B.Voc. AQUACULTURE

(ON-CAMPUS) (THREE YEAR) (2018-2019)

SCHEME OF EXAMINATIONS AND SYLLABUS

FIRST SEMESTER

SUB. CODE	PAPER TITLE	CREDIT	TOTAL CREDITS	TOTAL UNITS	TOTAL HOURS
BAQC 101	Biology of fishes	4	04	4	36
BAQC 102	Principles and Methods in Aquaculture	4	04	5	36
BAQC 103	Freshwater aquaculture	4	04	6	36
BAQP 104	Practical I (Covering course BAQC 101)	4	4		
BAQP 105	Practical II (Covering course BAQC 102)	4	4		
BAQP 106	Practical III (Covering course BAQC 103)	4	4		
BAQA 107	Apprenticeship/ training	6	6		
Total Credit			**30**		
SECOND SEMESTER					
BAQC 201	Brackishwater Aquaculture and Mariculture	4	04	4	36
BAQC 202	Hatchery Technology in Aquatic organisms	4	04	4	36
BAQC 203	Fishing Methods	4	04	4	36
BAQP 204	Practical IV (Covering course BAQC 201)	4	4		
BAQP 205	Practical V (Covering course BAQC 202)	4	4		
BAQP 206	Practical VI (Covering course BAQC 203)	4	4		
BAQA 207	Apprenticeship/ training	6	6		
Total Credit			**30**		
THIRD SEMESTER					
BAQC 301	Inland and marine Fisheries	4	04	6	54
BAQC 302	Bio-statistics and Computer Applications	4	04	6	54
BAQC 303	Aquaculture Nutrition	4	04		54
BAQP 304	Practical VII (Covering course BAQC 301)	4	4		

SUB. CODE	PAPER TITLE	CREDIT	TOTAL CREDITS	TOTAL UNITS	TOTAL HOURS
BAQP 305	Practical VIII (Covering course BAQC 302)	4	4		
BAQP 306	Practical IX (Covering course BAQC 303)	4	4		
BAQA 307	Apprenticeship/ training	6	6		
Total Credits			**30**		
FOURTH SEMESTER					
BAQC 401	Genetics and Biotechnology	4	04	6	54
BAQC 402	Pathology in Aquaculture	4	04	6	54
BAQC 403	Aquariculture	4	04	6	54
BAQP 404	Practical X (Covering course BAQC 401)	4	4		
BAQP 405	Practical XI (Covering course BAQC 402)	4	4		
BAQP 406	Practical XII (Covering course BAQC 403)	4	4		
BAQA 407	Apprenticeship/ training	6	6		
Total Credits			**30**		
FIFTH SEMESTER					
BAQC 501	Larval Nutrition and Culture of Fish Food Organisms	4	04	6	54
BAQC 502	Fishery Microbiology	4	04	6	54
BAQO 503 / BAQO504 / BAQO505	Open Course	4	04	6	54
BAQP 506	Practical XIII (Covering course BAQC 501)	4	4		
BAQP 507	Practical XIV (Covering course BAQC 502)	4	4		
BAQP 508	Practical XV (Covering course BAQO 503 / BAQO 504 / BAQO 505)	4	4		
BAQA 508	Apprenticeship/ training	6	6		
Total Credits			**30**		
SIXTH SEMESTER					

SUB. CODE	PAPER TITLE	CREDIT	TOTAL CREDITS	TOTAL UNITS	TOTAL HOURS
BAQC 601	Aquaculture management	4	04	6	54
BAQC 602	Aquaculture engineering	4	04	6	54
BAQC 603	Fisheries Economics and Extension	4	04	6	54
BAQE 604 / BAQE 605	Elective	3	03	3	72
BAQP 606	Practical XV (Covering course BAQC601)	4	4		
BAQP 607	Practical XVI (Covering course BAQC602)	4	4		
BAQP 608	Practical XVII (Covering course BAQC603)	4	4		
BAQPr 609	Project	10	10		
Total			**37**		
ALL SIX SEMESTER CREDITS			**187 credits**		

Open Course (Any One) in Fifth Semester

BAQO 503 - Ornamental Fish Culture

BAQO504 - Fish Preservation Techniques

BAQO505 - Value Added Fishery Products

Elective Course (Any One) in Sixth Semester

BAQE 604 - Feed and Animal Health

BAQE 605 - Post Harvest Technology

SYLLABUS
SEMESTER I
BAQC 101 : BIOLOGY OF FISHES

CORE-I
Total hours – 36
Credits – 4

Module 1: General Characteristics and Taxonomy of Fishes (6 Hrs.)

1.1. Principles of zoological classifications, binomial nomenclature and linear hierarchy.

Classification of commercially important fishes, crustaceans and molluscs.

1.1.1. General characters of fishes crustaceans and molluscs. Sense organs in fishes – organs ofsmell, taste buds, lateral line system. Ampullae of lorenzini etc. Sound production in fishes.

1.1.2. Specialized organs in fishes – electric organs, venom and toxins in fishes. Colouration and Bioluminescence in fishes.

1.1.3. Sense organs in crustaceans and molluscs. Buoyancy in fishes-swim bladder and mechanism of gas secretion.

Module 2: Feeding and Growth (6 Hrs.)

2.1. Feed and feeding habits – herbivores, carnivores and omnivores.

2.2. Feeding adaptations methods employed in the study of gut content analysis volumetric,gravimetric etc.. Age and growth – Techniques used in the study – use of scales and otoliths, length frequency analysis.

2.3. Length weight relationship.Equations used for deriving growth rates.

Module 3: Digestion, Respiration and Circulation (6 Hrs.)

3.1. Digestive system – General morphological feature of digestive system in fishes, Digestive system and process of digestion in prawn and mussel. (Type - Mullet, *P.monodon*, Fresh water Mussel).

3.2. Respiratory system – general description, aquatic respiration, respiratory gases, gaseous exchange, oxygen transport (Shark and Mullet).

3.3. Adaptations for air breathing in fishes. Respiration in crustaceans and mollusks Cardiovascular system – General features of heart and blood circulation, circulatory system and oxygen transport in fishes crustaceans and molluscs.

