



**Ph.D. Zoology, (Course Work) Syllabus, 2019**

**Paper-I (CORE COURSE -I) RESEARCH METHODOLOGY**

Paper Code:	<b>PHZY101CCT</b>	Semester Exam:	<b>70 Marks</b>
Instruction:	<b>4 h / week</b>	Duration:	<b>3 hours</b>
Credits:	<b>4</b>	Internal Assessment:	<b>30 Marks</b>

**Unit I: Scientific Literature Writing & Presentation Skills:**

- 1.1. Researching a scientific problem; defining aims & objectives, hypothesis generation, validation and interpretation of data.
- 1.2. Basic and applied research problems, translational approach.
- 1.3. Reading and critical analysis of scientific literature
- 1.4. Communicating research results in peer-reviewed journals.
- 1.5. Acknowledgement of contributions, authorship issues; IPR, Scientific ethics, plagiarism.
- 1.6. Communication skills (Poster and oral)
- 1.7. Review on a relevant research topic and presentation of the same in a seminar.

**Unit II: Experimental Research Design:**

- 2.1. Philosophy of Rene Descartes Measurement; sensitivity, accuracy, precision and specificity.
- 2.2. The limits and range of measurement in different systems.
- 2.3. Experimental design; single and double blind studies, placebo
- 2.4. Maintenance and storage of data, Concept of sampling, Cloud computing
- 2.5. Positive and negative controls, biological and technical replicates

**Unit III: Animal Experimentation:**

- 3.1. Animal handling and ethics
- 3.2. Maintenance of animals
- 3.3. Various routes of injections and sample collection
- 3.4. CPCSEA guidelines; Institutional ethics committees
- 3.5. Ethical consideration in research on human beings



**Unit IV: Laboratory Practices:**

- 4.1. Good laboratory practice; Safety and bio- and radio-hazards, disposal of biological and chemical wastes
- 4.2. Accuracy of liquid transfer
- 4.3. Preparation of Reagents, chemicals, buffers
- 4.4. General safety and precautions
- 4.5. Handling of Instruments in the CIF

**Text Books and References:**

1. A Hand Book of Methodology of Research, Rajammall, P. Devadoss and K. Kulandaivel, RMM Vidyalaya press, 1976.
2. Research Methodology Methods & Techniques, C.R. Kothari – New Age international Publishers, Reprint 2008.
3. Thesis and Assignment Writing, J. Anderson, Wiley Eastern Ltd., 1997.
4. Research Methodology, Mukul Gupta, Deepa Gupta – PHI Learning Private Ltd., New Delhi, 2011.
5. Fundamentals of Mathematical statistics, S.C. Gupta and V.K. Kapoor, Sultan Chand & Sons, New Delhi, 1999.
6. Statistical Methods , G.W. Snedecor and W.G. Cochrans, Iowa state University Press, 1967.



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**Paper-II (CORE COURSE -II)**

**TOOLS & TECHNIQUES IN RESEARCH**

Paper Code:	<b>PHZY104CCT</b>	Semester Exam:	<b>70 Marks</b>
Instruction:	<b>4 h / week</b>	Duration:	<b>3 hours</b>
Credits:	<b>4</b>	Internal Assessment:	<b>30 Marks</b>

**Unit I: Cell Culture and Molecular Biology Techniques:**

- 1.1. Cloning and sequencing of genes and genomics, PCR techniques
- 1.2. Microarray and gene expression
- 1.3. Metagenomics and Epigenomics
- 1.4. Gene targeting and its applications
- 1.5. Aseptic technique and preparation of media, Bacterial culture
- 1.6. Types of cell culture, Insect cell culture
- 1.7. Applications of cell culture

**Unit II: Image Analysis and Analytical Techniques**

- 2.1. Bright field; fluorescence; confocal
- 2.2. Image acquisition and analysis, SEM and TEM
- 2.3. Colorimetry; Spectrophotometry
- 2.4. Preparative Centrifugation Chromatography; GC; FPLC; HPLC
- 2.5. Electrophoresis; MALDI-TOF; LCMS (Mass spectrometry)
- 2.6. Immunological techniques, FACS, ELISA, IHC

**Unit III: Biostatistics & Bioinformatics:**

- 3.1. Databases, sequences, sequence alignment-pairwise/ multiple, global/ local protein family domain, sequence conservation.
- 3.2. Introduction to software used for proteomics data analysis
- 3.3. Basics of Biostatistics
- 3.4. Software related to statistical data analysis



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**Unit IV: Model System Organization:**

- 4.1. Pre-requisites of a model system; in vitro systems
- 4.2. Prokaryotic model organisms; Bacteria and Phages
- 4.3. Eukaryotic model organisms ; Yeast, *C. elegans* , *Drosophila*, *Xenopus*, Echinus, Zebra fish.

