# M.F.Sc & PhD Programs in Fish Pathology & Health Management -Syllabus

Indian Council of Agricultural Research New Delhi

MFSc & PhD Syllabus : Fish Pathology & Health Management

## COURSES

## M.F.Sc. (Fish Pathology & Health Management)

	CODE	COURSE TITLE	CREDITS
		MAJOR - CORE COURSES	
1.	FPH 501	Viral And Bacterial Diseases of Finfish and Shellfish	2+1
2.	FPH 502	Parasitic Diseases of Finfish and Shellfish	2+1
3.	FPH 503	Health Management in Aquaculture	2+1
4.	FPH 504	Systemic Fish Pathology	2+1
		MAJOR - OPTIONAL COURSES	
1.	FPH 505	Fish Immunology	1+1
2.	FPH 506	Microbiological Techniques	1+1
3.	FPH 507	Fish Virology and Cell Culture	1+1
4.	FPH 508	Clinical Pathology	1+1
5.	FPH 509	Non-infectious and Fungal Diseases	1+1

## PhD (Fish Pathology and Health Management) Major Courses

	Code	Course Title	Credits
		CORE COURSES	
1.	FPH 601	Fish and shellfish virology	2+1
2.	FPH 602	Advances in Parasitology and bacteriology	2+1
3.	FPH 603	Molecular mechanisms in disease process	2+1
		OPTIONAL COURSES	

1.	FPH 604	Aquatic Environment and Fish Health	2+1
2.	FPH 605	Fish Pharmacology	2+1
3.	FPH 606	Biotechnological Tools in Disease Diagnosis	1+1
4.	FPH 607	Case Studies	0+2

MFSc & PhD Syllabus : Fish Pathology & Health Management

## M.F.Sc. (Fish Pathology & Health Management) SYLLABUS MAJOR - CORE COURSES

## FPH 501 VIRAL AND BACTERIAL DISEASES OF FINFISH AND SHELLFISH

**Objective** To impart an exhaustive knowledge of viral and bacterial infections, their replication strategies and pathogenesis in fish and shellfish

## Theory

- Unit I Virology: General biology of viral infections, virus classification, virus replication. OIE Notifiable diseases
- Unit II Aetiology, pathogenesis, epidemiology, treatment and control, immunology and molecular biology of viruses/viral diseases of finfishes with emphasis on the following: Epizootic haematopoietic Necrosis (EHN), Infectious Haematopoietic Necrosis (IHN), Oncorhynchus masou Virus (OMV), Viral encephalopathy and retinopathy (VER), Spring Viraemia of Carp v(SVC), Viral Haemorrhagic Septicaemia (VHS),Lymphocystis and infectious pancreatic necrosis.
- Unit III Major viral pathogens of commercially important cultured crustaceans with special reference to shrimp and freshwater prawn: viral and bacterial; Biology, morphology, diagnostic methods, clinical signs and pathological changes associated with these pathogens; Viruses: WSSV, YHV, TSV,

IHHNV, MBV, HPV, BP, BMN, LOVV, GAV, mrNV;

- Unit IV Pathogenesis, virulence mechanisms, epidemiology, treatment and control measures of the bacterial diseases of finfish and shell fish with emphasis on: Furunculosis, Haemorrhagic septicemia, Columnaris disease, Tail and fin rot, Bacterial gill disease, Vibriosis, Mycobacteriosis, Nocardiosis, Haemophilosis, Edwardsiellosis, enteric red mouth.
- Unit V Bacterial diseases of shellfish such as Vibriosis; Necrotizing hepatopancreatitis, rickettsial diseases, mycobacteriosis.
- Practical Examination of moribund fish for viral and bacterial diseases; Sampling techniques, culture techniques, bioassay methods; Serological techniques in disease diagnosis, microbial identification
- Suggested 1. Roberts R J. 1989. Fish pathology 2<sup>nd</sup> edition. Bailliere Tindall London. 467 p.
   2. Stoskopf M K. 1993. Fish medicine. W B Saunders company Philadelphia. 882 p.
  - 3. Noga E J. 1996. Fish disease. Diagnosis and treatment. Mosby-Year book Inc., St. Louis, Missouri. 367 p.