Module 4: Reproduction and Migration (6 Hrs.)

4.1. Reproduction – ovary and testes, structure, development of primary and secondary sexual . 4.2. Sexual dimorphism in fishes and crustaceans. Maturation and spawning in fishes, factors

affecting maturation and spawning.

4.3. Fecundity, condition factor, size at first maturity. Oviparous, viviparaous and ovoviviparous fishes.

4.4. Parental care and breeding migration in fishes and crustaceans. Biological clocks- diurnal, lunar, circadian and tidal rhythms. Migration in fishes –anadromous and catadromous, homing, instinct and orientation.

PRACTICAL : BAQP 104 : PRACTICAL I

RPRINCIPLES AND METHODS IN AQUACULTURE

CORE-II
Total hours - 36
Credits - 4

Module 1 Introduction (6hrs.)

1.1.1. History, definition, scope and significance of aquaculture, comparison of aquaculture with agriculture and commercial fisheries.

1.2. Different aquaculture systems. Aquaculture - Global and Indian Scenario.

Module 2: Pond Ecology (Hrs 6)

2.1. General concepts of ecology, productivity, carrying capacity, food chain and food web. Ecology of culture ponds.

2.2. Nutrient cycles -- Nitrogen Phosphorous and Carbon. Laws of limiting factor. Fertilizations and manuring.

2.3. Liming and application of fertilizers and manures, role of nutrients, the NPK contents of various fertilizers and manures, rate and precautions in the application of fertilizers and manures.

2.4. Significance and important groups of phytoplankton, zooplankton and benthos in culture ponds.

2.5. Nutrient dynamics, algal blooms. Selection of site, physico-chemical conditions of soil and water optimum for culture.

2.6. Management of water and soil quality parameters. Correction of pH, measures for increasing the concentration of oxygen and reducing the concentration of ammonia and hydrogen sulphide.

Module 3 …Types of ponds (6-hours)

3.1. Type of ponds – hatching, nursery, rearing, stocking and broodstocks – construction and management of culture system.

3.2. Size and depth of ponds, maintenance of ponds – positioning of different types of ponds in a fish farm.

Module 4…Cultivable Freshwater fishes (Hrs.6)

4.1. Criteria for the selection of species.

4.2. Cultivable freshwater fishes- carps, airbreathing fishes, tilapia, freshwater prawn.

Module 5…Brackishwater culture and mariculture (Hrs.6)

5.1. Brackishwater resources and fishes of commercial importance – Milk fish, mullet, pearl spot, seabass, shrimps, crabs; selection of site.

5.2. Major brackish water culture systems in India.

5.3. Different organisms in Mariculture – mussel, edible oyster, pearl oyster and sea weeds.

PRACTICAL : BAQP 105 : PRACTICAL II

BAQC 103 :FRESHWATER AQUACULTURE

CORE-III
Total hours - 36
Credits – 4

Module 1: Freshwater Fish Culture (Hrs 6)

1.1. Various freshwater organisms used for aquaculture in India.

1.2. Culture of carps- Nursery rearing and stocking ponds – composite fish culture, Preparation

of ponds– different methods for the eradication of weed fishes, predators, aquatic insects

and aquatic weeds, stocking and post stocking management, harvesting.

1.3. Culture of air breathing fishes- Channa, Heteropneustes, Clarius, Anabas. Culture of cold water fishes in India.

Module 2: Culture of Prawns, Molluscs and Frog (Hrs 6)

2.1. Cultivable species of freshwater prawns and their biology – culture of M*acrobrachium rosenbergii*.

2.2. Freshwater pearl culture – Present status of freshwater pearl culture and production in India.

Module 3: Aquaculture for stable environment (Hrs 6)

3.1. Sewage fed fish culture, sewage treatment,– Sewage cum fish culture in India.

3.2. Fish in relation to public health – Larvivores fishes and mosquito eradication using fishes.

Module 4 Reservoir fisheries (6Hrs)

4.1. Major reservoirs in India, measures for increasing production from reservoirs inIndia and abroad, Game fishery.

Module 5: Integrated Farming (Hrs- 6)

5.1. Recent development in integrated farming – Rice cum fish culture, Duck cum fish culture, Poultry cum fish culture and Pig cum fish culture.

5.2. Organic aquafarming. Fish culture in cages and pens. Running water fish culture.

Module 6 : Systems in freshwater Aquaculture (6 hrs)

6.1. Fish culture in cages and pens, race way, indoor tanks, canals, silo culture, Aquaponics.

6.2. Monoculture, polyculture, composite fish culture.

PRACTICAL : BAQP 106 : PRACTICAL III

SEMESTER – II

BAQC 201 :BRACKISHWATER AQUACULTURE AND MARICULTURE

CORE-IV

Total hours - 36

Credits – 4

Module 1: Introduction

1.1. Introduction, history, development and present status of brackishwater farming in India.
1.2. Brackishwater as a medium for aquaculture, ecological factors – abiotic and biotic factors.
1.3. Selection of site, general planning and design of brackish water farms.
1.4. Rafts, racks, cages, poles and ropes

Module 2: Brackishwater Finfish Culture

2.1. Selection of cultivable species in brackish water systems, their biology and culture practices – monoculture and polyculture of – *Chanos chanos, Mugil cephalus,Lates calcarifer***.**
2.2. Nursery, rearing and grow out in ponds, cages and pens.

Module 3: Crustacean Culture

3.1. Species of shrimps cultured in brackishwater and their biology – *Penaeus monodon, Penaeus indicus, Litopenaeus vannamei*.
3.2. Extensive, semi-intensive and intensiveshrimp farming practices.
3.3. Crab culture (*Scylla serrata*, *Scylla occeanica, Portunus spp* and *Charybdis* sp.): Pond design, management of crab farm, fattening process of crab, economics-cage culture and pen culture
3.4.

