

# **Minutes of the Board of Studies in Aquaculture 2014-2015**





SACRED HEART COLLEGE KOCHI

Department of Aquaculture

Proceedings of the Board of Studies Meeting held on 13.10.2014 at 11am in the chamber of the Director of the Department

Members present

1. Dr. T.V. Anna Mercy, Professor, Dept. of Aquaculture.
2. Ms. Sangeetha, Faculty, Dept. of Aquaculture
3. Mr. Asha Babu, Faculty, Dept. of Aquaculture
4. Dr. V.C. George, Head, Dept. of Aquaculture.

Sd/-   
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Sd/-   
Sd/- 

1. Approval of M.G. University syllabus for P.G. Batch 2014-15. – Syllabus has already been revised recently
2. The grading may be done by awarding marks to the questions in the examination
3. Approval of internal/external assessment ratio: Ratio of 25% and 75% for internal and examinations respectively may be followed
4. The marks awarding pattern of M.G. University may be followed.
5. List of examiners both for theory and practicals are appended separately
6.
  1. Internship for skill development
    - a) Internship in fish processing factory – 15 days
    - b) Internship in national laboratories – 10days
    - c) Aquaculture practices in commercial fish farm and hatcheries- 5 days

The above three internships are integral part of the course and are residential programmes

2. Study tour: Study tour can be conducted provided the finance is given by the management

3. Possibility of awarding extra credits through innovative activities: As we have an ornamental fish hatchery, fishes can be produced commercially by students during extra horus. Both credits and production based incentive should be given.

The meeting was concluded at 12 noon.

Minutes of the Board of Studies (BOS) meeting held on 20.3.2015 at the  
Department of Aquaculture, Sacred Heart College, Thevera.

1. Agenda item -4. Presentation of syllabi and curriculum- for approval

Curriculum and detailed scheme for conducting a certificate course which is approved by Board of studies is attached herewith for discussion and approval Encl:1.

2. Agenda item no. 9: P.G admissions

As students of B.Sc. Zoology, Botany, Aquaculture, Industrial fisheries are eligible for admission to M.Sc course in Aquaculture and Fish Processing, it is suggested that the entrance examination to this post graduate course may be divided into two parts. Part 1. 20% compulsory for all applicants and Part 2. 80% marks based on questions of their individual optional subjects . Submitted for the approval of Academic council.



3. Agenda item no.10. Any other item matters with the consent of the chair: Ratification of the course as aided by university. Vigorous follow u is required.

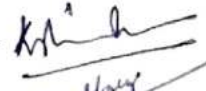
4. More space for laboratory as suggested by BOS. Possibility of shifting the Co-operative Society office adjacent to department library may please be shifted and this space can be efficiently used for library and the present space occupied for library can be used for laboratory. Ministry of Food Processing gives one time grant to procuring equipments for concerned discipline, but we must provide space and infrastructure.

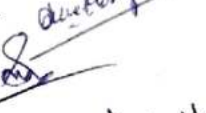
The meeting ended at 12.30 noon with a vote of thanks by the Chairman.

The following members were present in the meeting

- a. Dr. K. Sunil Mohammed Principal Scientist, CMFRI
- b. Dr. Ravisankar, C.N. Director, CIFT, Cochin
- c. Mr. Edwin Joseph, CEO, Winsor Exports, Maradu, Cochin
- d. Mr. Krishnakumar, Aquaplaza, B.T.Ranade Ave Rd. Edappally
- e. Dr. T.V. Anna Mercy, Professor, Dept. of Aquaculture.
- f. Ms. Sangeetha, Faculty, Dept. of Aquaculture
- g. Ms. Litty Mary, Faculty, Dept. of Aquaculture
- h. Dr. V.C. George, Head, Dept. of Aquaculture.

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## Notes for Board of Studies Aquaculture

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+ 2. Agenda item no. 9: P.G admissions

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✓ 5. Fish processing factories have agreed to give apprentice ship to our students in their factories

✓ 6. Under the earn while you learn programme, students may be permitted to sell the fingerlings of ornamental fish produced in the ornamental fish hatchery and 50% of the profit given to the students.