2+1

- 4. Sindermann C J. 1990. Principal diseases of marine fish and shellfish Vol. I and Vol. II 2<sup>nd</sup> edition. Academic press, Inc. San Diego, California 521 p and 516 p.
- 5. Austin B and Austin D A. 1993. Bacterial fish pathogens. Disease in farmed and wild fish. 2<sup>nd</sup> edition. Ellis Horwood Limited, West Sussex, England. 384 p.
- 6. Inglis V, Roberts R J, Bromage N R. 1993. Bacterial diseases of fish. Blackwell Science limited Cambridge 312 p.
- 7. Wolf, K. 1988. Fish Viruses and Viral diseases Cornell University Press, Ithaca, New York.

## Journals 1. Journal of Fish Diseases

- 2. Aquaculture
- 3. Diseases of Aquatic Organisms
- 4. Journal of Aquatic Animal Health
- 5. Fish Pathology
- 6. Veterinary Record
- 7. Veterinary Research
- 8. Journal of Invertebrate Pathology
- Broad
  Research
  Areas
  1. Characterization of viral and bacterial etiological agents of fish and shellfish infections
  2. Prophylactic and therapeutic measures to control infectious diseases of fish and shellfish

## FPH 502PARASITIC DISEASES OF FINFISH AND SHELLFISH

2+1

**Objective** To comprehend the taxonomy, morphology and pathology of common parasites of aquatic organisms.

## Theory

- Unit I Parasite taxonomy and morphology: Protozoan and metazoan parasites of fish and shellfish
- Unit II Life cycle of fish and shellfish parasites
- Unit III Parasite pathology: Pathology, treatments and control of the disease caused by protozoan parasites: *Costia necatrix, Trypanosoma, Trypanoplasma, Ichthyophthirius,* Urceolariid ciliates, Microsporidians, Myxozoans
- Unit IV Parasite pathology : Pathology treatments and control of the disease caused by Metazoan parasites: Trematodes: *Dactylogyrus, Gyrodactylus, Diplozoan, Sanguinicola, Neascus*

*cuticola,* Cestodes : *Diphyllobothrium latum, Caryophyllaeus, Ligula*; Nematodes: *Capillaria, Camallanus* 

- Unit V Parasite pathology : Pathology treatments and control of disease caused by Acanthocephalan parasites, Crustacean parasites : *Lernea, Argulus, Ergasilus,* fish leeches, cestodes : *Diphyllobothrium latum, Caryophyllaus Ligula*; nematodes: *Lapillaria, Camallanus*
- Unit VI Shellfish parasites : Pathology, treatment and control of the disease caused by the Microsporidian, Haplosporidian, ciliates, cephaline gregarines
- Unit VII Biodeterioration of wood marine fouling and boring organisms, preventive measures.
- **Practical** Collection and identification of parasites; Preparation of permanent slides, micrometry and diagrams of parasites; Histopathological slide preparation for parasites; Processing for study of helminths and their larval stages, egg count; Examination of intermediate host for larval stages; Processing and study of the arthropods and their larval stages, staining and study of the protozoans Fixation and staining of protozoa, examination of biopsy material, examination of tissue sections for parasites.

Suggested	1.	Roberts R J. 1989. Fish pathology 2 <sup>nd</sup> edition. Bailliere Tindall London. 467 p.
Readings	2.	Stoskopf M K. 1993. Fish medicine. W B Saunders company Philadelphia. 882 p.
	3.	Noga E J. 1996. Fish disease. Diagnosis and treatment. Mosby-Year book Inc., St. Louis, Missouri. 367 p.
	4.	Sindermann C J. 1990. Principal diseases of marine fish and shellfish Vol. I and Vol. II 2 <sup>nd</sup> edition. Academic press, Inc. San Diego, California 521 p and 516 p.
	5.	Ferguson, H.W. (ed) 2006. Systemic Pathology of fish: a text and atlas of normal tissues in teleosts and their responses in disease. Second Edition, Scotian Press, London.
	6.	Rhode K. 2005 Marine Parasitology. Steven Simpson Books. 592p
Journals	1.	Journal of fish diseases
	2.	Aquaculture
	3.	Diseases of aquatic organisms
	4.	Journal of aquatic animal health
	5.	Fish pathology
	6.	Parasitology
	7.	International Journal for Parasitology
Ducad	1	Characterization of viral and hacterial etiological agents of fish and shellfish infections
Broad	1. 2	Dreak de stie end the respective measures to enstabling stiened diseases of fish and
Area	۷.	shellfish

**Objective** To teach essential principles aquatic animal health management and specific issues associated with the system.

