, fitness, random drift, gone pool, Hardy Wienberg law.
8. Malagmony - different & development

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Practical

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Special Paper - Cytogenetics Practical examination of second day

Note: The practical examination on second day will also extend for five hours. Each student will maintain a record of the excursion and submit it at the time of this examination alongwith his/her collection and preparations.

The division of marks is as follows:

		Max. Marks
1.	Major dissection (Somatic chromosome preparation from bone marrow of rat	10 marks
2.	Minor dissection (leptotene, zygotene, pachytene diplotene stages of Meiosis Ist from rat testes	05 marks
3.	Slide preparation of sex chromatin of blood of female rat)	05 marks
4.	Ten spots for identification and comments	15 marks
5.	Problem I	05 marks
6.	Problem II	05 marks
7.	Excursion reports	10 marks
8.	Viva voce tests	10 marks
9.	Record, collection etc.	10 marks
	Total	**75 marks**

Syllabus

1. Study of somatic chromosomes preparation bone marrow of rat, or any other suitable satorial.
2. Demonstration of insect salivary gland chromosomes.
3. Preparation of polytene chromosomes from Drosophila or any other insect.

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4. Squash preparation to show mitosis and meiosis
5. Demonstration of mitochondria and other cell organelles
6. Study of slides and photomicrographs showing ultra structures, cell types and cell organelles including prokaryotic cells from water and soil and E.coli and also animal eukaryotic cells
7. Study of lethal hereditary syndromes in man (by chart)

Books Recommended

Problems relating to haemophilia, colour blindness, blood groups, sex determination, probability and population genetics.

Atherly, A.G , J.R. Girlton, J.F. MacDonald. The science of Genetics. Saunders College Publishing Harcourt Brace College Publishers, New York

Brooker, R.J. Genetics: analysis and principles, Benjamin/Cummings, Longman, Inc.

Gardener, E.J., M.J.Simmons and D.P.Snustad , Principles of genetics. John Wiley and Sons, New York

Lewin, B Genes VI. Oxford University Press, Oxford, New York, Tokyo

Watson J.D. et al. Molecular Biology of genes. The Benjamin/Cummings Publishing Co. Inc., Tokyo

J.Darnell, H.Lodish and D.Baltimore Molecular Cell Biology Scientific American Books, W.H. Freeman, N.Y.

Benjamin Lewin. Genes VI, Oxford University Press, New York

P.D. Dabre. Introduction to Practical Molecular Biology. John Wiley and Sons Ltd. New York

Lewis C.D. and Levin, R. Biology of Gene McGraw - Hill Toppan Co. Ltd. Gunther S.Stent Molecular Genetics Macmillan Publishing Co. Inc.

Goodenough V. Genetics New York Hott Rinehart and Winston.

Gardner Principles of Genetics Willey Eastern Pvt. Ltd.

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Winchesters, Genetics oxford IBM Publications.

Stickberger, Genetics Macmillan Publications.

Pai A.C. Foundations of Genetics, McGraw Hill Publications.

Verma RS. and J .K. Agarwal, Genetics S.Chand and Co.New Delhi.

Gupta P.K. Genetics, Rastogi Publications Shivaji Road Meerut.

Sinnot, E.W , L.C. Dunn and T. Dobzhansky - Principles of Genetics McGraw - Hill Book Company New York.

Stansfield, W.D. Theory and Problems of Genetics McGraw - Hill Book Company New York.

Stent, G.S. Molecular Genetics W.H. Freeman and Company, SanFrancisco.

Crick F.H.C. The genetic code.

Lewin, Benjamin Gene Expression 2nd Ed. John. Willey, London.

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Endocrinology - The special papers

Paper IV (E)- Comparative endocrinology and peptide hormone systems of vertebrates

Note: Attempt four questions in all; each question carries equal marks.

1. History definition, characteristics and classifications of hormones; Hormonal versus nervous integration; regulation of endocrine action.
2. Neurosercretion and neuroendcrines on Insect hormones (brain hormones, ecdysone, juvenile hormone, bursicon, diapause hormone eclosion, adipokinetic, proctolin, diuretic and heart beat accelerator hormones)

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3. Vertebrate endocrine organs: Structural evolution of endocrine glands. Morphology, comparative anatomy and histology of pituitary, Thyroid, Parathyroid, adrenal, gonads and thymus.
4. Vertebrate neuroendocrine system: the nature of neurosecretory cells; hypothalamo-hypophysial system.
5. Adenohypophysis: cell types, hormones, their functions, deficiency and teratogenic effects.
6. General structure, histology and functions of pineal apparatus and the urophysial system.
7. Neurohypophysis: hormones, antidiuretic and oxytocic action, milk ejection
8 Thyroid gland: Cytology, mode of secretion, cyclic architectural changes, functions of thyroid hormones, mechanism of action, hypo and hyperthyroidism and related abnormalities.
9. Parathyroid hormones: calcium and phosphorous, metabolisms, action on bones, kidney function.
10. Gastro-intestinal hormones: endocrine regulation of gastric functions and role of gastrin, enterogastrone, secretin, pancreozyme, urogastrone, and cholecystokinin.
11. Pancreas: Histology, chemical nature of insulin and glucagons; action of insulin and control of the insulin and glucagons release.