Module 4: Mariculture

4.1. Ecological subdivisions of the sea. Selection of site and selection of materials for sea farming.
4.2. Different designs of open sea farming structures – construction of cages – bioengineering problems and solutions – scope of open sea farming in India.
4.3. Important fin fishes cultured in the open seas and the culture systems. (Milk fish, Pearl spot and Mullets).
4.4. Present status and recent developments in mariculture.

PRACTICAL : BAQP 204 : PRACTICAL IV

BAQC 202 :HATCHERY TECHNOLOGY IN AQUATIC ORGANISMS

CORE-V
Total hours - 36
Credits – 4

Module 1: Carp Hatchery

1.1. Hatchery management-seed production of carps.
1.2. Hypophysation of Indian major carps and exotic carps, history of hypophysation. Pituitary gland. Collection and preservation of gland. Other ovulating agents.
1.3. Brood stock management, sexing, dosage for injection, mechanism of ovulation.
1.4. Development of carp eggs, different carp hatcheries. Nursery rearing of carp seed.

Module 2: Carp Production System and Seed production of other Fishes

2.1. Production of common carp seeds, breeding techniques. Sundanese, Tjimindi, Rantjapaku and Central Sumatra methods. Methods followed in China and India.
2.2. Transport of fish seed and brood fishes. Causes of mortality during transport, techniques of transport, open and closed systems, methods of transportation, use of anaesthetics.
2.3. Carp seed resources in major rivers. Bundh breeding, types of bundh breeding techniques. Problems of bundh breeding.
2.4. Seed production and nursery rearing of *Clarias batrachus*, *Mugil cephalus, Lates calcarifer*.

Module 3: Seed Production of Crustaceans and Molluscs

3.1. Seed production and nursery rearing of *Penaeus indicus, Penaeus monodon* and *Macrobrachium rosenbergii.*
3.2. Hatchery operations of pearl oysters, clams, crabs, lobster. Remote setting.

Module 4: Hatchery Management and Design of shrimp hatcheries

4.1. Components and general design of hatcheries.
4.2. Selection criteria for broodstock and brood stock management.
4.3. Water quality monitoring and management.
4.4. Quarantine and disease management in hatcheries.
4.5. Various components, equipments and infrastructure facilities required in hatchery.
4.6. Mechanical and biological filters.

PRACTICAL : BAQP 205 : PRACTICAL V

BAQC 203 : FISHING METHODS

CORE-VI
Total hours - 36
Credits – 4

Module 1: Fishing Crafts

1.1. Different types of fishing crafts in India- inland and marine– traditional, motorized and mechanized.
1.2. Recent statistics of each category- country crafts, trawlers, gill netters, purse seiners, long liners, trollers, deep sea vessels.
1.3. Boat building materials - wood, steel, FRP, ferro-cement, aluminum etc.

Module 2: Fishing Gears

2.1. Introduction, principle and evolution of fishing methods and gear.
2.2. Factors affecting the design of fishing gears and fish catching methods. Fishing accessories.
2.3. Introduction to netting materials - natural and synthetic fishing gear materials. Yarn numbering systems.

Module 3: Active Fishing Gears: Passive and Traditional Fishing Gears

3.1. Classification and description of modern fishing gears.- Design and operation of – trawls, purse seines, ring seines, beach / shore seine, boat seine, pole and line, squid jigs, trolling.

3.2. Design and operation of- gill nets, long lines, hooks, traps, stake net, dol net, chinese dip nets, cast nets.

3.3. Destructive and Prohibited fishing practices, fishing methods like electrical fishing, poisoning and use of dynamites.

Module 4: Fish Finding Devices and Conservation.

4.1. Introductory information on echo-sounder, sonar, net sonde, global positioning systems, remote sensing.

4.2. Potential fishing zones (EEZ) Turtle Exclusion Devices (TED) - By-catch Reduction Devices (BRD).

PRACTICAL : BAQP 206 : PRACTICAL VI

SEMESTER III

BAQC 301 :INLAND AND MARINE FISHERIES

CORE-VII

Total Hours-54

Credits – 4

Module 1: Riverine and Coldwater Fisheries (9 Hrs.)

1.1. Inland fish production in India- Riverine fisheries – major river systems in India, capturefisheries, fishing methods, recent statistics of catches, problems encountered in fisheriesdevelopment of major rivers.

1.2. Cold water fisheries- major rivers and species – problems encountered in fisheries development of rivers supporting cold water fisheries.

Module 2: Reservoir and Estuarine Fisheries (9 Hrs.)

2.1. Reservoir fisheries- Major reservoirs in India- capture fisheries, fishing methods, recent statistics of catches, problems encountered in fisheries.

2.2. Development Estuarine fisheries- definition and classification of estuaries- capture fisheries- resident and migrant species.

2.3. Fishing methods, recent statistics of catches, problems encountered in fisheries development of major estuaries.

Module 3: Marine Fisheries- Pelagic Resources (9 Hrs.)

3.1. Marine fishery resources in India- important fishing zones including Wadge bank, maritime states.

3.2. Major pelagic resource groups– sardines, mackerel, anchovies, ribbon fishes, tuna, seer fishes.

3.3. Methods of fishing - Recent catch statistics of pelagic fisheries.

Module 4: Marine Fisheries- Demersal Resources (9 Hrs.)

4.1. Major demersal resource groups- elasmobranchs, cephalopods, silver bellies, flat fishes, crabs, sciaenids, pomfrets, bombay duck, prawns, lobsters, molluscan resources.

4.2. Methods of fishing, recent catch statistics. Fishery of mud banks.

Module 5: Marine Fisheries - Deep Sea Resources (9 Hrs.)

5.1. Major deep sea resources - fishes, shrimps, lobsters – status of deep sea fishing in India.

5.2. Chartered fishing in India- policies and problems.

5.3. Marine fish production in India. - Estimated fishery resources – inshore – offshore - deep sea resource. Fishing regulations.

Module 6: Fishery Assessment and Regulations (9 Hrs.)

6.1. Stratified random sampling for estimation of fish landing.

6.2. Over fishing – Economic and biological, Conservation and regulation of fishing pressure - closed season, mesh size regulations, sanctuaries.

