

Course descriptions for professional master's programs

1-Management of Aquaculture farms

Course code	Course Title	Course Description
111101	Fish farming technology	<ol style="list-style-type: none"> 1. Introduction of the history and current state of Aquaculture throughout the world. 2. Types of Aquaculture- extensive and intensive culture systems. 3. Tank and biofilter construction 4. Biofiltration and the nitrification process 5. Feeding and nutrition 6. Fish health management practices 7. The business of aquaculture
111102	Fish nutrition	Metabolism and nutritional requirements of fishes and other aquatic animals. Biochemical concepts of nutrient utilization will be discussed. Emphasis is on the differences between nutrient use and requirements of aquatic animals versus terrestrial ones. This course is needed by aquaculture students.
111103	Fish hatchery technology	An integration of the concepts of basic biology of aquaculture species and hatchery techniques will be presented. Current finfish hatchery practices will be presented in a physiological context and in a quantitative fashion. Development of new hatchery protocols adapted from active areas of aquaculture research. Hypophysation, mechanism of endocrine action on carp spawning, use of different synthetic hormones, their formulation and mechanism action. Formulation and operation of different types of hatcheries. Selection of spawners, preparation and administration of different hormones, breeding operation, Incubation, embryonic development
111104	Cultivation of shrimp	<ol style="list-style-type: none"> 1. Shrimp Culture Systems 2. Cultivable Penaeid Shrimp Species 3. Water Quality Management 4. Stocking Management 5. Shrimp Nutrition and Feed Management 6. Probiotics and Immunostimulants in Shrimp Aquaculture 7. Shrimp Raceways: Operation and Management 8. Diseases and Health Management 9. Biotechnological Applications in Shrimp Aquaculture Management 10. Scope for Genetic Improvements in Shrimp Aquaculture

<p>111105</p>	<p>Aquaculture engineering</p>	<p>Introduction to technical components of farm designing, future trends in aquaculture engineering. Aquaculture facilities: planning process, site selection and evaluation, design, components and construction of tanks, ponds, cages and hatcheries. Water intake and outlet systems- pipe line, water flow and head loss, pumps. Water treatment: Equipment used for water treatment, filters, ultraviolet light, ozone, heating and cooling and other processes of disinfection. Aeration and oxygenation: design and fabrication of aerators, oxygen injection system. Recirculation and water use system: definition, components and design. Instrumentation and monitoring: instruments for measuring water quality. Feeding systems: different types of feeding equipment, feed control systems, dynamic feeding systems. Adjustment of pH, removal of particles, Ammonia removal, Disinfection, heating and cooling equipment in hatcheries.</p>
<p>111106</p>	<p>Fundamentals of fish species cultivation</p>	<p>Aquaculture principles; Aquatic environment -water quality criteria; Species cultured in Egypt; Status of aquaculture in Egypt; Resource Assessment and economics of farming and ranching; Harvest and yield; Wildlife harvesting; Maximum Sustainable Yield (MSY); Recreational and commercial harvesting; Ranching and farming of wildlife.</p>
<p>111107</p>	<p>Fish diseases and parasites</p>	<p>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. Common parasites of freshwater and marine fishes, their morphology, biology/life cycle, host-parasite interaction including pathology, treatment and control of the diseases caused by the following parasites: Protozoan parasites :: Metazoan parasites, Diseases produced by trematode larvae; Nematodes; Acanthocephalan parasites Crustacean Parasites: Fish leaches: causative agents of diseases, vectors of disease; Parasitic diseases of shellfish</p>
<p>111109</p>	<p>Planning of fisheries projects</p>	<p>The National Plan. GNP and national income accounting Fisheries sector plan. Linkages between policies, plans and projects. Project approach to fisheries and formulation of projects. Resource management issues, technical issues, credit issues, organization and management issues, social and environmental issues. Measurement of the value of the projects, basic concepts of project appraisal, techniques of project appraisals; investment criterion, interrelationship\ between net present value, internal rate of return and benefit cost ratio;</p>

