

**DEPARTMENT OF ZOOLOGY
UNIVERSITY OF KERALA
KARIAVATTOM**

M. Phil. Program
Course content & Syllabi – (Revised in 2007)

SCHEME OF EXAMINATION

A. Theory Papers:	
Paper I - Research Methodology (Test, <i>viva</i> , Sm I, Sm II)	100 Marks
Paper II - Instrumentation (Test, <i>viva</i> , Sm I and Sm II)	100 Marks
Paper III - Special Paper (Test, <i>viva</i> , Sem – Sm I and Sm II)	100 Marks
B. Dissertation – Based on Original Research work	300 Marks
C. <i>Viva voce</i> Examination based on Dissertation	100 Marks
Total :	700 Marks

Paper III Special Papers (Optional):

1. Comparative Endocrinology
2. Ethology
3. Comparative Muscle Physiology
4. Insect Neuroendocrinology
5. Biodiversity & Conservation Biology
6. Comparative Reproductive Physiology
7. Environmental Endocrinology

Detailed Syllabi Revised since 2007

Paper I. Research Methodology

100 marks

Unit I. Surgical techniques in neuroendocrine research.

Thyroidectomy, Orchidectomy, Ovariectomy in Vertebrates.
Extirpation and implantation of insect brain MNC.
Allatectomy, Ovariectomy in insects

Unit II. Immunochemical techniques.

Developing polyclonal antibodies, Hybridoma technology,
Immunocytochemistry, Radio Immuno Assay (RIA),
Enzyme-linked Immunosorbant Assay (ELISA),
Tissue/Organ culture, Radiosiotopes/Autoradiography.

Unit III. Staining Neurosecretory cells in insects.

CHP, Whole mount preparation (PAVB)

Unit IV. General Principles of Research and Scientific writing.

What is research-Purpose of research, Basic research and Applied research; concept versus data; Methods of reasoning vs techniques of investigation; scientific method and the inductive-deductive approach
Development of a research plan- defining the research question, formulating hypothesis, Developing methodology to answer the problem, examining technical feasibility, interactive practical exercise.
Interpretation of results and discussion-Data processing, why and when to use statistical techniques, analysis and synthesis.
How to write a scientific paper- When to start writing ? structure of a scientific paper- Abstract (indicative vs informative) (what question was asked ?), materials and methods, (How was it studied ?), Results (What was found ?), Discussion (What does it mean ?), References, need for brevity and clarity, some common mistakes (statistical interpretation, Table heads, expressions to avoid).
Interactive practical exercise on paper writing

Unit V. Biodiversity, Taxonomy, Wildlife Biology, Conservation.

Origin and evolution of Global Biodiversity, Genetic, Species and habitat diversity; distribution of biodiversity in diverse ecosystems, Factors contributing to species concentration; Origin and distribution of Indian fauna.
General Principles of Taxonomy, Speciation and categories of species, impediments in the study of taxonomy and present day status of taxonomic studies.
Conservation of world's biota, strategies for species conservation and their merits and Demerits.

Paper II. Instrumentation

100 marks

Unit I. Microscopy

Light Microscopy, Phase Contrast Microcopy, Electron Microcopy (SEM & TEM)
Confocal Laser Scanning Microcopy, Staining techniques, Micrometry, Photomicrography

Unit II. Electrophoresis

Gel electrophoresis, Paper Electrophoresis, Immunoelectrophoresis

Unit III. Chromatography

Thin layer chromatography, Column chromatography, High pressure Liquid Chromatography (HPLC), Gas Chromatography (GC)

Unit IV. Photometry and Manometry

Colorimetry, Spectrophotometry, NMR, Infrared Spectrometry,
Polarimetric method of determination of Oxygen consumption

Special Paper I. **Comparative Endocrinology**

Unit I. Endocrines – An outline of their structure-Pituitary, Thyroid, Adrenal, Pancreas etc.
Chemistry of Hormones produced by Endocrine glands, Steroid hormones, Peptide hormones, Thyroid hormones-Gastrointestinal hormones, Tissue Hormones.

Unit II. Hormones and metabolism, Hormones in intermediary metabolism, Hormones in ionic and water balance, Hormones in development, Growth and Metamorphosis.

Unit III. Hormones and Behavior, Role of sex hormones in reproductive behavior, Hormones and colour change.