Paper V (E) - Molecular Endocrinology

Note: Attempt four questions in all; each question carries equal marks.

1.0 Definition and scope of molecular endocrinology
  1.1 Discovery of hormones and reductionist biology
2.0 Chemical nature of hormones
3.0 Purification and characterization of hormones

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4.0 Production of hormones by biochemical and rDNA technologies

5.0 Structure of hormones.

5.1 Structure-function relationship hormones - comparative analysis and evolutionary perspectives.

6.0 Nature of hormone action.

6.1 Hormone receptors - identification, quantitation purification and physico—chemical properties.

6.2 Membrane receptors - structure and signal transduction mechanisms.

6.3 G-proteins

6.4 Nuclear receptors - structure and function Orphan receptors Metabolic and developmental hormones.

6.5 Hormonal regulation of carbohydrate, lipid, protein and nucleic and metabolism

6.6 Hormonal regulation of growth, reproduction and development through differentiation gene expression.

7.0 Body fluids and hormones: .

7.1 Reproductive cycles in vertebrates and hormonal concentrations in body fluids.

7.2 Biosynthesis of hormones - molecular details.

7.3 Transcriptional and post-translational regulation of hormone biosynthetic genes.

7.4 Hormone and receptor genes in population.

8. Genetic analyses of hormonal disorders.

9. Hormones and evolution.

Suggested Reading Material

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.

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4. L.P. Freedman. Molecular Biology of Steriod and Nuclear Hormone Receptors, Birkhauser.

5. G. Litwach. Bicohemical Actions of Hormones, Academic Press.

Practical

List of Suggested Practicals

1. Bioassay of any hormone involving target tissue growth/differentiation.
2. Radireceptor assay for any hormone.
3. RIA and ELISA for any hormone or second messenger.

Syllabus for practical examination of Endocrinology to be held on second day

Note: The practical examination on second day will also extend for five hours. Each student will maintain in record of the excursion and submit it at the time of this examination along with his/her collection and preparations.

1.	Dissection (any two endocrine glands)	10 marks.
2.	One microtomic slide preparation	10 marks.
3.	Ten spots for identification and comments (slides etc)	15 marks.
4.	Excursion reports	10 marks.
5.	Project report	10 marks
6.	Viva voce test (on special paper only)	10 marks.
7.	Practical record, collections, preparations	10 marks.
	TOTAL	75 marks.

Syllabus for Practical Examination:

Dissection - Endocrine gland of vertebrates: fish, amphibia, birds and mammals.

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Microtomic Preparation - Examinees will be required to bring propertly stretched slides of pituitary, thypoid, gonads, adrenal and thymus and shall suitably stain to demonstrate the histology of the gland.

Project - Each student shall be given a project involving experimental procedures. The candidate will keep complete record of his/her project including photographs, slide, data etc. and will submit the same at the time of the practical examination.

SUGGESTED READINGS:

Barrington, EJW (1975) General and comparative endocrinology, Oxford, Clarenden press

Barrington, EJW (1962) Hormones and evolution Oxford.

Call, Ed. (1971) An ABC of endocrinology. Little brown and Coaspalls Boston.

Frioden, EH (1976). Chemical endrocrinology. Academic Press, HY

------and H Lipper (1971). Biochemical endocrinology of vertebrates, prentice hall, Englewood Cliffs, NJ.

Gorbman, A. and Howard A. Born (1962) A text book of comparative Endocrinology. Wiley Eastern.

Sawin, C.T. (1969). The hormones. Little Brown & Co. Boston.

Toppermen, CT (1969). Metabolic and endocrine physiology (3rd ed.) near book Medical Publishers, Inc. Chicago.

Turner, CD and JT Bagnara (1976). General endocrinology, Saunders Philadelphia.

Bentley, P.J. Comparative Vertebrate endocrinology, Cambridge University Press.

R.H. Williams. Text Book of Endocrinology. W.B. Saunders

C.R. Martin. Endocrine Physiology. Oxford University Press

Gorbman, A. et.al. Comparative Endocrinology. J. Wiley and Sons.

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Special Papers -Environmental Biology and Applied ecology

Paper IV (F) - (Environmental Biology)

Note: Attempt four questions in all; each question carries equal marks.