		financial and economic appraisal, monitoring and evaluation.
111111	Fisheries Legislation	Legislative jurisdiction over marine fisheries and aquaculture; Constitutional jurisdiction; private property, and public. Common property and open access rights over coastal fisheries and coastal zones. Legal and economic aspects of coastal zone management. Institutions for the implementation of fisheries and coastal zone management plans. aquaculture leases; duration, rent, renewal, assignability and transferability. Important provisions of the Land Reforms Act and its impact on aquaculture development. International negotiations and settlements over open seas and conflict management over deep sea resources.
111113	Processing of Fisheries products	Introduction to Seafood Processing – Assuring Quality and Safety of Seafood, Processing Technologies: Shellfish Handling and Primary Processing, Chilling and Freezing of Fish, Heat Processing of Fish, Irradiation of Fish and Seafood, Preservation of Fish by Curing, Drying of Fish, Fish Fermentation, Frozen Surimi and Surimi-based Products, Packaging of Fish and Fishery Products, Fish Processing Installations: Sustainable Operation. Seafood Quality Assessment. Microbiological Examination of Seafood. Assuring Safety of Seafood – Risk Assessment.
111114	Aquaculture water quality	Water Quality: Chemistry, Basic properties of Water, Important water chemistry parameters in intensive aquaculture, Nitrogen in Intensive Aquaculture, Measuring and Monitoring System Parameters, Integrating the RAS through water chemistry. Water Quality: Microbiology: Methods for studying microorganisms in nature /built system, Linking Water Chemistry to Microorganisms, Common Disease causing Microorganisms in Intensive Aquaculture, Microbiomes & Animal health, Emerging Research Directions in the Field including Aquaponics Considerations.
111115	Principals of Fisheries Biology	Ecology and ecosystems, Population growth and regulation, Marine ecosystems, Human impacts on marine ecosystems, Photosynthetic marine organisms, The flow of energy and material, Productivity and fisheries, Exploited species, Fishing and fishers, Fishing gear and methods, Stock structure and abundance, Stock assessment, Stock abundance and catches – dynamic production models , Including growth and mortality, Including different age classes, Simulation and ecosystem models, Fisheries management.
111117	Environmental and health hazards	Environmental Health issues, Environmental Health Literacy, The Environment at Risk, Environmental Epidemiology, Risk Assessment And Management, Environmental Risk Taking, Environmental Policy and Regulation, Zoonotic and Vector-Borne Diseases – Emerging Diseases, Environmental

		Toxicology, Toxic Metals and Elements, Pesticides and Other Organic Chemicals, Ionizing and Nonionizing Radiation, Water Quality, Air Quality, Food Safety – foodborne Illness, Solid and Liquid Wastes, Occupational Health
11118	Data analysis	Students will learn concepts, techniques and tools they need to deal with various facets of data science practice, including data collection and integration, exploratory data analysis, predictive modeling, descriptive modeling, data product creation, evaluation, and effective communication. The focus in the treatment of these topics will be on breadth, rather than depth, and emphasis will be placed on integration and synthesis of concepts and their application to solving problems. To make the learning contextual, real datasets from a variety of disciplines will be used.
11119	Feasibility study of fisheries project	Rationale for the development of a management plan, The present exploitation of the fish stocks, Socio-economic , Project component: Objectives, Scope of work, Ecological data, Catch statistics, Hydrology, Socio-economics, Training, Project staff, Reference group, Equipment. Time aspects. The project's relation to the policies. Institutional collaboration. International resource management. Budget and staff proposal.