## Theory

- Unit I Disease monitoring, surveillance, epidemiology, quarantine, certification and import risk analysis
- Unit II Prophylaxis, hygiene and therapy of fish and shellfish diseases
- Unit III Commonly used drugs/chemicals in aquaculture, drug delivery
- Unit IV Vaccines and vaccination, probiotics and bioremedial measures
- Unit V Application of health management protocols and biosecurity principles in aquaculture
- Unit VI Longterm strategy in health management; Advances in disease control and management; Principles of SPF/SPR. Biosecurity in aquaculture
- PracticalSampling procedures for disease investigation; methods of drug delivery; screening<br/>methods for biocontrol agents; case study
- Suggested 1. Stoskopf M K. 1993. Fish medicine. W B Saunders company Philadelphia. 882 p.
- Readings
- 1 1. Stoskopi w k. 1993. Fish medicine. W B Saunders company Philadelphia. 882 p
- Noga E J. 1996. Fish disease. Diagnosis and treatment. Mosby-Year book Inc., St. Louis, Missouri. 367 p.
  - 3. John Plumb 1999. Health Maintenance and Principal Microbial Diseases of Cultured Fishes. Second Edition. Blackwell Publishing 344p.
- Journals 1. Aquaculture
  - 2. Fish and shellfish Immunology
  - 3. Diseases of Aquatic Animal Health
  - 4. Aquaculture Research
  - 5. Asian Fisheries Science
  - 6. Fish Veterinary Journal
- Broad1. Epidemiology of specific diseasesResearch<br/>Area2. Therapeutic approaches for control of infections3. Development of vaccines and probiotics as prophylactics

#### FPH 504 SYSTEMIC FISH PATHOLOGY

**Objective** To understand the various systems of fishes and shrimps with specific reference to their pathological significance.

## Theory

- Unit I Introduction : Anatomy and physiology of teleost Integumentary, musculoskeletal, respiratory, circulatory, reticuloendothelial, renal, excretory and digestive systems
- Unit II Pathophysiology: Stress and general adaptation syndrome, inflammatory response, necrosis and types, stages
- Unit III Integumentary system : cuticular, epidermal dermal and hypodermal changes, hyperplasia and ulceration
- Unit IV Respiratory system : Lamellar oedema, lamellar hyperplasia and lamellar fusion
- Unit V Blood vascular system : Pathology of heart, vessels, blood composition, cellular components of blood and haemopoietic tissue
- Unit VI Digestive system : Digestive tract and its pathology; hepatic necrosis, lipid infiltration, hepatic granuloma, cirrhosis, pancreatic atrophy, neoplasia; epithelial sloughing of intestine.
- Unit VII Excretory system : kidney and its pathology, renal tubules and collecting ducts
- Unit VIII Nervous system : Pathology of brain, spinal cord, peripheral nerves, meninges, sense organs
- Unit IX Musculoskeletal and Endocrine system : Pathological changes in red and white muscle bone and cartilages. Endocrine systems and pathology
- Unit X Systemic pathology in shrimp : Integument, respiratory, digestive and nervous system and its pathology
- **Practical** Necropsy techniques, Systemic pathology of different organs and their identification

## **Suggested** 1. Roberts R J. 1989. Fish pathology 2<sup>nd</sup> edition. Bailliere Tindall London. 467 p.

- Readings
- 2. Noga E J. 1996. Fish disease. Diagnosis and treatment. Mosby-Year book Inc., St. Louis, Missouri. 367 p.
- 3. Sindermann C J. 1990. Principal diseases of marine fish and shellfish Vol. I and Vol. II 2<sup>nd</sup> edition. Academic press, Inc. San Diego, California 521 p and 516 p.
- 4. Ferguson, H.W. (ed) 2006. Systemic Pathology of fish: a text and atlas of normal tissues in teleosts and their responses in disease. Second Edition, Scotian Press, London.