1. Scope, major areas, historical background of environmental biology in India.
2. Tools and techniques- Population sampling techniques, methods of estimating primary and consumer production; measurement of environmental factors; remote sensing.
3. Statistical studies - Biometry and biological data; descriptive statistics and depiction of life patterns of animal with environmental effects by applying Boolean algebra.
4. The Environment- Elements and processes, interaction of Environmental elements, dynamic environment
5. The Atmosphere - Pressure, winds and air masses, moisture, temperature, and light.
6. Hydrosphare- Renalms of water; organisms in fresh and marine waters.
7. Lithosphere - Land forms, rocks, soil and soil erosion, underground water.
8. Comparison of autecology and synecology.
9. Biosphere - Ecosystems, Diversity, kinds, functional aspects
10. Community - Structure and dynamics energy flow; biogeochemical cycles.
11. Population interactions- intra-and interspecific interactions; ecological genetics- Natural selection, adaptations and ecotypes, speciation, ecological indicators.

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Paper V (F) - (Applied Ecology)

Note: Attempt four questions in all; each question marks.

1. Environmental aspects of human population demography, growth. factors regulating human population; the impact on environmental imbalance.
2. Resources - Conservation with exploitation kinds - Terrestrial (soil, climate, climatic regions of India, forests, flora and fauna of India) deforestation and its impact various forestries, grasslands, flora, fauna and their management, legal aspects; Govt. & Voluntary agencies for conservation, mineral resources and their conservation).
3. Aquatic resources (Fish resource; land planning with fishery projects) fresh water irrigation, marine resources -minerals and conservation; economic utility; marine parks.
4. Urban Water Management- Sources, water quality, criteria standards, Solid particle contents and their type, sewage and waste water treatment and disposal
5. Pollution - A. Air-Gases, BPM, heavy metals inorganic substances; Ozone erosion, prevention and control.

   B. Soil - Pesticides, synthetic fertilizers, fly ash, residual toxicity of persistant pesticides; Prevention and control.

   C. Water - Industrial and urban wastes; various toxicants, Marine pollution; Eutrophication and related economic implications; prevention and control.
6. Toxicology - Branches; dose response relationship; and LD_{50} and LC_{50} local and systemic effects; cumulative toxicity.
7. Factors effecting toxicity i.e. biological and chemical and route of administration.

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8. Wildlife Indian wildlife endangered flora and fauna, management; preservation of wildlife (in situ and ex situ): planning and management of parks, sanctuaries, reserves, zoological gardens, and domestic wildlife attractants

9. Energy - Types and sources, strategies for conservation.

10. Environmental Assessment- Biological monitoring; bioindicators, assessment of environmental alteration.

11. Environmental awareness and mass education - Principles and programmes of environmental education with special reference to India; UNCED on Earth Summit and SACEP; Deptt. of environment, forest and wildlife.

12. Preventive measures for conservation of resources and recycling of wastes.

Practical
Syllabus for Practical Examination to be held on second day

Note: The practical examination on second day will also extend for five hours; each student will maintain a record of the execution and submit it at the time of this examination, alongwith his/her collections and preparations.

1.	One field exercise (Max. time one hour)	10 marks
2.	Estimation of Soil/water quality (chemical)	10 marks
3.	Observations of abiotic (Physical) factors	05 marks
4.	Specific comments on an ecosystem model (including observations in field)	05 marks
5.	One statistical problem	10 marks
6.	Plankton number in a given sample	
	a) Quantitative	$2^{1/2}$ Marks
	b) Qualitative identification	$2^{1/2}$ Marks
7.	Excursion report	10 marks
8.	Viva voce test	10 marks
9.	Record collections, preparations	10 marks
	Total	**75marks**

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1. Determination of minimum size of quadrate (species area curve).
2. Determination of minimum number of quadrates.
3. Determination of frequency of individual species; line transect method, point frame method.
4. Study of biomass of producers in the field.
5. Estimation of DO, free CO_2 Chlorides, dissolved organic matter in water.
6. Study of physical and chemical characteristics of soil.
7. Study of different ecosystems in field, including food chains and webs and to construct pyramids.
8. Exercises on population, toxicology and genetics on the basis of provided data.
9. Identification of Zooplanktons and phytoplankton/Es and estimation of numbers.
10. Study of domestic wild life attractants and preparation of at least one.
11. Observations and studies on planning and management of Zoological park and forestry.

Books Recommended

Began, M. et al. Ecology, Individuals, population and Communities Blackwell Sci. Publi. Oxford, U.K.

Elseth, B.D. and K.M. Baumgartner. Population biology, Van Nostrand Co. New York.

Krebs, C.J. Ecological methodology. Harper and Row, New York

Odum: Ecology (Amerind)

Odum: Fundamentals of Ecology (W.B. Saunders)

Ricklefy: Ecology (W.H. Freeman)

Turk & Turk Environmental Science (W.B. Saunders)

Cormondy, E.J. concepts of Ecology (Prentice Hall)

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