Unit IV. Mechanism of hormone action, Steroid hormones, peptide hormones, Thyroid hormones, Hormones and reproduction

Unit V. Role of sex hormones in reproduction, Hormones in population control, Human and pests, Neuroendocrine integration, Hormonal heterophylly

- References:**
1. A. Text book of comparative Endocrinology, Gorbman & Bern, John Wiley
 2. Comparative Endocrinology of Invertebrates, Highnam & Hill, Arnold
 3. An Introduction to Invertebrate Endocrinology, Tombes, Academic
 4. Comparative Vertebrate Endocrinology, Bentley Cambridge University press
 5. Metabolic and Endocrine physiology, Tepperman, year Book, Med. Publication
 6. Insect Endocrine-----K.K. Nayar
 7. Insect Hormones -----Wigglesworth
 8. William Endocrinology (1995)
 9. Endocrinology Dc G root Vol. 1-3 (1996)
 10. Endocrinology –Norris (1998)
 11. An Introduction to Endocrinology of Invertebrates- Tombes, Academic
 12. Reproduction in Mammals, Serial Books, Cambridge University Press
 13. Advances in Reproduction Physiology (Series), Mc Laren, Logos & Acad
 14. Fertilization, Rothchild, Methuen
 15. Fertilization, Austin, Prentice Hall India
 16. Chemistry & Physiology of Fertilization, Monroy, Holt etc. 1965.
 17. Vertebrate Reproductive cycles, Bullough, Mthuen 1961
 18. Biology of sex, C.J. Avers, John Willey
 19. Sex and Fertility, Clive wood, Thomas & Hudson 1969
 20. Physiology and Genetics and Reproduction (Basic Sciences. Vol. 48)
 21. Control of growth and Metamorphosis, Jenkin pergamon Press 1970
 22. Biology of gestation (ED. BY) Assali, Academic Press

23. Insect Behavior, Haskel, Symp. Roy. Ent. Soc. Lond. 3 1966
 24. Animal communication by Pheromones, Shorey, Academic press, 1976
 25. Control of injurious Animals, Cherrett et al, English University press
 &

Relevant Reviews and Journals

Special Paper II Ethology

Unit I Origin and Development: Introduction, history of Ethology, Aims and methods, Application, Ethology in India, Current status

Unit II. Neuroethology: Nervous system, Neurones, Central Nervous System, Brain and Behaviour, Neurotransmission Environmental Neuroendocrine transducer organs, Hormones and Behavior

Unit III. Motivation : Features, Models, Types, Physiological basis

Unit IV. Learning; Types of Learning, Neural Mechanism, Biochemical and Biophysical aspects, instinct, imprinting

Unit V. Insect societies: Social organization of termites or Honey bee Dance (Waggle dance)

Unit VI. Mammalian social organization : Social organization among Primates, Dominance Hierarchy, Territorial Behavior

Unit VII. Animal Communication: Communication Modalities, social Signals Olfaction, Scent Marking, pheromones

Unit VIII. Reproductive Behavior : Determination of sex and sexual Behavior courtship and mating, sexual Dimorphism, Parental Care, Hormones and Behavior

References:

1. Animal Conflict --F.A. Huntingford A.K. Tumer
2. Animal Behavior -- causes and effects --ED . T.R. Halliday & P.J.B. Slater
3. Animal Behavior -- Communications -- ED. T.R. Halliday & P .J. B Slater
4. Hormones and Behavior -- ed. S. Eleftherion & R.L Sprott

Special paper III Comparative Muscle Physiology

- Unit I.** General Aspects of contractile tissue-Structure and ultra structure
Types of muscle
- Unit II.** Invertebrate Muscle –Myonemes-Arthropodan-Molluscan “Catch Mechanism” Echinoderm
- Unit III.** Vertebrate Muscle-Skeletal Muscle Red and white fiber types and Intermediate types of muscle in fishes and Birds-plain Muscles
- Unit IV.** Physiological adaptations and Muscle to Exercise-diving –
Swimming Flight
- Unit V.** Muscle Metabolism- Fuel Reserves-Glycolysis-Molecular basis of muscle Contraction-Theories of Muscle contraction.
- Unit VI.** Cardiac Muscle-Physiology and Biochemistry-Ultra structure-Role of drugs on Heart

References:

1. Structure and function of Muscle---Ed. C.H. Bourne Vols.1, 3
2. Physiology of Mollusca—Ed . Wilbur & Young, Vol.1
3. Chemical Biology of fishes -- E.D.R.M. Love
4. Physiology of fishes -- Ed. M. Brown, Vol. 2.
5. Avian Myology --Ed. George & Berger
6. Muscle contraction --A. Szent Gyorgyl
7. Comparative Animal Physiology -- Prosser & Brown
8. Text Book of Biochemistry -- West & Todd
9. Insect Physiology -- K.D. Roeder
10. Biochemistry of Muscle contraction Ed. J. Gergely
11. Physiology of Crustacea -- Ed T.H. Waterman, Vol. 2.
12. The Biology of Physical Activity -- D.W. Edington and V.R. Edgerten
13. Comparative Animal Physiology -- W.S. Hoar
14. Strategies in Biochemical Adaptations --Hochachka

Special Paper IV **Insect Neuroendocrinology**

Unit I. Insect neuroendocrine system - Evolution of invertebrate neuroendocrine system, Neuroendocrine integration, Neurosecretion, Neurosecretory cells, Types of neurosecretory cells, Neuropeptides, Neurohormones, Neurotransmitters.

Unit II. Corpora Allata – Structure and development, Juvenile hormones, Chemistry, Synthesis, JH action, Receptors, JH titer regulation, Degradation, JH, Esterase, JH analogues, Anti-substances.

Unit III. Prothoracic glands-Structure, Development, Ecdysone, Chemistry, Synthesis Action, Receptors, Ecdysone titer regulation, Ovarian ecdysone, Testicular ecdysone, Phytoecdysone.

Unit IV. Endocrine control mechanisms of: - Embryonic development, Post-embryonic development, Metamorphosis, Reproduction, male and female, Metabolism, Diapause.

Unit IV. Applied endocrinology – IPM, Endocrine manipulations in Insect control, Insect growth regulators, Hormonal analogues, Agonists, Antagonists, Biotechnological approaches of hormones in insect pest control.

References:

- Insect Endocrinology-K.K.Nayar (1975)
 Insect Hormones – V.B. Wigglesworth
 Insect Hormones – V.J.A. Novak (1975)
 Insect neurohormones – Raabe(1982)
 Insect Neurochemistry and Neurophysiology- Borkovec and Gelman (1986)
 Juvenile Hormones – Gilbert
 Comparative Endocrinology of Invertebrates – Highnam & Hill (1969)
 Endocrinology of Insects - Downer and Laufer (1983)
 Comprehensive Insect Physiology, Biochemistry and Pharmacology Vol 7 and 8 – **Eds.** Kerkut and Gilbert (1985)
 Recent Advances in Insect Endocrine Research – **Eds.** Muraleedharan & Mariamma(1995)
 Agricultural Zoology Reviews Vol 5 – Ed. K. Evans (1992)
 Advances in Entomology – Eds. D. Muraleedharan, K. S.S.Nair, N.Mohandas, P.L. Tandon, M.S. Palaniswamy and Mariamma Jacob (2001)
 Insect Neuropeptides – **Eds.** J.J. Menn, T.J. Kelly and E.P. Masler (1991)
 Relevant Journals: Journal of Insect Physiology
 Insect Biochemistry and Molecular Biology
 Achieves of Insect Biochemistry and Physiology

Paper V. **Biodiversity, Conservation Biology**

Unit I. Biodiversity, deforestation, scope of the subject, methodology,
biodiversity, indices, systematic, IUCN, threatened categories of animals.
The Earth summit, Convention on biodiversity
Biodiversity hot spots, Economic evaluation of biodiversity

Unit II. Wildlife Habitat : Wildlife of Kerala, Wildlife of India

Unit III. Endangered wildlife of Kerala, Natural Habitat, Animal Habitat interactions,
Habitat requirements

Unit IV. Conservation Biology: Definition and scope, conservation initiative,
conservation of threatened species conservation of common species Ex situ
and in situ conservation

Unit V. Conservation convention and co-operations: International agencies(UNEP,
IUCN, WWF etc) National conventions, .International Conventions, Indian
Wildlife Act-Status and Prospects

References:

1. The Book of Indian Animals- prater S.H. Bombay Natural History Society, Bombay (1980)
2. A revised Survey of the Forest types of India- Champian & Seth (1938), Manager of publications, Government of India
3. Wildlife management Techniques- (Nataraj Publishers, Dehra Dun 1984
4. The Book of Indian Bids- Salim Ali, Bombay Natural History Society, Bombay (1971)
5. Biodiversity Implications for Global food security M.S. Swaminathan and S. Jara Mae Milton Pub. 1992
6. Manual of Wildlife Conservation-Teague, R.D. Nataraj Publishers Dehra Dun (1987)
7. Wildlife of India- Saharia V.B. Nataraj publishers, Dehra Dun (1985)
8. Conservation in Developing countries- (Eds) Daniel J.C. and Serrao J.S. Oxford University press (1990) Bombay
9. Environmental problems and prospects in India- M. Balakrishnan (Eds) 1993 Oxford & IBH, New Delhi
10. Tropical Ecosystems – A synthesis of Tropical Ecology and Conservation Biology- M. Balakrishnan et al (Eds) 1994 Oxford & IBH New Delhi
11. Conservation & economic evaluation of biodiversity vol. 1 & 11(1997) (eds) P. Pushpangadan, K. Ravi & V. Santhosh) Oxford IBH Publishing Co. NewDelhi
12. Hot spots of endemic plants of India, Nepal Bhutan M.P. Nagar (1996) TBG & RI, Palode, Trivandrum.
13. Global Biodiversity R.K. Sinha (1997) INA Shree Pub, New Delhi
14. Ecological diversity and its measurement Magurran A.E (1988) croon Heln, London
15. The diversity of Life E.O. Wilson 1992. The Belknap press of Harvard University,, Cambridge.
16. Biological Diversity M.A. Huaton 1994 Cambridge University press
17. Economics and Biological Diversity J.A. Mc Neely (1988) IUCN, Switzerland.

Paper VI. **Comparative Reproductive Physiology**

- Unit I.** Sex determination, Intersexuality, Sex reversal and sex differentiation.
- Unit II.** Reproductive Physiology, Reproductive cycles and Reproductive Diapause, Gametes, Capacitation, Fertilization, Parthenogenesis, Vitellogenesis, Hormones in Reproduction.
- Unit III.** Viviparity and related phenomena, Metamorphosis.
- Unit IV.** Environment and Reproduction, Role of environmental factors in Reproduction, Nutrition
- Unit V.** Sexual Behaviour, Courtship, Mating and Pheromones, Population control, Human and Pests.

References:

- Vertebrate Reproductive Physiology – Art van Tienhoven.
Invertebrate Reproduction – K.K. Nayar, Oxford IBH.
Insect Reproduction – F. Engelmann, Pergamon Press.
Marshall's Physiology of Reproduction -**Ed.** Parkes, Longmans.
Sex and Internal Secretion – Young, 3rd Edn, 2 volumes.
Sex Determination – Bacci, Pergamon Press
Sex Determination – Crew, Mathuen publications.
Comparative Endocrinology of Invertebrates – Highnam and Hill, Arnold

Paper VII. ENVIRONMENTAL ENDOCRINOLOGY

Unit 1 Definition and Scope:

Concept of environmental endocrinology, Environmental endocrinology as a unit of functional ecology-Importance and relevance. Endocrine as a chemical link.

Unit 2 Interaction with Environmental factors:

Role of environmental factors on the physiological systems of aquatic and terrestrial animals- temperature, photoperiodism, changes in geochemical factors on growth and survival of animals. Organization of components of ecosystem-population dynamics.

Unit 3 Environmental stress and endocrines:

Pattern of environmental interaction with endocrines and its physiology- endocrine disruptors, physical, chemical and biological factors on the function of various endocrine tissues xenobiotic biotransformation, hormonal control of detoxification, role of cytochrome P450

Unit 4 Mechanism of Environmental Adaptation:

Morphological and Physiological basis of stress adaptation, hormonal control of stress tolerance, molecular mechanism of stress adaptation in aquatic and terrestrial animals, stress resistance, stress avoidance.

Unit 5 Endocrine adaptation:

Impact of environmental stress on bioenergetics and ionoregulation of animals, environmental influence on acid – base balance and reproduction.

References.

- Fish physiology – Chapman & Hall , London, J.C. Rankin & F.B. Jensen, 1993.
 Fish Physiology, Vol, XII , Randall D. J , Academic Press 1997
 Introduction to cellular signal transduction. Ari. Sitaramaya Birkhauser, Boston (1999).
 Animal Physiology – Knut – Schmidt – Nielsen. Vth Edition , Cambridge University Press, 1997.