

**Ph.D. Programme in Animal Science
(W.E.F. 2019-2020)**



**Department of Animal Science
Kazi Nazrul University
Asansol-713340, West Bengal
India**

DOCTOR OF PHILOSOPHY (Ph.D.) IN ANIMAL SCIENCE

Summary of the Ph.D. coursework

	SEMESTER CREDITS		Total credits
	Theory	Practical	
Semester – I	8		8
Semester – II		4	4
Total	8	4	12

SEMESTER – I (CREDITS – 8)					
COURSE CODE	COURSE	DIVISION	CREDIT POINT	EXAM HOURS	FULL MARKS
PHDAS-101	Research Methodology	Theory	4	10+40	50
PHDAS-102	<u>Elective Paper (Any One)</u> 1. Endocrinology & Chronobiology 2. Molecular Parasitology & Immunology 3. Animal Genetics & Breeding 4. Molecular & Clinical Toxicology 5. Vector Biology & Vector Borne Diseases of Animals 6. Animal Biotechnology	Theory	4	10+40	50

SEMESTER – II (CREDITS – 4)					
COURSE CODE	COURSE	DIVISION	CREDIT POINT	EXAM HOURS	FULL MARKS
PHDAS-201	Review of Research Work	Practical	4	30+20	50

NOTES ON MARKS DISTRIBUTION:

1. In each course, 20% marks is allotted for Internal Assessment, i.e., 10 marks for a paper of 50 marks.
2. Marks distribution for each paper will be as follows: **Eight** questions (out of ten) of **1** mark each, **Eight** questions (out of ten) of **2**marks each and two question (out of four) of **8** marks are to be answered.

SEMESTER – I (CREDITS – 8)

PHDAS-101 (Research Methodology)

Total credit: 4

1. Microscopy and its Applications in Biology

Microscopy: Basic principles and applications of light and fluorescence microscopy, *in situ* hybridization and histology, confocal microscopy and applications of a confocal microscope, Electron microscopy.

2. Biophysical techniques

Spectroscopic techniques including UV-Visible, IR, Fluorescence Spectrophotometer, SPR, CD spectra etc. Mass spectrometry: Basic principles, MALDI-TOF, LC-MS. Chromatography and ultracentrifugation: Principle and applications in analytical and preparative separation, X-ray crystallography, Proteins crystallization and methods for determination of protein structure.

3. Basic Molecular Biology Techniques

Molecular cloning; PCR; Recombinant protein expression and purification; Western blotting; qRT-PCR; gene silencing by siRNA/shRNA; Gene knockout technologies.

4. Immunological Techniques

Immunoblots, ELISA, Flow cytometry analysis and sorting (demo included), Raising of antibodies against a protein/ peptide in rabbit/ mouse/ rat.

5. Bioinformatics and Biostatistics

Basics of sequence alignment, Phylogenetic analysis, Functional genomics including microarrays, Marker analysis, Single Nucleotide Polymorphisms, Next Generation Sequencing; Biostatistics.

6. Animal handling techniques

CPCSEA guidelines, Anaesthesia, Handling of *Drosophila*, Arthropod Pests & Parasites, Zebra-fish, Mice, Rat, Rabbit and Cattle.

7. Research and publication ethics

Concept of ethics, Ethics in scientific research, Scientific misconducts (Plagiarism, fabrication and falsification), Components in publication ethics (Authorship, conflict of interest)

PHDAS-102 (Any one Elective)

Total credit: 4

Elective 1: Endocrinology & Chronobiology

1. Comparative aspects of endocrine physiology in vertebrates. Evolution of pituitary gland; Physiological actions of hormones secreted from pituitary, adrenal and thyroid gland.

2. Milestones in clock research; Chronobiology in 21st century; Evolution of biological timing system; Clocks, genes and evolution. Biological Rhythms - Ultradian, Tidal/ Lunar, Circadian and Circannual rhythms.
3. Melatonin: Input or output signal of the clock system; Molecular Biology of the circadian pacemaker system: Experiments in the generation of models for the feedback loop comprising the clock, Pre-molecular genetics era, Generic core circadian feedback loop; Molecular clockworks in Fish and Mammal.
4. Photoreception and photo-transduction; The physiological clock and measurement of day length; Role of photic and non-photoc cues in seasonality. Human health and diseases - Chronodisruption.