6.3. Important fishing regulations KMFR, Deep Sea Fishing Policy.

PRACTICAL : BAQP 304 : PRACTICAL VII

BAQC 302 :BIO-STATISTICS AND COMPUTER APPLICATIONS

CORE-VIII
Total Hours-54
Credits – 4

Module 1: Basic Statistics (9 Hrs)

1.1. Origin, growth, meaning, definition and use of statistics.
1.2. Methods of data collection. Biological data collection.
1.3. Sampling methods. Biological sampling.
1.4. Frequency distribution, tabulation and diagrammatic representation of data.

Module 2: Measures of central tendency (9hours)

2.1. Arithmetic mean, median, mode, quartiles, geometric mean and harmonic mean.

2.2. Measures of dispersion and its application.

2.3. Skewness and kurtosis. Definition, derivation and application of regression and correlation.

Module 3: Statistical Tests (9 Hrs)

3.1. Application and use of least square method. Application of probability.

3.2. Permutation and combination. Distribution- normal, binomial and poisson.

3.3. Testing of hypothesis. Chi-square test, t test, f-test, Z- test.

3.4. Degrees of freedom, test of goodness of fit, test of independence. Analysis of Variance.

Module 4: Computer - History & Introduction (9hours)

4.1. History of computing; Computer organisation; Binary system; Hardware and software; Generation of computers; Computer programming; System flowcharts.

4.2. Microporcessors, Storage devices, Memory systems and ASCII Code; Input- Output devices; Disk Operating System; Booting; Formatting; Operating Systems.

Module 5: Introduction to Office applications (9hours)

5.1. Office application software, Word Processing, Worksheet, presentation softwares, and data analysis. SQL.

Module 6: Web Development and programming (9hours)

6.1. Basics of web development using HTML. Introduction to the World Wide Web, Creation of email accounts and search for organized information.

PRACTICAL : BAQP 305 : PRACTICAL VIII

BAQC 303 :AQUACULTURE NUTRITION

CORE-IX
Total Hours-54
Credits – 4

Module 1: Nutritional Requirements of Fish (9 Hrs)

1.1. Protein and amino acid requirement, carbohydrate and lipid requirement, Essential fatty acids, Non protein nitrogen sources.

1.2. Vitamin and mineral requirements, vitamin C for fish and shell fishes.Feeds and feed additives, pigments, immunostimulants, non-nutritional feed additives – chemoattractants, feeding stimulants, growth promoters, preservatives.

Module 2: Feed ingredients & quality (9 Hrs)

2.1. Different feed ingredients- animal, plant, microbial origin, SCP, silages, fermented products.

2.2. Anti-nutritional factors. Compounded feeds, pellets, crumbles and microencapsulated feed.

2.3. Storage, quality standards, proximate composition & chemical evaluation. Digestibility studies and methods.

Module 3: Feed & Feed Manufacturing (9 Hrs)

3.1. Different forms of feed-fodders, mash, pellets, floating and sinking feeds. Feed formulation - methods, square method.

3.2. Feed manufacturing processes, Extrusion, Pelletization , Different size and grades of fish / shrimp feeds - starter, grower and finisher feeds.

3.3. Micro-bound feed, micro encapsulated feed. Storage and transportation of feeds.

3.4. Quality problems- toxins, pests, rancidity.

Module 4:Feed Management (9 Hrs)

4.1. Practical feeding in grow-outs of fishes & shrimps.

4.2. Feed ration, feed quantity estimation, feeding frequency. Check trays, demand feeders, automatic feeders, feed dispensers.

4.3. Farm made feeds, factory made fish & shrimp feeds in India. Record keeping.

Module 5: Feed Quality (9Hours)

5.1. Feed energetics, feed conversion efficiency, protein efficiency ratio, feed conversion ratio, net protein utilization, leaching, water stability. Quality standards.

Module 6: Larval nutrition (9Hours)

6.1. Larval stages, nutritional requirements of fish and shellfish larvae, quality requirements of larval feeds (particle size, digestibility).

6.2. Natural food and its importance in aquaculture, nutritional quality of commonly used fish food organisms, bioenrichment, biofilm/periphyton and its uses.

PRACTICAL : BAQP 306 : PRACTICAL IX

SEMESTER IV

BAQC 401 :GENETICS AND BIOTECHNOLOGY

CORE-X
Total Hours-54
Credits – 4

Module 1: Basic Genetics (9 Hrs)

1.1. Introduction- Genetics, Mendel's law of inheritance, interaction of gene,supplementary and complementary genes.

1.2. Principles of fish genetics. Cytogenetics, Biochemical genetics, quantitative genetics,population genetics.

Module 2: Selection and Hybridisation (9 Hrs)

2.1. Genetic selection, mass selection, genotypic selection, family and sib selection, progeny testing and combined selection.

2.2. Principles of breeding- methods and selection, selective hybridisation, intra-specific and inter-specific hybridisation.

2.3. Hybrid vigor, inbreeding and cross breeding.

Module 3: Sex determination. (9 Hrs)

3.1. Practical application of genetics in aquaculture. Genetics of sex determination in fish.

3.2. Gonochorism, Hermaphroditism, Protandry, Protogyni, Environmental Influence of Sex Determination.

Module 4: Aquaculture Biotechnology (9 Hrs)

4.1. Recombinant DNA technology, determinants of DNA replication, cloning, vectors,transformation.

4.2. Use of PCR for the detection of white spot syndrome in shrimp.

4.3. Aquaculture biotechnology- Biotechnological tools for aquaculture, gene manipulation in fish, transgenic fish production.

Module 5: Chromosome manipulation in fish and shell fishes (9 Hrs)

5.1. Polyploidy, gynogenesis and androgenesis. Monosex production, super male and super female fish production techniques.

Module 6: Marine Biotechnology (9 Hrs)

6.1. Scope and the present status of marine biotechnology, general application of molecular biological techniques to the marine sciences.

6.2. Synthetic hormones for induced breeding. Application of tissue culture in sea weed and pearl production. arine toxins.

6.3. Industrial chemicals and pharmaceuticals from marine sources. Use of probiotics and antibiotics in aquaculture operations. Cryopreservation.