**Text Books and References:**

1. Research Methodology Methods & Techniques, C.R. Kothari – New Age international Publishers, Reprint 2008.
2. Thesis and Assignment Writing, J. Anderson, Wiley Eastern Ltd., 1997.
3. Research Methodology, Mukul Gupta, Deepa Gupta – PHI Learning Private Ltd., New Delhi, 2011.
4. Fundamentals of Mathematical statistics, S.C. Gupta and V.K. Kapoor, Sultan Chand & Sons, New Delhi, 1999.



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**Paper-III-A (Discipline Specific Course)**

**Immunology of Human Diseases**

Paper Code:	<b>PHZY105DST</b>	Semester Exam:	<b>70 Marks</b>
Instruction:	<b>4 h / week</b>	Duration:	<b>3 hours</b>
Credits:	<b>4</b>	Internal Assessment:	<b>30 Marks</b>

**UNIT-1: Basis of Human Disease**

- 1.1. Genetic basis of human diseases
- 1.2. Environmental basis of human diseases
- 1.3. Complex disorders
- 1.4. Epigenetics and human diseases
- 1.5. Molecular methods of disease diagnosis

**UNIT- 2: Basic Immunology**

- 2.1. Anatomy and histology of immune system
- 2.2. Humoral and Cell mediated immune responses.
- 2.3. Recognition and effector mechanisms of cell mediated and humeral immune responses
- 2.4. HLA and human diseases
- 2.5. Inflammation, Immune tolerance and autoimmunity

**UNIT-3: Immunology of Pregnancy and Infertility**

- 3.1. Immunology of Non-pregnant uterus
- 3.2. Immunology of oocyte growth and female immune response to seminal fluid
- 3.3. Peri-implantation of embryo development and immunology of implantation
- 3.4. Genetic disparity and Immunological Paradox of Pregnancy
- 3.5. Immunology of pregnancy related disorders with special emphasis on recurrent pregnancy loss (RPL) and infertility
- 3.6. Management strategies and therapeutic target of RPL

**UNIT-4: Lung immunology in health and disease**

- 4.1. Anatomy, Physiology and immunology of Lung
- 4.2. An overview of Respiratory disorders
- 4.3. Immunology and genetics of allergy
- 4.4. Pathophysiology of Asthma
- 4.5. Immunology of Asthma
- 4.6. Management and therapeutic targets of asthma



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**Paper-III (Discipline Specific Course) Cancer Biology**

Paper Code:	<b>PHZY106DST</b>	Semester Exam:	<b>70 Marks</b>
Instruction:	<b>4 h / week</b>	Duration:	<b>3 hours</b>
Credits:	<b>4</b>	Internal Assessment:	<b>30 Marks</b>

**Unit I: Basics of cancer:**

- 1.1. Cell Cycle and checkpoints
- 1.2. Characteristics of Cancer Cells, Hyperplasia and Neoplasia
- 1.3. Characteristics of Metastatic Cancer Cells
- 1.4. Types and Classification of Cancers
- 1.5. Causes of cancer, Carcinogens, Mutagens, and Oncogenic viruses

**Unit II: Cancer Genetics**

- 2.1. Oncogenes and Tumor Suppressors genes
- 2.2. pRb and Control of the Cell Cycle
- 2.3. p53 and Apoptosis: Master Guardian and Executioner
- 2.4. Cell Immortalization and Tumorigenesis
- 2.5. Multi-Step Tumorigenesis
- 2.6. Cytoplasmic Signaling Circuitry
- 2.7. Invasion and Metastasis

**Unit III: Management of the disease:**

- 3.1. Screening and diagnostic methods
- 3.2. Tumor Immunology & Immunotherapy
- 3.3. Rational Treatment of Cancer
- 3.4. Traditional chemotherapeutics and Radiotherapy
- 3.5. Stem Cells and Cancer
- 3.6. Vaccine
- 3.7. Future of cancer research

**Unit: IV: Cervical Cancer:**

- 4.1. Epidemiology and Natural history of cervical cancer
- 4.2. Premalignant Process; CIN