Suggested readings:

1. *Comparative Vertebrate Endocrinology*, Bentley, P. J., Cambridge University Press, UK
2. *Vertebrate Endocrinology*, Norris D.O., Elsevier Academic Press,
3. *Hand Book of Physiology*, American Physiological Society, Oxford University Press, Section 7: Multiple volumes set
4. *Chronobiology Biological Timekeeping*: Jay. C. Dunlap, Jennifer. J. Loros, Patricia J. DeCoursey (ed). 2004, Sinauer Associates, Inc. Publishers, Sunderland, MA, USA
5. *Biological Rhythms*: Vinod Kumar (ed 2002) Narosa Publishing House, Delhi/ Springer-Verlag, Germany

Elective 2: Molecular Parasitology & Immunology

1. Parasitic association, Host-parasite interactions, Effect of parasitism on the host, Sources of parasitic infections.
2. Life cycle, mechanism of pathogenesis and drug development against protozoa (*Entamoeba*, *Plasmodium*, *Leishmania*), *Schistosoma*, Intestinal Tapeworms and Extra-intestinal Tapeworm, Filarial nematodes.
3. Cells and organs involved in immune system, Innate immunity, Anatomical barriers, Physiochemical mediators and cell types of innate immunity, Innate receptors (TLR, Scavenger receptor etc.), Signal transduction pathways in activation of innate immunity. Immunoglobulins- structure classes and subclasses. Generation of Antibody Diversity and Gene rearrangement class switching.
4. Different types of serological tests (Precipitation, Agglutination, Immunofluorescence, RIA, ELISA, Flowcytometry). Vaccines for bacterial, viral, protozoal and parasitic infections.

Suggested readings:

1. *Human parasitology* - Burton J Bogtish.
2. *General parasitology* - Thomas C Cheng
3. *Medical parasitology* - Markell and Voges
4. *Foundation of parasitology* - Roberts Janovy
5. *Immunology* - Kuby (Free man publication)
6. *Immunology and immunotechnology* - Ashim k. Chakravarty (Oxford university Press)
7. *Essentials of immunology* by Roitt (Blackwell scientific publication)
8. **Online resources:** Worm base, Pubmed, International Journal of Parasitology, Journal of Parasitology, Molecular and Biochemical Parasitology, Journal of Infectious diseases, Trends in Parasitology, Journal of Immunology, Immunity, Nature, Cell, Science etc.

Elective 3: Animal Breeding & Genetics

1. Molecular markers and their application; RFLP, RAPD, Microsatellite/ Minisatellite markers, SNP marker, DNA fingerprinting. Genomic selection.
2. DNA sequencing, Genome sequencing, Genomic Library, Polymerase Chain Reaction (PCR), its types (PCR-RFLP, AS-PCR etc.) and applications; Transgenesis and methods of gene transfer.
3. Fundamental theorem of natural selection. Artificial selection/ Selective breeding: Multistage, Restricted and retrospective selection indices. Development of specialized sire and dam lines; inbred lines and their maintenance; inbreeding and hybridization.
4. Heterosis. General combining ability, Specific combining ability and reciprocal effects; Utilization of non-additive genetic variance. Crossbreeding systems – crossbreeding effects; recurrent and reciprocal recurrent selection and their forms.

Suggested readings:

1. Akano IE 1992. *DNA Technology*. IAP Academic Press.
2. Micklos DA, Fryer GA & Crotty DA. 2003. *DNA Science*. Cold Spring Harbour.
3. Setlow JK. 2006. *Genetic Engineering – Principles and Methods*. Springer.
4. Falconer DS & Mackay TFC. 1996. *An Introduction to Quantitative Genetics*. Longman.
5. Jain JP. 1982. *Statistical Techniques in Quantitative Genetics*. Tata McGrawHill.
6. Tomar SS 1996. *Text Book of Population Genetics*. Vol. I. *Qualitative Inheritance*; Vol. II. *Quantitative Inheritance*. Universal Publ.

Elective 4: Molecular & Clinical Toxicology

1. Toxicity tests, Dose, dosage and dose response, Methods of toxicity testing: Bioassays, Acute and Chronic toxicity tests and their importance, Lethal dose and lethal concentration, Threshold limitations: Hormesis, Lower dose extrapolation.
2. Pesticides - Classification and mode of action, Effects in Non-targets and environment, Mechanism of action and metabolism of common groups of pesticides: Organophosphate, Organochlorine, Carbamates and Pyrethroids.
3. Study of toxic impacts of common drugs: Paracetamol, Aspirin, Acetaminophen, Thalidomide. Biotransformation and Metabolism of drugs. Factors affecting toxicity and metabolism of drugs. Impacts of drug toxicity on Lungs, Liver and Kidneys.
4. Case history and Toxicity of Lead, Arsenic and Cadmium, Metal chelation, Importance and scopes of Toxicology in Forensic and Clinical science.