PRACTICAL : BAQP 404 : PRACTICAL X

BAQC 402 :PATHOLOGY IN AQUACULTURE

CORE-XI
Total Hours-54
Credits – 4

Module 1: Pathology and Parasitology (9 Hrs)

1.1. Introduction to fish diseases –Definition and categories of diseases – Disease and environment. pathology and parasitology.

1.2. Stress as a factor in the occurrence of diseases. Parasitism – host-parasite relationship.

Module 2: Fungal and Viral Diseases (9 Hrs)

2.1. Fungal diseases (finfish) – Saprolegniosis, brachiomycosis, ichthyophorus diseases.

2.2. Lagenidium diseases – Fusarium disease Viral diseases (finfish) – IPN, IHN, Viral Hemorrhagic Septicemia, Spring Viremia of carps – Major CCVD, Carp lymphocytes.

2.3. Major shrimp viral diseases – *Bacculovirus penaeii*, Monodon Bacculovirus, Bacculoviral midgut necrosis, IHHNV, Hepatopancreatic parvo like virus, Yellow head bacculovirus, white spot bacculovirus.

Module 3 Bacterial, Protozoan and Metazoan Diseases. (9 Hrs)

3.1. Common bacterial diseases (Enteric red mouth disease, Bacterial cold water disease, furunculosis, vibriosis, dropsy and Gill and fin rot) their diagnosis and treatment.

3.2. Protozoan diseases- Ichthyophthiriasis, Costiasis, whirling diseases, trypanosomiasis. 3.3. Metazoan Diseases- diseases caused by annelids, helminthes, crustaceans and molluscs.

Module 4: Nutritional diseases (9 Hrs)

4.1. Nutritional pathology – lipid liver degeneration, Vitamin and mineral deficiency diseases. 4.2. Aflatoxin and dinoflagellates. Antibiotic and chemotherapeutics. Nutritional cataract.

4.3. Genetically and environmentally induced diseases.

Module 5: Immunology (9 Hrs)

5.1. Defence mechanism in fish and shell fish, Application and development of vaccines.

5.2. Diagnostic tools – immune detection- DNA/RNA techniques.

5.3. General preventive methods and prophylaxis.

Module 6: Fish Health Management (9Hrs)

6.1. Good pond management practices- Eco-friendly and sustainable aquaculture. Quarantine. 6.2. Methods of pathological examination of fish and infectious diseases.

6.3. Production of disease-free seeds. Evaluation criteria of healthy seeds.

6.4. Good Feed management for healthy organisms. Zero water exchange. Probiotics in health management.

PRACTICAL : BAQP 405 : PRACTICAL XI

BAQC 403 :AQUARICULTURE

CORE-XII
Total Hours-54
Credits – 4

Module 1: Introduction (9 Hrs)

1.1. Introduction to aquarium, ornamental fishes and aquarium accessories.

1.2. World aquarium trade and present status. Design and construction of public fresh water and marine aquaria and oceanarium. Aerators, filters and lighting.

1.3. Water quality requirements. Temperature control. Biofilters in aquarium.

Module 2: Aquarium Management (9Hrs)

2.1. Setting up of aquarium – under gravel filter, pebbles, plants, drift wood, ornamental objects and selection of fishes, Quarantine measures.

2.2. Aquarium maintenance and water quality. Control of snail and algal growth.

2.3. Handling, care and transportation of fish. Temperature acclimation, oxygen packing.

Module 3: Freshwater Ornamental Fishes (9 Hrs)

3.1. Species of ornamental fishes; their taxonomy and biology- Live bearers, Gold fish and koi, Gourami, Barbs and Tetras, angel fish, cichlids.

3.2. Maturation, secondary sexual characters, breeding habits, spawning, parental care, fertilization and development of eggs.

3.3. Hatching, larval rearing and their health.

3.4. Freshwater plants – their taxonomy and morphology, multiplication of aquarium plants – different methods.

Module 4: Commercial Production (9 Hrs)

Requirements and design for the commercial production units of ornamental fishes. Commercial production of goldfish, live bearers, gouramies, barbs and tetras, angel fish. Natural ponds for the mass production of ornamental fishes Mass production of aquarium plants.

Module 5: Marine Ornamental Fishes (9 Hrs)

5.1. Marine ornamental fishes – varieties and their habitat.

5.2. Major marine ornamental fish resources of India. Method of collection of live fish. Use of anesthetics.

5.3. Breeding of marine ornamental fishes (clown fishes and Damsel fishes). Reef aquarium and live rocks.

5.4. Other ornamental organisms – anemones, worms, lobsters, shrimps, octopus, starfish.

Module 6: Nutrition and Disease (9 Hrs)

6.1. Nutritional requirements of aquarium fishes. Different kinds of feeds.

6.2. Culture of fish food organisms; Preparation of dry feeds; feeding methods. Use of pigments for colour enhancement.

6.3. Larval feeds and feeding. Provision of nutrients and optimum environmental conditions for their growth.

6.4. Common parasites infecting ornamental fishes. Bacterial, viral, fungal diseases of ornamental fishes and their control and prophylaxis.

PRACTICAL : BAQP 406 : PRACTICAL XII

SEMESTER V

BAQC 501 :LARVAL NUTRITION AND CULTURE OF FISH FOOD ORGANISMS

CORE-XIII
Total Hours-54
Credits – 4

Module 1: Live Feeds (9 Hrs)

1.1. Different live feeds and their nutritional value. Manipulation of pond for natural feed production.

1.2. Candidate species of phytoplankton and zooplankton for fish and shell fish culture –diatoms, micro algae, nano planktons, Artemia, copepods, cladocera and rotifers.

