MFSc Aquatic Animal Health- Course Curriculum at a Glance

A	**MAJOR COURSES**			**20 Credits**
	A1	**CORE COURSES**		12 Credits
1	AAH 501	Viral Diseases of Finfish and Shellfish	2+1	
2	AAH 502	Bacterial and Fungal Diseases of Finfish and Shellfish	2+1	
3	AAH 503	Parasitic Diseases of Finfish and Shellfish	2+1	
4	AAH 504	Finfish Pathology	1+1	
5	AAH 505	Shellfish Pathology	1+1	
	A2	**OPTIONAL COURSES**		8 Credits
1	AAH 506	Fish and Shellfish Immunology	2+1	
2	AAH 507	Disease diagnostic techniques	2+1	
3	AAH 508	Non-infectious Diseases and Disorders	1+1	
4	AAH 509	Principles of Aquatic Animal Health Management	2+0	
5	AAH 510	Principles of Pharmacology and Therapeutics	1+1	
B	**MINOR COURSES** (Courses outside major discipline / from other relevant disciplines)			**9 Credits**
C	**SUPPORTING COURSES** (Compulsory)			**5 Credits**
1	FST 501	Research Methodology	1+1	
2	FST 502	Statistical Methods	2+1	
		Total Course Work Credits		**34 Credits**
D	**MASTERS' SEMINAR**			**1 Credit**
1	AAH 591	Masters' Seminar I	0+1	
E	**FIELD TRAINING**			**2 credits**
1	AAH 551	Field Training / Internship	0+2	
F	**MASTERS' RESEARCH**			**20 Credits**
	AAH 599	Masters' Research (Semester III)	0+10	
	AAH 599	Masters' Research (Semester IV)	0+10	
		Total MFSc Program Credit Hours		**57 Credits**

AQUATIC ANIMAL HEALTH

Course Contents

AAH 501	**VIRAL DISEASES OF FINFISH AND SHELLFISH**	**2+1**
Objective	To impart an exhaustive knowledge of viral infections, their pathogenesis, epidemiology, treatment and control in fish and shellfish.	
Theory		
Unit I	Virology: General biology of viral infections, virus classification, virus replication.	
Unit II	Etiology, 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 (SVC), Viral Haemorrhagic Septicaemia (VHS), Lymphocystis, Koi herpes virus (KHV), Infectious Salmon anaemia, Salmonid alphavirus and Red seabream iridoviral disease.	
Unit III	Major viral pathogens of commercially important cultured crustaceans with special reference to shrimp and freshwater prawn: Aetiology, clinical signs, pathogenesis, diagnostic methods, epidemiology, treatment and control associated with these Viral pathogens: WSSV, YHV, TSV, IHHNV, MBV, HPV, BP, BMN, LSNV, GAV, MrNV & XSV, Infectious myonecrosis virus.	
Practical	Examination of moribund fish for viral diseases; Sampling techniques, virus isolation and replication, bioassay methods; Serological and molecular diagnostic techniques. Examination of shrimp and freshwater prawn for viral infection.	

AAH 502	**BACTERIAL AND FUNGAL DISEASES OF FINFISH AND SHELLFISH**	**2+1**
Objective	To impart knowledge of bacterial and fungal infections in fish and shellfish	
Theory		
Unit I	Aetiology, pathogenesis, virulence mechanisms, epidemiology, prophylaxis, treatment and control measures of Bacterial diseases of finfish with emphasis on Furunculosis, Aeromoniasis, Columnaris disease, Bacterial gill disease, Vibriosis, Mycobacteriosis, Nocardiosis, Haemophilosis, Edwardsiellosis, enteric red mouth, Pasteurellosis, Pisci rickettsiosis, Streptococcosis and Clostridium disease.	
Unit II	Bacterial diseases of shellfish such as Vibriosis, AHPND, Necrotizing	

	hepatopancreatitis, rickettsial diseases, mycobacteriosis.
Unit III	Fungal diseases of finfish viz Aphanomycosis, Cotton wool disease, Branchiomycosis, and Aspergillosis.
Unit IV Unit V	Fungal pathogens of shellfish viz Lagenidium, Sirolpidium, Fusarium. Epizootic ulcerative syndrome (EUS) in fishes- Etiology, epidemiology, pathogenesis diagnosis and management.
Practical	Examination of moribund fish for bacterial diseases; Sampling techniques, culture techniques, isolation and identification of bacterial pathogens; Identification of virulence factors. Serological and mmolecular diagnostic techniques. Isolation, culture and identification of fungal pathogens.