Suggested readings:

1. *Timbrell, J. (2002). Introduction to Toxicology, 3rd Ed., Taylor & Francis, London.*
2. *Walker, C. H., Hopkin, S. P., Sibly, R. M. & Peakall, D. B. (2000). Principles of Ecotoxicology, 2nd Ed. Taylor & Francis, London.*
3. *Duffus, J.H. & Worth H.G.J. (Ed.) (2006). Fundamental Toxicology. RSC publishing.*
Klaassen, C. D. (Ed.) (1996). Casarett & Daul's Toxicology: The Basic Science of Poisons. 5th ed. McGraw-Hill, New York.
4. *Plant, N. (2003). Molecular Toxicology, 1st Ed. Bios Scientific Publishers.*
Stine, K. E. & Brown, T. M. (2006). Principles of Toxicology. 2nd Ed. CRC, Taylor & Francis Group, New York.
5. *Lu, F. C. (1996). Basic Toxicology: Fundamentals, Target organs and Risk Assessment. 3rd ed. Taylor & Francis.*
6. *Pandey, K., Shukla, J. P. & Trivedi, S. P. (2005). Fundamentals of Toxicology, New Central Book Agency (P) Ltd. Kolkata.*
7. *De, A. K. (2000). Environmental chemistry. 4th ed. New Age International (P) Ltd. Publishers.*

Elective 5: Vector Biology and Vector Borne Disease of Animals

1. Equipments, Methods and Parameters to Study Vectors, Pests and Parasites; Arthropod Classification and Identification - Source and Methods; Molecular Phylogenetics/ DNA fingerprinting for Taxonomy and Phylogeny.
2. Management Strategies: Entomopathogenic Bacteria, Fungus and Nematode; Selection and Establishment of Predators in Biocontrol; Development of Phytochemicals for Biocontrol; Sterile Insect Technique; Insect Growth Regulator; Nanotechnology in Insect control;

- Insecticide Resistance and Strategies for its Management; Evaluation of Management Strategies.
3. Epidemiology and Threat of Vector Born Diseases – Globally and in India; Vector Born Diseases in Economically Important Animals; An Account of the Arthropods affecting Animals; Biology and Management of Some Important Vectors and Parasites; Insect Vectors of Plant Pathogens.
 4. Major Parasite and Pathogen Groups Causing Diseases to Animals; Culture, Maintenance and Preservation of Microbes in Laboratory; Preliminary Tests for Developing New Drugs in Microbiology; Biotechnology in Entomology, Parasitology and Microbiology.

Suggested readings:

1. *Imm's general textbook of Entomology (Vol II): Richards & Davies, 1977.*
2. *Medical Entomology: Hati, 1979.*
3. *Biological and Environmental Control of Disease Vectors: Cameron & Lorenz (Eds.), 2013.*
4. *Medical and Veterinary Entomology: Mullen & Durden (Eds.), 2019.*
5. *Diseases of Mites and Ticks: Bruin & Geest, 2009.*
6. *General Parasitology: Cheng, 2005*
7. *Veterinary Parasitology: Taylor, Coop & Wall, 2016.*
8. *Microbiology – Principles and Explorations: Black & Black, 2015.*
9. *Helminths, arthropods and Protozoa of Domesticated Animals: Soulsby, 2012.*
10. *Veterinary Parasitology: Taylor, Coop & Wall, 2016*
11. *Textbook of Veterinary parasitology: Bhatia, Pathak & Juyal, 2016*

Elective 6: Animal Biotechnology

1. **Animal Cell Culture:** Introduction to basic tissue culture techniques; chemically defined and serum free media; animal cell culture, their maintenance and preservation; various types of cultures suspension cultures, continuous flow cultures, immobilized cultures; somatic cell fusion; cell cultures as a source of valuable products; organ cultures.
2. **Animal Diseases and their diagnosis:** Bacterial and viral diseases in animals; monoclonal antibodies and their use in diagnosis; molecular diagnostic techniques like PCR, in-situ hybridization; northern and southern blotting; RFLP.
3. **Therapy of animal diseases:** Recombinant cytokines and their use in the treatment of animal infections; monoclonal antibodies in therapy; vaccines and their applications in animal infections; gene therapy for animal diseases.

4. **Micromanipulation of embryo's:** What is micromanipulation technology; equipments used in micromanipulation; enrichment of x and y bearing sperms from semen samples of animals; artificial insemination and germ cell manipulations; in vitro fertilization and embryo transfer; micromanipulation technology and breeding of farm animals.
5. **Transgenic animals:** Concepts of transgenic animal technology; strategies for the production of transgenic animals and their importance in biotechnology; stem cell cultures in the production of transgenic animals.

Suggested readings:

1. *Animal Biotechnology. Ranga M.M. Agrobios India Limited, 2002*
2. *Text Book of Animal Biotechnology. Ramadass P, Meera Rani S. Akshara Printers, 1997.*
3. *Masters J.R.W. Animal Cell Culture: Practical Approach. Oxford University Press. 2000*
4. *Suggested Readings Lewin B. 2008. Gene IX.*
5. *Jones & Bartlett. Primrose SB. 2001. Molecular Biotechnology. Panima.*
6. *Twyman RM. 2003. Advanced Molecular Biology. Bios Scientific.*

SEMESTER – II (CREDITS – 4)

PHDAS-201 (Review of Research Work)

Students have to work on any of their topic of research interest on which they are required to make a comprehensive review and submit to the department. The review work will be evaluated by the members of BRS, Department of Animal Science.