1.3. Enrichment of live feed. Weaning of fish and prawn larvae.

Module 2: Culture of Phytoplankton (9Hours)

2.1. Methods of collection, maintenance of pure culture of Phytoplankton.

2.2. Different media used for culture. Batch culture and continuous culture and their application in hatcheries.

2.3. Mass culture. Culture of important microalgae, Chaetoceros, Tetraselmis, Skeletonema, Spirulina and Chlorella.

Module 3 : Culture of Zooplankton (9Hours)

3.1. Methods of collection, maintenance and rearing of rotifers, cladocerans, copepods, and insect larvae.

3.2. Mass culture of zooplankton. Harvest, storage and feeding.

Module 4: Artemia culture (9 Hours)

4.1. Different strains of Artemia. Artemia culture. Cyst production.

4.2. Enrichment of Artemia cyst and larvae. Decapsulation of Artemia cysts. Hatching, storage and feeding.

Module 5: Alternative live feeds. (9 Hours)

5.1. Culture methods of Infusoria, Chironomids, white worms, earthworms, mosquito larvae.

5.2. Nutritional qualities of alternative live feeds. Applications

Module 6: Periphyton culture (9Hours)

6.1. Importance of periphyton in aquaculture. Species composition and nutritional quality.

6.2. Methods for the development and maintenance of periphyton.

PRACTICAL : BAQP 506 : PRACTICAL XIII

BAQC 502 :FISHERY MICROBIOLOGY

CORE-XIV
Total Hours-54
Credits – 4

Module 1: Introduction (9 Hrs.)

1.1. History and development of microbiology – Contributions of Louis Pasteur, Koch and Winogradsky.
1.2. Diversity of microbial community – General characteristics of bacteria, fungi, viruses, algae and protozoans.

Module 2: Structure of microbes (9 Hrs.)

2.1. Structure of prokaryotic cell, Structure and function of bacterial cell wall, plasma membrane, capsule, flagella and endospore.

2.2. Structure of fungi and yeast cell. Structure of virus. Classification of viruses.

2.3. Life cycle bacteriophages - lytic and lysogenic cycle.

Module 3:Isolation and culture of microbes (9 Hrs.)

3.1. Prokaryotic growth – characteristic features of bacterial growth curve – Effect of environmental factors on growth.

3.2. Nutrition and growth of bacteria – different types of media for isolation of bacteria and fungi.

3.3. Isolation and cultivation of microorganisms from water and sediment. Different culture techniques.

Module 4: Aquatic Microbiology (9 Hrs.)

4.1. Microflora of aquatic environment. Autotrophic and heterotrophic microorganisms in aquatic environment.

4.2. Nutrient regeneration, role of microbes in biogeochemical cycles – Carbon, Nitrogen, Phosphorus and Sulphur cycles.

4.3. Autochthonous and allochthonous microorganisms in aquatic environment.

Module 5: Bacteria in culture pond (9 Hrs.)

5.1. Health significant bacteria in culture pond.

5.2. Culture characteristics and epidemiology of *E. coli*, pathogenic Vibrios, *Salmonella*, *Aeromonas hydrophila*, and *Pseudomonas*.

Module 6: Fish Microbiology (9 Hrs.)

6.1. Perishability of seafood –Microbial spoilage of fish and shell fish. Spoilage microflora.

6.2. Intrinsic and extrinsic factors affecting spoilage. Microflora associated with body parts. Food borne pathogens. Sources of contamination.

PRACTICAL : BAQP 507 : PRACTICAL XIV

OPEN COURSE

BAQO 503 : ORNAMENTAL FISH CULTURE

CORE-XV
Total Hours-54
Credits – 4

Module 1: Introduction (9 Hrs)

1.1. Introduction to Aquarium and ornamental fishes. World aquarium trade and present status.
1.2. Acessories- Aerators, filters, lights, heaters. Water quality requirements. Different kinds of feeds.
1.3. Culture of fish food organisms; preparation of dry feeds; feeding methods.

Module 2:Freshwater Ornamental Fishes (9 Hrs)

2.1. Different varieties of Ornamental fishes- Live bearers, Gold fish and koi, Gourami, Barbs and Tetras, angel fish and cichlids.

2.2. Broodstock development, breeding, larval rearing and grow out. Larval feeds and feeding.

2.3. Induced breeding.

Module 3: Commercial Production of Freshwater Ornamental Fishes and plants (9 Hrs)

3.1. Requirements and design for the commercial production units of ornamental fishes.

3.2. Commercial production of goldfish, live bearers, gouramies, barbs and tetras, angel fish.

3.3. Mass production of aquarium plants. Natural ponds for the mass production of ornamental fishes.

3.4. Marketing of aquarium fishes, retail outlets, export of ornamental fishes.

Module 4: Marine Ornamental Fishes (9 Hrs)

4.1. Marine ornamental fishes – varities and their habitat. Major marine ornamental fish resources of India.

4.2. Method of collection and transportation of live fish. Use of anesthetics. Quarantine measures.

4.3. Breeding of marine ornamental fishes. Other ornamental organisms – anemones, worms, lobsters, shrimps, octopus, starfish.

Module 5: Aquarium Management (9 Hrs)

5.1. Setting up of Fresh water, Marine and reef aquariums. Maintenance of water quality.

5.2. Common diseases of aquarium fishes, their diagnosis and treatment.

5.3. Handling, care & transportation of fish. Temperature acclimatisation, oxygen packing.

Module 6: Marketing of Aquarium Fishes (9 Hrs)

6.1. Marketing of aquarium fishes. Whole-sale markets of aquarium fish. Design of retail outlet. 6.2. Export of ornamental fishes, procedures for export.

6.3. Training and promotion schemes for the entrepreneurs involved in ornamental fish breeding and marketing by governmental agencies.

6.4. Regulations on export/import of ornamental fishes.

BAQO 504 : FISH PRESERVATION TECHNIQUES

CORE-XV
Total Hours-54
Credits – 4

Module 1: Fish handling (9 Hrs.)

1.1.1. Common fishes, shrimps and molluscs landed and processed in Andhra Pradesh. Handling of fish on board, in the landing center and processing centre.

1.2. Design and layout of preprocessing and processing centers.

Module 2: Chilling and Freezing (9 Hrs.)

2.1. Icing of fish, different types of ice, quality of ice. Fundamental principles involved in chilling and freezing of fish and fishery products.