## Journals 1. Fish pathology

- 2. Journal of Invertebrate Pathology
- 3. Journal of Fish Diseases
- 4. Diseases of aquatic organisms
- 5. Journal of aquatic animal health
- 6. The Veterinary Record
- 7. Bulletin of the European Association of Fish Pathologists

Broad	1. Histopathological investigations of specific disease conditions	
Research Area	2. Ultra structural changes in the specific tissues following infect	ions

## **MAJOR - OPTIONAL COURSES**

FPH 505	FISH IMMUNOLOGY 2+1
Objective	To teach basic principles of fish and shellfish immunology.
Theory	
Unit I	Introduction to fish immunology and terminologies; historical developments; Phylogeny of fish immune system
Unit II	Lymphoid tissues and cellular components of immune system
Unit III	Non specific humoral and cellular defence mechanisms
Unit IV	Specific defence mechanisms; Memory function and immunological tolerance;
Unit V	Complement system, function, components, complement activation
Unit VI	Antigens and antigenicity; structure of antibody. Types of antibodies Theories of antibody formation Antibody mediated immune response: general characteristics, immunoglobulin classes, structure and function and synthesis;
Unit VII	Phagocytic systems; Lymphoid systems; Antigen processing and major histocompatibility complex;
Unit VIII	Cell mediated immune response and its components; Hypersensitivity reactions;
Unit IX	Invertebrate defence mechanisms
Practical	Preparation of antigen; Raising of antibodies; Antigen-antibody reactions; Agglutination tests; Precipitation tests: gel diffusion; Immunoelectrophoresis, counter

FPH 507	MICROBIOLOGICAL TECHNIQUES 1+1	
Objective	To comprehend different microbiological techniques used in research.	
Theory		
Unit I	Techniques in sterilization; Preparation of media. Safety in microbiology laboratory, bio safety levels	<b>)</b> -
Unit II	Microscopy: bright field, fluorescence, phase contrast, dark field and electro microscope	n
Unit III	Stains, staining and its chemistry	
Unit IV	Isolation and culture of different types of bacteria; Techniques for identification biochemical, serological and molecular techniques	n:
Unit V	Techniques for isolation and identification of fungi; Basics of mycological and virologic techniques.	al

Practical Practical on microscopic techniques; Antibiotic sensitivity testing; Identification of microorganisms, anaerobic bacteria, mycological and virological techniques.

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## prophenoloxidase) Suggested 1. Iwama G and Nakanishi T. 1996. The Fish immune system. Organism, pathogen and Readings environment. Academic press, California 380 p 2. Janis Kuby. 1997 Immunology W H Freeman & Co (Sd); 3rd edition). 664 p 3. A E Ellis. 1988. Fish Vaccination Academic Press. 255p. Journals 1. Fish and shellfish Immunology 2. Diseases of Aquatic organisms 3. Developmental and Comparative Immunology

immunoelectrophoresis; Isolation of antibody from serum; ELISA; Western blotting; Isolation of lymphocytes and blastogenesis; Non-specific immune response (NBT and

Broad Host immune responses against candidate antigens, immunomodulation, inflammatory Research responses against specific stress factors, ontogeny of immune system, immunotolerance. Area

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- bio-
- tron
- tion:

Suggested Readings	1. Chakraborthy, P., 1995. A text book of microbiology. New Central Book Agency (P) Ltd.
	2. Criusted, J.1986. Methods in Microbiology, Academic press, London.
	3. Harry W.S.J.R., Paul, J. V. and John, J. L., 2000. Microbes in action. Freeman and Company,
	4. II (ICMSF). Academic Press, New York.
	5. James, M. 1978. Modern Food microbiology.2nd edition. D. Van Nostrand Company, N.Y.
	6. Michael, J. Pelizar, J. R., Chan, E. C. S., 1998. Microbiology. Tata McGraw Publishing Company, New York.
	7. Paul, J. H. 2001. Marine Microbiology- Methods in Microbiology, Vol 30. Academic Press.
	8. Publishing Company Ltd., New Delhi.
	9. Samuel, C. P. and Dunn C. G., 1959. Industrial microbiology, MC Grow Hill Book Company
	<ol> <li>Silliker, J.H., Elliof, R.P., Baired A.C. and Boyan, F.L., 1980. Microbial ecology of foods. Vol.II (ICMSF). Academic press, New york.</li> </ol>
	11. William, C. Frazier and Dennis C. Westhoff, 2000. Food microbiology. Tata Mc Graw Hill
Journals	1. Letters in Applied Microbiology
	2. Applied Bacteriology
	3. Journal of Applied Microbiology
	4. Microbiology
Broad Research Area	1. Isolation and identification of bacterial and fungal agents of infection
FPH 508	FISH VIROLOGY AND CELL CULTURE 1+1
Objective	To understand classification and structure of viruses and methods of their culture.
Theory	
Unit I	Virus taxonomy, viral structure, viral genetics
Unit II	Replication of viruses, host-virus interaction, viral vectors, bacteriophages, propagation of viruses
Unit III	Principles of cell culture, development of primary cell culture, maintenance of cell lines

- Unit IV Scaling up of cell culture, characterization and preservation of cell lines
- Unit V Hybridoma and monoclonal antibody production.
- PracticalVirus isolation techniques, virus propagation, viral quantitation, neutralization<br/>techniques, electron microscopy, cell culture characterization (counting, staining),<br/>karyotyping, cell culture preservation, viable cell counts, MTT assay

## **Suggested** 1. Roberts R J. 1989. Fish pathology 2<sup>nd</sup> edition. Bailliere Tindall London. 467 p.

Readings

Area

- 2. Alan Cann 2005 Molecular virology Academic Press 315 p
  - 3. Dimmock N Easton A and Leppard K. 2006 Introduction to Modern Virology. Sixth edn Blackwell publishing 536 p
  - 4. David M. Knipe, PhD; Peter M. Howley, MD; Diane E. Griffin, MD, PhD; Robert A. Lamb, PhD, ScD; Malcolm A. Martin, MD; Bernard Roizman, ScD; Stephen E. Straus, MD 2007. Fields Virology. 5th edn. Lippincott Williams & Wilkins 3177p
  - 5. Freshney I R. 1994. Culture of animal cells: A manual of basic technique 3<sup>rd</sup> edition. Wiley-Liss, Inc. New York. 486 p.
  - 6. Mothersill C and Austin B. 2000. Aquatic invertebrate cell culture. Springer Praxis, Chichester UK. 405 p.
  - Riji John K and Rosalind George M 2004. Finfish and shellfish diseases (Practical Manual). Dept. of Aquaculture, Fisheries College & Research Institute, TANUVAS, Thoothukkudi – 628008.
- **Journals** 1. Journal of Fish Diseases
  - 2. Diseases of Aquatic Organisms
  - 3. Journal of Aquatic Animal Health
  - 4. Veterinary Record
  - 5. Veterinary Research
  - 6. Journal of Invertebrate Pathology
  - 7. Methods in Cell Science
- Broad1.Characterisation of viral agents of infections, improved diagnostic methods includingResearchPCR, nucleic acid probes and monoclonal based techniques.
  - 2. Development and characterisation of fish cell lines.

## FPH 509 CLINICAL PATHOLOGY

**Objective** To teach methods in clinical pathology of aquatic organisms

## Theory

- Unit I Detailed study of normal and abnormal constituents of blood with reference to pathogenic condition
- Unit II Stress induced conditions in fishes and their pathology
- Unit III Physiological effects of stressors on fish, tolerance level (pH, ammonia, oxygen, temperature, handing stress, crowding, transportation, chemicals and bacterial toxins)
- Unit IV Cellular response to stress, response to some specific disease.