- 4.3. Symptoms and Risk factors
- 4.4. Role of HPV in development of cervical cancer
- 4.5. Cytological detection of cervical cancer, precancerous and cancerous lesions
- 4.6. Prevention and management strategies
- 4.7. Cervical cancer Vaccination

**Reference books:**

- \* Molecular Biology of Cancer: Mechanisms Targets and Therapeutics, 2nd"Edition by Lauren Pecorino. Oxford University Press. 2009.
- \* The Biology of Cancer by Robert Weinberg, Second edition, 2014
- \* The Biology of Cancer by Robert A Weinberg , Robert A. Weinberg, Garland Science; 1 edition (2006)
- \* Introduction to Cancer Biology by Robin Hesketh, Cambridge University Press. 2012.
- \* Cancer Biology by Roger J.B. King, Mike W. Robins. Benjamin Cummings; 3 edition, 2006.



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**Paper-III – C (Discipline Specific Course)**

**Aquatic Toxicology**

Paper Code:	<b>PHZY102DST</b>	Semester Exam:	<b>70 Marks</b>
Instruction:	<b>4 h / week</b>	Duration:	<b>3 hours</b>
Credits:	<b>4</b>	Internal Assessment:	<b>30 Marks</b>

**Unit I: Laboratory Management**

- Maintenance of Experimental fish
- Aquatic animal Handling and restrains
- Water quality criteria for fish
- Physical properties of water
- Chemical Analyses of water
- Feeding Methods
- Routes of doses and sample collection

**Unit II: Fish Physiology and Biochemistry**

- Water as a biological medium- Gas exchange; Osmoregulation; Excretion
- Fish immune system and important endocrine glands,
- Immuno-endocrine interactions
- Muscle physiology.
- Physiological response to environmental stress
- Stress hormones; stress adaptation and Stress protein.
- Biochemical indicators of Oxidative stress
- Xenobiotic metabolism in fish.
- Biomarkers in Aquatic animals.

**Unit III: Aquatic Animal Health**

- Principles of disease diagnosis in fish.
- Techniques in health management: Microbiological, haematological, histopathological, immunological and molecular techniques;
- Biochemical tests: Antibody and nucleic acid based diagnostics.
- Immunoparasitology.
- Stress protein
- Health management and Herbal immunostimulants
- Feed formulation and Preparation of artificial feeds.





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### Unit iv: Aquatic pollution

- Aquatic pollution-Classification of water pollution
- Biological effects of organic matter.
- Toxicity of Industrial effluents and Petroleum Hydrocarbons
- Pesticide types and categories.
- Bioaccumulation and Biomagnification
- Biotransformation of Xenobiotics in fish.
- Toxicity tests-Toxicant bioassay using fish
- Methods of Toxicological analysis

### **Reference Books**

- \* APHA, AWWA, WPCF. 1998. Standard Methods for the Examination of Water and Wastewater, 20th Ed. American Public Health Association, American Water Works Association, and Water Pollution Control Federation, Washington, D. C.
- \* ADCP (Aquaculture Development and Co-ordination Programme). 1980. Fish Feed Technology. ADCP/REP/80/11. FAO.
- \* Halver J & Hardy RW. 2002. Fish Nutrition. Academic Press.
- \* Carvalho GR & Pitcher TJ. (Eds.). 1995. Molecular Genetics in Fisheries. Chapman & Hall.
- \* Reddy PVGK, Ayyappan S, Thampy DM & Krishna G. 2005. Text book of Fish Genetics and Biotechnology. ICAR.
- \* Kanakaraj P. 2001. A Text Book on Animal Genetics. International Book Distributing Co.
- \* Iwama G & Nakanishi T. (Eds.). 1996. The Fish Immune System - Organism, Pathogen and Environment. Academic Press.
- \* Wedmeyer G, Meyer FP & Smith L. 1999. Environmental Stress and Fish Diseases. Narendra Publ. House.
- \* Hoar WS, Randall DJ & Donaldson EM. 1983. Fish Physiology. Vol. IX. Academic Press.
- \* Stumm W & Morgan JJ. 1996. Aquatic Chemistry: Chemical Equilibria and Rates in Natural Waters. John Wiley & Sons.
- \* Hoffman DJ. 1995. Handbook of Ecotoxicology. Lewis Publ.
- \* Kumar A. (Ed.). 2008. Aquatic Environment and Toxicology. Daya Publ. House.
- \* Mayer H. 1977. Aquatic Toxicology and Hazards Evaluation. ASTM Publ.
- \* Dhevendaran K. 2008. Aquatic Microbiology. Daya Publ. House.