2.2. Various freezing methods. RSW/CSW systems. Changes during freezing and frozen storage.

Module 3: Drying, Smoking, Canning and Freeze-Drying (9 Hrs.)

3.1. Principles of drying and salting of fish, factors affecting drying. Traditional drying / curing methods.

3.2. Packing and storage of dried products. Principles of freeze drying and canning of fish. Different stages of canning of fish/prawn. Retortable pouch processing. Spoilage of canned products.

3.3. Cut open test and commercial sterility and quality examination of canned products.

Module 4: Quality Control in Sea Food Processing (9 Hrs.)

4.1. Concept of quality in fish and fishery products. Organoleptic analysis of fish and fishery products.

4.2. Microbiological analysis of fish and fishery products. TPC and MPN of coliforms in sea food. *Salmonella, Vibrio, Staphylococcus* and *E. coli* in sea food.

4.3. Quality standards for sea food. Concept of HACCP.

Module 5:**Fishery By-products** (9 Hrs.)

5.1. Fish meal and fish oil. Different methods of production of fish oils and their uses. Different of fish meal.

5.2. Nutritional significance of fish oil. Chitin and chitosan.

5.3. Fish silage- production and uses. Shark fin rays,FPC, Pearl essence, isinglass, gelatin, squalene, beche-de-mer, carrageenan, agar, ambergris.

Module 6:**Packing, Cold Storage and Export of Fishery Products** (9 Hrs.)

6.1. Functions of packing. Different types of packing materials and its quality evaluation.

6.2. Packing requirements for frozen and cured products. Statutory requirements for packing. Labelling requirements.

6.3. Different types of cold storages. Requirements in retail outlet. Insulated and refrigerated vehicles.

6.4. Export of marine products. Role of MPEDA and EIA in export promotion and

quality control.

BAQO 505 : VALUE ADDED FISHERY PRODUCTS

CORE-XV
Total Hours-54
Credits – 4

Module 1: Value Addition in Sea Foods (9 Hrs)

1.1. Different types of value added products from fish and shell fish – status of value addition in Indian seafood sector.

1.2. Advantages of value addition. Significance of value addition in the seafood industry.

Module 2: Fish Mince Based Products (9 Hrs)

2.1. Fish mince and Surimi. Production of fish mince – merits and demerits. Analog and fabricated products.

2.2. Quality assessment of surimi,.. Equipment, raw material for surimi, Role of cryoprotectants in surimi production.

Module 3: Coated Fishery Products (9 Hrs)

3.1. Preparation of coated fishery products.

3.2. Different types of batter and breading and its applications – Packaging and storing of coated products – Quality evaluation.

Module 4: Other Value Added Products (9 Hrs)

4.1. Preparation of products - fish / prawn pickle, fish wafers, prawn chutney powder, fish soup powder.

4.2. Preparation of products - fish protein hydrolysate, fish stacks, extruded fish products, fillets, fish curry, fish cutlet, mussel products, marinated products.

Module 5: By-Products (9 Hrs)

5.1. Production of chitin, chitosan and glucosamine hydrochloride from shrimp shell waste.

5.2. Preparation of fish silage. Uses of silage.

5.3. Isingless, shark fin rays, gelatin from fish waste, Ambergris, beche-de-mer, squalene, fish meal and oil.

Module 6: Spoilage and quality (9 Hrs)

6.1. Spoilage in thermal processed products.

6.2. Quality evaluation of thermal processed products – Curing and drying of fish – Spoilage in dry fish products.

SEMESTER VI

BAQC 601 : AQUACULTURE MANAGEMENT

CORE-XVI
Total Hours-54
Credits – 4

Module 1: Principle of Aquaculture Systems (9 hrs.)

1.1. Definition, Principles and need for Aquaculture, Organisational systems, Operational systems and Degree of Intensification.

1.2. Principles of culture systems and management, Scope of Aquaculture Management.

Module 2: Human Resource, Water and health management (9 hrs.)

2.1. Management skills, Motivation, Productivity, Water Quality Management, Aeration, Water Injection, Effluent- environmental impacts and treatment.

2.2. Management of water supply.

Module3: Environmental Ethics (9 hrs.)

3.1. Management of scarce Natural Resources to commodity production for human consumption, Moral standing, animal rights.

Module 4: Production Economics (9 hrs.)

4.1. Microeconomic principles, Fixed and variable costs, Marginal analysis, cost concept, Taxes, Interest, Maintenance, Insurance, Depreciation, Total ownership costs.

Module 5: Records for managerial analyses, Production system limits(9 hrs.)

5.1. Management Principles, Definition, Scope, Principles, Henry Fayol Scientific Management - Application to Aquaculture, Capacity estimates, Production.

5.2. Capacity assessment (PCA), Procedure for PCA.

Module 6: Decision making tools (9 hrs.)

6.1. Partial Budgeting, The Delphi Technique, Benefit-cost analysis, Present value analysis, Sensitivity analysis, decision trees.

PRACTICAL : BAQP 606 : PRACTICAL XV

BAQC 602 : AQUACULTURE ENGINEERING

CORE-XVII
Total Hours-54
Credits – 4

Module 1: Introduction (9 hrs.)

1.1 Technical components of farm designing, recent trends in aquaculture engineering.

Module 2: Aquaculture facilities (9 hrs.)

2.1. Planning process, site selection and evaluation, design, components and construction of tanks, ponds, cages and hatcheries.

Module 3: Water intake and outlet, treatment (9 hrs.)

3.1. Pipe line, water flow and head loss, pumps-different types.

3.2. Equipment used for water treatment, filters, ultraviolet light, ozone, heating and cooling and other processes of disinfection.

Module 4: Aeration, oxygenation and Recirculation (9 hrs.)

4.1. Design and fabrication of aerators, compressors, blowers, paddle wheel aerators, oxygen injection system.

4.2. Recirculation and water use systems Definition, components and design.

Module 5: Feeding system (9 hrs.)

5.1. Different types of feeding equipment, feed control systems, dynamic feeding systems.

Module 6: Instrumentation and monitoring (9 hrs.)

