

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, IHNV, 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, Piscirickettsiosis, 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, Sirolopidium, 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 molecular 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: <i>Costia necatrix</i> , <i>Trypanosoma</i> , <i>Trypanoplasma</i> , <i>Ichthyophthirius</i> , Urceolariid ciliates, Microsporidians, Myxozoans | |
| Unit IV | Parasite pathology : Pathology treatments and control of the disease caused by Metazoan parasites: Trematodes: <i>Dactylogyrus</i> , <i>Gyrodactylus</i> , <i>Diplozoan</i> , <i>Sanguinicola</i> , <i>Neascus cuticola</i> , Cestodes : <i>Diphyllbothrium latum</i> , <i>Caryophyllaeus</i> , <i>Ligula</i> ; Nematodes: <i>Capillaria</i> , <i>Camallanus</i> | |
| Unit V | Parasite pathology: Pathology treatments and control of disease caused by Acanthocephalan parasites, Crustacean parasites: <i>Lernea</i> , <i>Argulus</i> , <i>Ergasilus</i> | |
| 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 molluscs; To understand the histopathological changes in various organs/tissues due to various diseases of crustaceans and molluscs; 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 molluscs 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 | <ul style="list-style-type: none"> • 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 molluscs. • 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 | <p>Practical on microscopic techniques; Antibiotic sensitivity testing; Identification of microorganisms, anaerobic bacteria, mycological and virological techniques.</p> <p>Molecular techniques in disease diagnosis</p> <p>Serological techniques in disease diagnosis</p> |
|------------------|---|

| | | |
|------------------|---|------------|
| 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 & ichthyotoxins 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 | <p>Devices to improve soil and water quality management</p> <p>Feed management and neutraceuticals</p> | |
| Unit V | <p>Management measures for pathogen: Therapeutics and sanitizers</p> <p>Management measures for environment: Bio-remediators, biocontrol agents</p> | |
| 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 | <ol style="list-style-type: none"> 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 | |