AAH 503	**PARASITIC DISEASES OF FINFISH AND SHELLFISH**	**2+1**
Objective	To comprehend the taxonomy, morphology, pathology and host-parasite relation of common parasites of aquatic organisms and to understand the significance of parasites in fish health.	
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*	
Unit VI	Shellfish parasites: Pathology, treatment and control of the disease caused by the Microsporidian, Haplosporidian, ciliates, cephaline gregarines.	
Unit VII	Host-parasite relation; Fish-borne parasitic zoonosis	
Practical	Collection and identification of parasites; Preparation of permanent slides, micrometry and diagrams of parasites; Histological slide preparation of parasite-infected tissues; Processing for study of helminths and their larval stages; Examination of intermediate host for larval stages; Processing and study of the arthropods and their larval stages; Fixation staining and study of the protozoans; Examination of biopsy material, examination of tissue sections for parasites.	

AAH 504	FINFISH PATHOLOGY	1+1
Objective	To understand the structural and functional changes in cells, tissues and organs in relation to the development of various finfish diseases.	
Theory		
Unit I	Introduction to general pathology, types of cellular adaptations: hypertrophy, hyperplasia, atrophy and metaplasia. Reversible cellular changes & accumulations: fatty changes & pigments. Cell death: necrosis, its mechanisms and different morphological patterns.	
Unit II	Inflammation: Causes, cellular responses to inflammation, mediators, various patterns of inflammation, difference between acute and chronic inflammation.	
Unit III	Normal constituents of blood, alterations in the haematological parameters and enzymes with reference to different pathological conditions.	
Unit IV	Pathology of brain, skin, gills, liver, spleen, Intestine, kidney and pancreas.	
Practical	Complete blood profile, necropsy techniques, complete histology and different staining techniques to examine and interpret the histopathological changes in fish tissues.	

AAH 505	SHELLFISH PATHOLOGY	1+1
Objective	To understand the anatomy and histology of crustaceans and molluscans; To understand the histopathological changes in various organs/tissues due to various diseases of crustaceans and molluscans; To appreciate the innate immune responses of shellfish.	
Theory		
Unit I	Brief introduction to crustacean and molluscan anatomy.	
Unit II	Normal histology of different organs/system of crustaceans and molluscans with special reference to penaeid shrimp and bivalve.	
Unit III	Major pathological changes due to various diseases in integumentary system, lymphoid organ, gill, hepatopancreas, gut and other organs/tissues	
Unit IV	Innate immune mechanisms of crustaceans.	
Practical	• Dissection of shrimp and bivalve and studying the anatomy. • Preparation of common fixatives used in shellfish histology. • Detailed study on normal histology of different organs/tissues. • Study of prepared histological materials of different diseases of crustaceans and molluscans. • Haematological techniques	