2-Processing of Aquatic Products

Course code	Course Title	Course Description
112101	Advanced Food microbiology	<p>I. SURVIVAL: “Wanted Dead or Alive?”</p> <ul style="list-style-type: none"> •Enumeration of viable but non-culturable (VBNC) cells •Adaptations to stress: Biofilm formation and quorum sensing <p>II. TOOLS OF THE TRADE:</p> <ul style="list-style-type: none"> •Sampling strategies: Enrichment, Fecal coliforms •Molecular detection: PCR, QPCR, RT-PCR. •Molecular typing: MLST, PFGE, PCR-based methods, microarray <p>III. THE PATHOGENS:</p> <ul style="list-style-type: none"> •Enteric viruses: Norovirus update •<i>E. coli</i>: toxins and animal models •<i>Salmonella</i>: Environmental pathogens •Listeria: Intracellular pathogens •Campylobacter: Complex pathogens •Vibrio: Defining virulence <p>IV. EMERGING ISSUES:</p> <ul style="list-style-type: none"> •Genomics (including a genomics workshop) •Antibiotic resistance bacteria •Evolution of disease •Solutions: Intervention, vaccines, probiotics, genomics •Food Security
112102	Applied biochemistry	<p>Seafood Proteins: Sarcoplasmic Proteins: Classification, Enzymes, Hydrolases, Oxidoreductases, Other enzymes, Pigments, Heme Proteins, Myoglobin, Hemocyanins, Parvalbumins, Antifreeze proteins. Myofibrillar Proteins: Myosin - Isolation, Sub-unit composition, Stability, Gelation, Actin, Tropomyosin, Troponins, Paramyosin, Connectin. Collagen in fish muscle and skin: Location, connective tissue in the muscle, Characteristics of seafood collagen, Collagen on the quality of seafoods, gaping, Functional properties of seafood proteins: Solubility, emulsification, viscosity, water holding, gelation, Denaturation: By high and low temperatures and kinetics, dissociation/ aggregation/coagulation etc., reversibility, significance to processing and quality, Hydrolysis and hydrolysates: Process and applications, Nutritional evaluation</p>
112103	Seafoods processing technology	<p>Packing, storage and transportation. Introduction to freezing and chilling: Historical development; principles of chilling and freezing, methods of chilling; transportation and marketing of chilled and frozen fish. Freezing fish : Methods of freezing, changes during freezing fish; Packaging of frozen</p>

		fish; Fundamentals of fish preservation, drying, smoking, curing, salting, fermentation, marinating and pickles. Introduction to fish canning, principles of thermal processing, Fishery by-products : Fish meal, bone meal, fish oil, surgical sutures from intestine, chitin and chitosan; Fishery product packaging and packaging materials.
112104	Postharvest technology	Harvesting methods - drainable ponds, undrainable ponds, cage and raceway farms, handling and transport; principles and importance of fish preservation; preservation methods - traditional and advanced methods of fish preservation – sun drying, salt curing, pickling, smoking, chilling, freezing and canning.
112105	Quality control of fisheries products	Concept of quality in fish and fishery products. Determination of moisture content in fish and fishery products, Organoleptic analysis of fish and fishery products. Microbiological analysis of fish and fishery products. TPC and MPN of coliforms in sea food. <i>Salmonella</i> , <i>Vibrio</i> , <i>Staphylococcus</i> and <i>E. coli</i> in seafood. Quality standards for sea food. Concept of HACCP. Value added fishery products, fish curry, cutlets fish finger. Preparation of fishery by products.
112106	Packaging technology	Introduction to canning principle. Historical developments. Containers-can making materials and cans, characteristics of seam. Steps in canning-raw materials, preparatory treatments. Precooking, packing, exhausting, seaming, thermal processing, cooling and storage. Thermal processing – heat resistance of microorganisms, heat penetration, graphical method of formulation. Fo-value. Canning of commercially important fishes, shellfishes and other food products-salient features. Retort pouch packing – principles and techniques; HTST process and aseptic packing-principles and techniques spoilage of canned foods-types, causes and preventive measures. food packaging-objectives and requirements. Characteristics of various packaging materials – meats, paper and paper boards, corrugated fibre board, plastics, multi-layer lamination, testing of packaging materials and containers. Environmental aspects of food packaging.
112107	Biochemical analysis	General principles of separation of micro and macro molecules, selection of appropriate tools for analysis of fish samples. Outlines of common techniques involved in biochemical analysis. Centrifugation techniques: types of centrifugation, concept of Svedberg unit, analytical ultracentrifuge. Filtration technique: different types of filtration, types of filters and means of using them. Spectroscopic techniques: Principles, UV-Visible and IR spectroscopy, spectro-fluorimetry, flame photometry, atomic absorption spectrophotometry, ICP- AES, mass spectrometer. Electrophoretic techniques: General principles. Classification, Paper electrophoresis, Native and reduced PAGE, IEF,