6.1. Instruments for measuring water quality.

PRACTICAL : BAQP 607 : PRACTICAL XVI

BA 603 : FISHERIES ECONOMICS AND EXTENSION

CORE-XVIII

Total Hours-54

Credits – 4

Module 1: Introduction (6 Hrs)

1.1. Economics- definition, meaning and scope of economics with reference to fisheries. Basic concepts of economics- goods, services, wants, utility.

1.2. Demand and supply, value price, individual demand and market demand, elasticity of demand, law of diminishing marginal utility.

1.3. Theory of production- the production function, the laws of returns, returns to scale,production function in a fishery. Average, marginal and total revenues. Pricing-various factors influencing the price of a product.

Module 2: Basics of Business (6 Hrs)

2.1. Nature and scope of business, meaning, definition, characteristics and functions of business.

2.2. Requisites of a successful business, essential qualities of a good business man, different economic systems in operation- capitalism, communist economy and mixed economy.

2.3. Classification of companies- sole, proprietorship, partnership, co-operative society, charter companies, public corporations and registered companies.

Module 3: Marketing and Economic Analysis (6 Hrs)

3.1. Marketing – Introduction, basic marketing functions, consumer behavior and demand concepts, different types of market, identifying and selecting markets, regulation of markets, advertising and sales promotion, organizing market surveys and test marketing of a new product.

3.2. Fish marketing – prices and price determination of fishes. Marketing institutions – Primary institutions- producer fishermen, fishermen cooperatives and fisheries corporations.

3.3. Secondary institutions – merchant middlemen, agent middlemen and speculative middlemen.

3.4. Methods of economic analysis of business organizations – pay-back period, average rate of return, discounting method, net present value method, benefit cost ratio method and internal rate of return. Preparation of project report and appraisal of project.

Module 4: Fisheries Economics (6 Hrs)

4.1. Aquaculture economics – Application of economic principles to culture operations. Various inputs.

4.2. Production function - its assumptions in aquaculture analysis. Least cost combination of inputs, laws of variable proportions.

4.3. Cost and earnings of aquaculture systems – carp culture, different shrimp farming systems and hatcheries.

4.4. Cost and earnings of mechanized and non mechanized fishing units and freezing plants.

4.5. Socio- economic conditions of fishermen in India and Andhra Pradesh. Contributions of fisheries to the national economy. Budget allocation for fisheries in Union and State budget.

Module 5: Fisheries Co-operatives (6 Hrs)

5.1. Co operation- basic principles, co operative legislation and its administrative structure.

5.2. Fishermen co operatives, its functions, village societies, producing and marketing apex societies.

5.3. Financing and special problems of fishermen co operatives and remedial measures.

5.4. Role of National Co operative Development Corporation, Matsyafed and NABARD in uplifting the socio economic conditions of fishermen.

Module 6: Fisheries Extension (6 Hrs)

6.1. Extension education – its meaning, importance and scope in fisheries.

6.2. Various methods of extension – individual, group and mass methods, farm and home visits, seminars, discussions, exhibition and personal contacts.

6.3. Extension and rural development – rural sociology, social structure and stratification, social institutions and community organizations.

PRACTICAL : BAQP 608 : PRACTICAL XVII

SKILL BASED ELECTIVE I

OPEN COURSE- CHOICE BASED

SEMESTER VI

BAQE 604 : FEED AND ANIMAL HEALTH

Total Hours-72

Credits – 4

Module 1

1.1. Fin and Shell Fish Nutrition and Feed Technology,Nutraceuticals, Probiotics, Unconventional Feed Ingredients.

Module 2

2.1. Fin and Shell Fish Health Management Viral and Bacterial diseases, Fungal diseases, Protozoan parasites, Helminth parasites, Crustacean parasites.

2.2. Microbial analysis of fish E-Coli, S-aureus And identification of Solmonella and V-Cholera Determination of blood groups in fishes Fish haematology.

Module 3

3.1. Disease diagnosis, Prevention and Control measures in Aquaculture PCRtechniques on WSSV

SKILL BASED ELECTIVE II

SEMESTER VI

BAQE 605 : POST HARVEST TECHNOLOGY

Total Hours-72

Credits – 4

Module 1: Introduction

1.1. Fish Processing technology and Quality Control

1.2.. Principles of fish preservation. Precautions taken in handling fish in the fishing vessel, landing center and processing plant.

1.3. Importance of hygiene and sanitation in fish handling. Quality of water and ice in fish handling and processing.

1.4. Common equipments and utensils used in the processing plant. Preparation of ice. Different types of ice used in the seafood industry and their merits. Preservation by refrigerated seawater and chilled sea water.

Module 2: Freezing and Canning

2.1. Fundamental principles involved in chilling and freezing of fish and fishery products. Various freezing methods. Freezing of shrimps and fishes.

2.2. Preparation of fish fillets. Changes during the cold storage of fish and fishery products. Principles involved in canning of fish. Different types of containers.

2.3. Different stages of canning of Tuna. Retortable pouch processing. Constant pressure autoclave and study of F-value. Spoilage of canned products. Cut open test and commercial sterility.

Module 3: Drying, Smoking and Freeze-drying

3.1. Principles of smoking, drying and salting of fish, factors affecting drying. Traditional drying / curing methods. Different types of drying. Drying of fish and prawns. Packing and storage of dried products.

3.2. Spoilage of dried products. Preventive measures. Standards for dry fish products. Cold smoking. Principles of freeze drying.

3.3. Accelerated freeze drying and packing of freeze dried products. Modern methods of preservation by irradiation and modified atmospheric storage.

Module 4: Quality Control

4.1. Different types of spoilage in fishery products – chemical, physical and biological spoilage. Waste management in fish processing industries.

4.2. Sanitation procedures in sea food processing plants. Quality control – basic concepts, quality and quality control. Necessity for quality control and factors controlling quality parameters.

4.3. Salient features of sea food quality, quality factors. Risk factors in sea food biotoxins, sea food pathogens, endogenous parasites, physical, chemical and biological hazards. Precautions to be taken to avoid hazards in seafood industry.