PracticalStudy of cellular components of blood: T.E.C., D.L.C., T.L.C., haemoglobin, total protein,<br/>glucose and other parameters, cholesterol, lipid profile, creatinine, urea and enzymes in<br/>blood during disease conditions

Suggested	1.	Roberts R J. 1989. Fish pathology 2 <sup>nd</sup> edition. Bailliere Tindall London. 467 p.
Readings	2.	Stoskopf M K. 1993. Fish medicine. W B Saunders company Philadelphia. 882 p.
	3.	Noga E J. 1996. Fish disease. Diagnosis and treatment. Mosby-Year book Inc., St. Louis, Missouri. 367 p.
	4.	Sindermann C J. 1990. Principal diseases of marine fish and shellfish Vol. I and Vol. II 2 <sup>nd</sup> edition. Academic press, Inc. San Diego, California 521 p and 516 p.
	5.	Ferguson, H.W. (ed) 2006. Systemic Pathology of fish: a text and atlas of normal tissues in teleosts and their responses in disease. Second Edition, Scotian Press, London.
Journals	1.	Journal of Fish Diseases
	2.	Diseases of Aquatic Organisms
	3.	Fish Pathology
	4.	Journal of Aquatic Animal Health
	5.	The Veterinary Record
	6.	Bulletin of the European Association of Fish Pathologists
Broad	1.	Biochemical changes of blood and enzyme parameters due to stress
kesearcn Area	2.	Stress induced physiological changes in fish

#### FPH 511 NON-INFECTIOUS AND FUNGAL DISEASES

**Objective** To comprehend the etiology and management of different non-infectious and fungal diseases.

## Theory

- Unit I Studies on the causes, pathogenesis, pathology, diagnosis and differential diagnosis of various diseases due to nutritional imbalance and avitaminosis, anorexia, mineral deficiency and toxicity
- Unit II Metabolic diseases in finfish and shellfish. Genetic diseases and neoplastic lesions
- Unit III Fungal diseases of finfish and shellfish- External and internal fungal infections.
- Unit IV Epizootic ulcerative syndrome (EUS) in fishes- Etiology, epidemiology, pathogenesis diagnosis and management.
- Unit V Fungal diseases of shellfish, larval mycosis, fusarium disease, Crayfish plague.
- **Practical** Study of gross and histopathological changes due to various metabolic diseases and nutritional disorders. Isolation of fungal pathogen.
- **Suggested** 1. Roberts R J. 1989. Fish pathology 2<sup>nd</sup> edition. Bailliere Tindall London. 467 p.
- **Readings** 2. Stoskopf M K. 1993. Fish medicine. W B Saunders company Philadelphia. 882 p.
  - 3. Chhorn Lim, Carl D. Webster 2001. Nutrition and Fish Health. Haworth Press 365p
- Journals 1. Journal of fish diseases
  - 2. Diseases of aquatic organisms
  - 3. Fish pathology
  - 4. Journal of aquatic animal health
- **Broad** 1. Nutritional diseases, pathological investigations following toxicity, genetic disorders.
- Research 2. Fungal infections, treatment, prophylaxis

## PhD (Fish Pathology and Health Management) – SYLLABUS Major - Core Courses

FPH 601	FIS	SH AND SHELLFISH VIROLOGY	2+1
Objective	То	learn the etiology and pathogenesis of common fish and shell fish viruses	
Theory			
Unit I	Mo IPN	olecular virology and pathogensis of selected viruses infecting fish and shellfi N, VHS, IHN, VHS.	ish such as
Unit II	No	odavirus infection of fish and freshwater prawns, WSSV, YHV	
Unit III	An	ntiviral drugs, viral vaccines, emerging viruses and evolution of new viruses	
Practical	Co inf	ellection and analysis of molecular information of various viruses using formation available on public domain	sequence
Suggested	1.	Roberts R J. 1989. Fish pathology 2 <sup>nd</sup> edition. Bailliere Tindall London. 467 p	
Readings	2.	Alan Cann 2005 Molecular virology Academic Press 315 p	
	3.	Dimmock N Easton A and Leppard K. 2006 Introduction to Modern Virology Blackwell publishing 536 p	. Sixth edn
	4.	David M. Knipe, PhD; Peter M. Howley, MD; Diane E. Griffin, MD, PhD; Lamb, PhD, ScD; Malcolm A. Martin, MD; Bernard Roizman, ScD; Stephen MD 2007. Fields Virology. 5th edn. Lippincott Williams & Wilkins 3177p	Robert A. E. Straus,
	5.	Freshney I R. 1994. Culture of animal cells: A manual of basic technique a Wiley-Liss, Inc. New York. 486 p.	3 <sup>rd</sup> edition.
	6.	Mothersill C and Austin B. 2000. Aquatic invertebrate cell culture. Spring Chichester UK. 405 p.	er –Praxis,
Journals	1.	Journal of Fish Diseases	
	2.	Aquaculture	
	3.	Diseases of Aquatic Organisms	
	4.	Journal of Aquatic Animal Health	
	5.	Fish Pathology	
	6.	Journal of Invertebrate Pathology	
Broad	1.	Identification and characterizarion of common fish and shellfish viruses.	
Research Area	2.	Development and characterisation of fish vaccines.	