		capillary electrophoresis, 2D Gel electrophoresis. Chromatographic Techniques : General principle, types of chromatography - adsorption, partition, ion-exchange, molecular sieve, affinity, Gas chromatography, thin layer chromatography. High performance Liquid chromatography, LC MS-MS: Theory and instrumentation
112108	Fish plants management	Plant design: Fundamentals of processing plant design: Site selection, design and preparation of layout of processing plants - freezing plant, cold storage, canning plant, dryers etc. Functions and construction of refrigeration system: Tests and inspection, Operation and handling, size and required power of compressor, maintenance of refrigerating machine, troubles and causes. Effluent treatment: Legislation and standards of effluent discharge, water pollution control measures in the food industry, waste water treatment process; dissolved air floatation, sedimentation, chemical treatment, biological treatment. Measurement techniques: Sensors. Instrumentation techniques, configuration of instrumentation system
112109	Water quality	WATER CHEMISTRY: Elements, radicals, and compounds Chemical water analysis -Hydrogen ion concentration and pH Chemical equilibria -Chemical kinetics Gas solubility - alkalinity Colloids and coagulation -Organic compounds -Organic matter in wastewater -Laboratory chemical analyses WATER MICROBIOLOGY: Bacteria and fungi -Viruses- Algae -Protozoa and multicellular animals -Aquatic food chain -Waterborne diseases -Coliform bacteria as indicator organisms - Tests for the coliform group Testing for enteric viruses-Biochemical oxygen demand Biological treatment systems. Quality of surface waters -Water quality in flowing waters Water quality in impounded waters -Groundwater quality- Water quality standards -Microbiological quality of drinking water -Chemical quality of drinking water
112110	Marine aquaculture technology	Scenario of shore-based aquaculture and sea farming in different parts of the world. Resources of marine species for shore-based aquaculture and sea farming in Egypt. Cultivable traits of important candidate species of fish and shellfish with notes on their biology, (sea bass, mullets, milkfish, groupers, snappers, tiger shrimp, white shrimp, mud crab, mussels, clams, oysters, seaweeds, etc.). Shore-based aquaculture systems – traditional, semi-intensive, intensive aquaculture practices of commercially important species. Sea farming practices of selected species, sea ranching.

112112	Hazard analysis and control points	International scenario in seafood inspection and quality control- HACCP and Good manufacturing practices. HACCP principles, practical aspects of planning and implementation, verification, validation and audit. HACCP based quality control systems. Hazard analysis, preparation of HACCP plan, implementation of HACCP based quality control systems.
112113	Sensory and organoleptic properties	Functional properties of seafood proteins: Solubility, emulsification, viscosity, water holding, gelation, texture profile analysis. Thermal properties of foods: Calorie, heat loss, heat gain, specific heat, Newton's laws of cooling, heat transfer, latent heat, laws of fusion, thermal conductors, thermal diffusivity. Fish as raw material for processing: Body structure, physical properties, shape, specific weight, bulk weight, angle of slip, weight composition. Changes in functional properties of proteins as affected by icing, freezing, drying, salting and heating. Evaluation of different functional properties like water absorption, fat absorption,, gelling, emulsification capacity and stability of fish/shell fish proteins.
112114	Cooling and freezing technology	Chilling and freezing of fish, Relationship between chilling and storage life, Relative spoilage rates, Modified-atmosphere packaging systems, Freezing: General aspects of freezing, Prediction of freezing times by numerical methods, Freezing systems, The application of freezing systems in fish processing, Freezing on board, Onshore processing, Changes in quality on chilled and frozen storage, Chilled storage, Frozen storage, Thawing, Use of cooling gels in fish transportation, Temperature control and legislation in fish transportation

3-Aquaculture Biotechnology:

Course code	Course Title	Course Description
112116	Principles of Molecular Biology	Genetic elements, DNA structure and replication, RNA structure and functions, gene expression and its regulation, mutations, gene transfer and recombination, Bacteriophages and their replication, viruses and their replication. Protein structure and function, post translational modifications of proteins, proteins localisation in cells. Organisation of prokaryotic and eukaryotic cells. Gene mapping and DNA sequencing, polymerase chain reactions (PCR) and DNA fingerprinting.
112117	Fish Genetics – advanced	Genetic Variation: DNA, RNA, genetic code, Protein structure. Genetic Structure in Natural Populations: stock, relationship between alleles and genotypes, population structure, genetic markers, Sex Reversal and Breeding, Biochemical and Molecular Markers, Conservation genetics, Genetic Considerations in the Hatchery, Artificial Selection in the Hatchery: Qualitative traits, Quantitative traits, types of artificial selection, Setting up a breeding programme, Inbreeding, cross-breeding and hybridization. Genetic Engineering in Aquaculture: The DNA construct, Transgene delivery, Transgene integration, Detecting integration and expression of the transgene. Gene Expression, Isolation and Cloning. Genethics.
112118	Fish and Crustacean biology	Study of food and feeding habits of commercially important fish. Qualitative and Quantitative methods of analysis of stomach contents. Age and growth determination by direct and indirect methods. Reproductive biology – maturity stages, gonadosomatic index, pondoral index, fecundity, sex ratio and spawning. Eggs and larval stages and developmental biology of finfishes and shell fishes. Tagging and marking of finfish and shellfish.
112120	Biosafety of seafoods	Seafood safety: microbial hazards, chemical hazards. Seafood and Environmental Toxicant Exposures. Seafood Toxins: Fish Toxins, Other Poisonous Marine Animals, Shellfish Chemical Poisoning, Pathogens Transmitted by Seafood, Laboratory Methodology for Shellfish Toxins, Ciguatera Fish Poisoning, Tetrodotxin, Epidemiology of Seafood Poisoning, The Medical Management of Seafood Poisoning, Toxicology and Risk Assessment, Nutritional Toxicology, Food Additives, Analysis of Aquatic Contaminants, Agricultural Chemicals, Radioactivity in Food and Water, Food Irradiation, Drug Residues in Foods

		of Animal Origin, Migratory Chemicals from Food Containers and Preparation Utensils
112121	Practical skills in biotechnology	General Instruction and Laboratory Methods, Tools and Techniques in Biological Studies, Biotechnological techniques: Biochemistry, Enzymology, Electrophoresis, Microbiology, Cell Biology and Genetics, Molecular Biology, Tissue Culture Techniques, Tests.
112122	Genetically modified products	The Development of Biotechnology, Risks and Benefits of Agricultural Biotechnology, Biological Risk Assessment, Public Perception of Biotechnology, Risk Assessment and Contained Use of Genetically Modified Microorganisms, Safety in the Contained Use and the Environmental Release of Transgenic Crop Plants, Safety in the Contained Use and Release of Transgenic Animals and Recombinant Proteins, Safety Aspects of Aquatic Biotechnology, Applications of Transgenic Aquatic Macroorganisms, Applications of Products from Genetic Engineering in the Aqueous Environment, Release of Transgenic Aquatic Animals and Plants or Inanimate Products in the Aqueous Environment, Preventing or Controlling the Release of Transgenic Organisms
112124	Genetic improvement of aquatic organisms	History of Genetic Biotechnology in Aquaculture, Phenotypic Variation and Environmental Effects, Polyploidy, Gynogenesis, Androgenesis, Cloned Populations and Nuclear Transplantation, Sex Reversal and Breeding, Biochemical and Molecular Markers, Population Genetics and Interactions of Hatchery and Wild Fish, Gene Mapping, Quantitative Trait Locus Mapping, Gene Expression, Isolation and Cloning, Gene-transfer Technology, Combining Genetic Enhancement Programmes, Genotype–Environment Interactions, Environmental Risk of Aquatic Organisms from Genetic Biotechnology.
112125	Crustacean farming	Keys to the identification of penaeid and non-penaeid prawns and different species : Biology of two important freshwater prawns, Macrobrachium rosenbergii and M. malcolmsonii. Food and feeding, Age and growth migration, maturation and breeding; Natural seed availability and collection, brood stock management, selection of spawners, induced spawning of two commercially important species, larval rearing, operation of prawn hatchery, water quality management, feeding management, culture of live food organisms like artemia, rotifers and cladocerans, algal culture. Nursery rearing of post larvae. Culture of freshwater prawn : pond preparation and prestocking management, stocking, water quality management, supplementary feed