AAH 506	FISH AND SHELLFISH IMMUNOLOGY	2+1
Objective	To impart knowledge on basic principles of fish and shellfish immunology.	
Theory		
Unit I	Introduction to fish immunology and terminologies; historical developments; Phylogeny and ontogeny of immune system	
Unit II	Lymphoid tissues and cellular components of immune system, T and B cells	
Unit III	Non specific immune system: phagocytosis, Complement system: function, components, complement activation	
Unit IV	Specific defence mechanisms; Memory function and immunological tolerance	
Unit V	Antigens and antigenicity, antigen processing, super antigens, haptens	
Unit VI	Antibody: Structure, types, theories of antibody formation, regulation of immune response, antibody mediated immune response: polyclonal and monoclonal antibody production and application. Basic concept of aptamers, aptabodies and edible antibodies	
Unit VII	Immune genes and their regulation	
Unit VIII	Cell mediated immune response and its components; Hypersensitivity reactions; Auto-immune disorders	
Unit IX	Invertebrate defence mechanisms, quasi immune response	
Practical	Lysozyme assay in fish, Preparation of antigen; Raising of antibodies; serum separation, Antigen-antibody reactions; Agglutination tests; Precipitation tests: gel diffusion; ELISA; Antibody titration, Western blotting; Isolation of lymphocytes; Non-specific immune response (NBT assay and prophenoloxidase) in shrimps.	

AAH 507	DISEASE DIAGNOSTIC TECHNIQUES	2+1
Objective	To comprehend different disease diagnostic techniques	
Theory		
Unit I	Techniques in sterilization; Preparation of media. Microbiological techniques: Safety in microbiology laboratory, bio-safety levels	
Unit II	Microscopic techniques: bright field, phase contrast, dark field and fluorescence	
Unit III	Conventional diagnostic methods	
Unit IV	Protein-based diagnostic methods	
Unit V	Nucleic-acid based diagnostic methods	
Unit VI	Cell culture-based diagnostic methods	

Practical	Practical on microscopic techniques; Antibiotic sensitivity testing; Identification of microorganisms, anaerobic bacteria, mycological and virological techniques. Molecular techniques in disease diagnosis Serological techniques in disease diagnosis

AAH 508	**NON-INFECTIOUS DISEASES AND DISORDERS**	**1+1**
Objective	To comprehend the etiology and management of different non-infectious diseases.	
Theory		
Unit I	Studies on the causes, pathogenesis, pathology, diagnosis and differential diagnosis of various diseases due to nutritional imbalance and anorexia.	
Unit II	Vitamin deficiencies and mineral deficiencies and their toxicity.	
Unit III	Algal blooms, important mycotoxins & icthyotoxins and their effects on fish health.	
Practical	Study of gross and histopathological changes in different tissues inflicted due to various nutritional deficiency	

AAH 509	**PRINCIPLES OF AQUATIC ANIMAL HEALTH MANAGEMENT**	**2+0**
Objective	To understand the principles of aquatic animal health management, biosecurity and specific issues associated with the system.	
Theory		
Unit I	Introduction to various aspects of health management	
Unit II	Definition of health and disease	
Unit III	Disease monitoring, surveillance, epidemiology, quarantine, certification and risk analysis	
Unit IV	Devices to improve soil and water quality management Feed management and neutraceuticals	
Unit V	Management measures for pathogen: Therapeutics and sanitizers Management measures for environment: Bio-remediators, biocontrol agents	
Unit VI	Management measures for host: SPF, SPR, SPT, Vaccine, Probiotics, Immunomodulators	
Unit VII	BMP and biosecurity principles in aquaculture	

AAH 510	PRINCIPLES OF PHARMACOLOGY AND THERAPEUTICS	1+1
Objective	To learn the principles and protocols of therapeutics in aquaculture	
Theory		
Unit I	Basic principles of pharmacology Classification and action of antibiotics and other antimicrobials.	
Unit II	Antibiotic resistance and its impact on human health; drug dosages and their calculation. Accumulation of drugs in body tissues and their elimination	
Unit III	Therapeutics in aquaculture. Common therapeutants used in aquaculture their mode of action, dosage and mode of application. Alternative therapeutants. Residual effect and withdrawal period of various chemotherapeutants. Legislative framework of chemotherapy in aquaculture. Potential impacts of chemicals used in aquaculture.	
Practical	On-farm practical sampling sessions and case studies. Dose determination and application of therapeutants.	
Readings	1. Treves-Brown, K.M., 2000. Applied Fish Pharmacology. Kluwar Academic Publishers, 309 p 2. Lydia Brown (Ed). 1993. Aquaculture for Veterinarians. Pergamon Press; 447 p	