FPH 602	ADVANCES IN PARASITOLOGY AND BACTERIOLOGY	2+1
Objective	To understand the pathobiology of parasitic and bacterial infection in fishes	
Theory		
Unit I	Environmental parasitology: macro-environmental and micro-environmental influparasite incidence; Host parasite interaction: pathological changes induced in ho parasitic infection;	uence on st due to
Unit II	Molecular parasitology; Parasite biochemistry; Evolution of parasites; Hyperpa Antiparasitic drugs applied in aquaculture and their action. Parasitic immunity	arasitism;
Unit III	(Content on bacteriology has to be included).	
Unit IV		
Unit V		
Practical	Isolation techniques of parasites. Molecular characterization of parasites. molecular probes for identification of parasites and tracking life stages of p (Content on bacteriology has to be included)	Use of parasites.
Suggested Readings	To be added	
Journals	To be added	
Broad Research Area	To be added	
FPH 603	MOLECULAR MECHANISMS IN DISEASE PROCESS	2+1
Objective	To understand the molecular mechanism of common diseases and methods for st them	tudying
Theory		
Unit I	Uptake of macromolecules by cells. Viral gene expression. Channelising the events to study the cell viability, cell proliferation, cell lineage.	e cellular
Unit II	Biological performance of each cell, i.e., changes in mitochondrial junction, mor Ca+ metabolism, vesicle trafficking; membrane transport system; protein dynamics and expression profile of each cell	rphology, molecule
Unit III	RNA interfering mechanisms	

Practical	FISH technique, TUNEL assay, MTT assay, NO assay, COMET assay to detect apoptosis.
	FRET and FRAP microscopy techniques

Suggested To be added Readings

Journals	To be added
Broad Research Area	To be added

FPH 604

## Major - Optional Courses

AQUATIC ENVIRONMENT AND FISH HEALTH

Objective	To comprehend the basic principles of aquatic animal health management relation to their environment
Theory	
Unit I	Environmental variables related to fish health; Water quality and sediment characteristics
Unit II	Nature and type of pollutants. Impact of pollutants on environment and fish health.
Unit III	Biological indicators and indices of water quality. Sanitation in aquaculture systems.
Unit IV	Algal blooms and environmental microflora. Microbial toxins.
Unit V	Probiotics and bioremedial measures. Nitrogen balance in aquatic ecosystem.
Practical	Estimation of major pollutants using spectrophotometry. Hematological, histoptathological and biochemical analysis of fish exposed to specific pollutants. Testing the efficacy of aquaculture sanitizers
Suggested Readings	<ol> <li>Thomas Braunbeck, David E. Hinton, Bruno Streit. 1998. Fish Ecotoxicology. Birkhäuser 406p</li> </ol>
	<ol> <li>Noga E J. 1996. Fish disease. Diagnosis and treatment. Mosby-Year book Inc., St. Louis, Missouri. 367 p.</li> </ol>
	<ol> <li>Gary A. Wedemeyer.1996. Physiology of Fish in Intensive Culture Systems. Springer 232p</li> </ol>
Journals	1. Aquaculture
	2. Aquaculture Research

1+1

- 3. Diseases of Aquatic Organisms
- 4. Journal of Aquatic Animal Health
- 5. Fishfish and Shellfish Immunology

Broad	1.	Stress	induced	changes	in	the	physiological	parameters,	effect	of	sublethal
Research		concentrations of pollutants in fish, elimination of toxic chemicals by fish									
Area	2.	Change	es in the b	lood chem	nistr	y follo	owing adverse	water quality			