		and feeding, disease management, aeration, water exchange, harvesting, polyculture of prawn along with carps : Problems and prospects of freshwater prawn culture. Culture of other crustaceans. Important freshwater mussels toproduction of pearls, key to the identification of different pearl producing mussel species, principles of pearl formation, techniques of pearl production : Collection of mussel and preoperative culture, surgery, post operative care, harvesting, enhancing the rate of pearl formation: Structure and composition of pearl materials : Post harvest operations; Processing and value addition.
112126	Analysis of environmental hazards	THE LETHALITY OF THE VERY SMALL, Invisible to the Human Eye, Where the Small Things Are? Keeping Things Under Wraps: Levels of Biosafety, Tracking Diseases, Quarantine and Treatment, Biohazards in the Modern World: Biohazard Control around the World, Biohazard Accidents and Biohazard Incidents, The Rise of Worldwide Pathogens, Drug Resistance, Microbes on the Molecular Level, Microbes as Sets of Symptoms, The Ecology of Microbes: Patterns of Transmission, Microbes in the Environment, Controlling Microbes by Controlling Their Environment
112127	Environmental remediation	Environmental Pollution and Restoration: a Role for Bioremediation, Suspicious to Solutions: Characterizing Contaminated Land, Legal and Regulatory Frameworks for Bioremediation, Modeling Bioremediation of Contaminated Groundwater, Bioremediation of Contaminated Soils and Aquifers, Monitoring Bioremediation, Bioremediation of Marine Oil Spills, Bioremediation of Metals and Radionuclides, Preemptive Bioremediation: Applying Biotechnology for Clean Industrial Products and Processes.
112128	Aquatic Ecology	Hydrological cycle; physico-chemical properties of water; light in aquatic environment; physical limnology; biological activity in lakes; nutrient limitation; tropic interaction in lakes; characteristics of and material flow in streams and rivers; tides and estuarines; practical exercises included.
112129	Biotechnology of fish farming	Transgenic Fish: Issues and Applications, Application of PCR-DGGE Method in Determining origin of Fish, Bacterial Fish Diseases and Molecular Tools for Bacterial Fish Pathogens Detection, DNA Vaccines Application in Aquaculture, The Use of Probiotics in Aquaculture, Genetic Engineering in Aquaculture: Ecological and Ethical Implications
112130	Bioreactors	Microbiological and enzymatic processes in biotechnology. Classification of bioprocesses. Stoichiometry and kinetics of biotransformations. Types of bioreactors. Continuous and

		batch tank bioreactors. Design methods of tank bioreactors and their cascades. Analysis of bioreactor dynamics. Bubble reactors and fluidized bed reactors for aerobic processes. Enzymatic processes. Characteristics of membrane bioreactors. Design solutions of biochemical reactors: tank bioreactors, column bioreactors for aerobic processes, plate column and fluidized bed reactors, airlift reactors. Hollow-fibre bioreactors.
112131	Biological treatment of wastes	Wastewater Treatment, BOD Removal, Types of Biological Processes, Municipal Wastewater, Activated Sludge Process, Conventional (Plug Flow) Activated Sludge, Tapered Aeration, Step Feed Aeration, Contact Stabilization, Anaerobic Digestion, Liquids-Solids Separation, Solidification Techniques, Liquids/Solids Treatment Systems (LSTS), Soil Biofilters, Trickling Over Process, Basis for Biodegradation, Testing for Recalcitrance, Anaerobic Processes
112132	Fish and Crustacean diseases	Fin Fish and Shell fish Pathology and Management: Protozoan and Viral Disease: Causative agents, Symptoms, prophylaxis and histopathological studies of Protozoan and viral diseases of freshwater, brackish water and marine water fin fish and shell fishes and ornamental fishes. Bacterial and Fungal Disease: Causative agents, Symptoms, prophylaxis and histopathological studies of bacterial and fungal diseases of freshwater, brackish water and marine water fin fish and shell fishes and ornamental fishes. Bacterial diseases of shell fish. Disease Management: Principles of disease diagnosis, epidemiological and clinical diagnosis, microbiological and post mortem examination of fin fishes in fresh water, brackish water and marine water environment. Environmental impact of disease management. Aquaculture medicines and its importance in fisheries. Rules and regulation for use of aquaculture medicine.