3. Bioremediation measures to reduce pollution loads, Control of blooms and nitrogen pollution in ponds

## FPH 605 FISH PHARMACOLOGY

**Objective** To teach theoretical aspects of sea safety and disaster management, water warning signal and bad weather preparations

#### Theory

- Unit I Introduction to pharmacology, pharmacological terms and definitions, sources of drugs
- Unit II Principles of drug activity, pharmacokinetics. Absorption, distribution, biotransformation and excretion of drugs.
- Unit III Pharmacodynamics, concept of drug receptor, dose response relationship, half-life and withdrawal period, factors affecting drug effect and dosage, principles of drug safety in terms of species and environment.
- Unit IV Antibacterial agents, antiviral, antiparasitic, antiseptic and disinfectant. Fish anesthesia and anesthetics
- **Practical** Antibiogram preparations; Antibiotic residual assays; Studies on histopathololgical changes caused due to chemotherapy. Important anesthetics and their mode of action

## Suggested1.Richard D. Howland, Mary Julia Mycek, Richard A. Harvey, Pamela C. Champe 2005.ReadingsPharmacology. Lippincott Williams and Wilkins 552p

- 2. K.M. Treves Brown. 2000.Applied Fish Pharmacology. Aquaculture Series 3, Kluwer Academic Publishers. Dordrecht, The Netherlands. 309 p.
- 3. Stoskopf M K. 1993. Fish medicine. W B Saunders company Philadelphia. 882 p.
- 4. Noga E J. 1996. Fish disease. Diagnosis and treatment. Mosby-Year book Inc., St. Louis, Missouri. 367 p

1+1

## Journals 1. Diseases of Aquatic Organisms

- 2. Indian Journal of Pharmacology
- 3. Journal of Clinical Pharmacology
- 4. European Journal of Pharmacology
- **Broad** 1. Effect of chemicals, disinfectants, antibiotics in fish.
- Research<br/>Area2.Pharmacodynamics of drugs in fish, drug delivery systems, excretion of drugs, residual<br/>assays, herbal compounds as therapeutic drugs

## FPH 606BIOTECHNOLOGICAL TOOLS IN DISEASE DIAGNOSIS1+1

**Objective** To understand the principles and applications of different biotechnological tools used for disease diagnosis.

## Theory

- Unit I Advances in disease diagnostic procedures in aquaculture.
- Unit II Molecular diagnostic methods such as *in situ* hybridization nucleic acid probe-based diagnosis; Choice and characteristics of probe, Probe labelling
- Unit III Hybridization : hybridization strategies, factors affecting the rate of hybridization, Immobilization of nucleic acid on filters. Types of hybridization: Southern, Northern, Dot/Slot blot hybridization
- Unit IV Various types of polymerase chain reaction (PCR) such as conventional one step, nested and semi-nested PCR, RT-PCR, real-time PCR; LAMP
- Unit V DNA Microarrays : DNA chips, preparations of DNA arrays, label and applications; other related molecular techniques
- Unit VI Monclonal antibody-based diagnostics
- PracticalNucleic acid extraction, PCR detection of various pathogens. Monoclonal antibody-based<br/>diagnostic application. Protein profiling, DNA fingerprinting
- Suggested 1. Altman, A and Rita R . Colwell Agricultural Biotechnology CRC Press 770p
- Readings 2. Noga E J. 1996. Fish disease. Diagnosis and treatment. Mosby-Year book Inc., St. Louis, Missouri. 367 p.
- **Journals** 1. Fish and shellfish Immunology
  - 2. Diseases of Aquatic organisms

MFSc & PhD Syllabus : Fish Pathology & Health Management

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- 4. Fish Pathology
- 5. Asian Fisheries Science
- 6. Journal of General Virology
- 7. Trends in Biotechnology

Broad Research Area	Development of improved diagnostic techniques using molecular and immunological methods
FPH 607	CASE STUDIES 0+1
Objective	To acquire hands-on experience in conducing systematic disease investigation and comprehend essential steps in reporting.
Practical	
Unit I	A detailed investigation and reporting of five field cases. Project preparation presentation
Suggested Readings	To be added

and