## Expenses

Course credit - 5 + 5 (5 credits theory  
5 credits practical)

Totals hours - 300 hrs.

Faculty charges @ Rs. 500 x 300 = 1,50,000/-

Hatchery running for 3 months = 15,000/-

Other expenses = 35,000/-

Total expenses anticipated = 2,00,000/-

No. of Students ~~20~~ 20.

Fees  $2,00,000/20 = 10,000/-$

Reques Two thousand / person only

Genealogy

Certificate course in Ornamental Fish culture

Venue : Dept. of Aquaculture, S.H.College, Thevera

Duration : ~~three months~~ (Average 300 hours) <sup>10 credits (5 credits theory and 5 credits for practicals) total (Duration 3 months)</sup> LL 300 hours.

Fees : ~~777~~ 10,000 (Per person)

Qualification: those who are able to read and write

Course modules

Module 1 : Ornamental fish culture: Introduction, scope, varieties of fishes , present status 15hrs

Module 2 : Aquarium setting: tank construction, tank setting, pumps,lights, planting, 15hrs.

Module:3. Ornamental fish breeding: Live bears, Cichlids, carps, Gouramis, Barbs, Zebra etc, 15 hrs

Module 4: Live feed culture/ water quality , Biosecurity, BMP 15hrs.

Module 5: Marketing. setting up of hatchery/ Bank loans, subsidy schemes 10hrs.

Module 6: Aquatic plants. Varieties, culture, 10hrs

Total theory 80 hrs.

Practicals :

Breeding of Live bears 25hrs

Breeding of Cichlids 50hrs

Breeding of Gold fish/Koi 50hrs

Barbs/Zebra 25hrs.

Gourami fighter 25hrs

Live feed culture 25hrs

Tank construction/setting. 20hrs.

Total 220

Grant total 300hrs.

Budget: Faculty charges @ ~~500~~ 500 x 300 = 1,50,000  
 Hatchery hiring charges for 3 months = 15,000  
 Other expenses 35,000  
 Total expenditure anticipated Rs 2,00,000-

Changes made in the Syllabus.

Sl. No.	Old Syllabus			Revised syllabus.	
	Semester I	Theory	Practical	Theory	Practical
1.		4papers 90hrs. each	One 90hours	4 papers.72 hours each	2papers 72 hrs each
2.					
3.	II	4 papers 90 hrs. each	One 90hours	4 papers.72 hours each	2papers 72 hrs each
4.	III	3papers 90 hrs. each	Two, 90hours	3 papers.72 hours each	3 papers 72 hrs each
5.	IV	3papers 90 hrs. each	Two, 90hours	3 papers 72hrs each	3 papers 72 hrs each
6.	Project	2credits		3 credits	
7.	Comprehensive viva	2 credits		2 credits.	
8.	Contents are modified (deleted/added) to fit into the 72 hrs as described in the syllabus in detail.				
9.	During the First and second semester only one practical examination will be conducted.				



Abstract of the Courses for M.Sc programme on Aquaculture and Fish processing

Semester	Course code	Course titles	Teaching hours	Credit	Total credits
I	1. AQCT01	Taxonomy and Biology of commercial and cultivable fin fish and shell fishes	4	4	19
	2. AQCT02	Biophysics, Instrumentation, Micro techniques and research methodology	4	4	
	3. AQCT03	Biostatistics and computer application	4	4	
	4. AQCT04	Aquaculture engineering	3	3	
	5. AQCP01	Taxonomy and Biology of fin fish and shell fish	5	2	
	6. AQCP02	Instrumentation, micro techniques, Biostatistics, Computer application and aquaculture engineering	5	2	
	CSE P1				
	<b>Total</b>		<b>25</b>	<b>19</b>	
II	7. AQCT05	Ecology of culture systems and Aquatic biology	4	4	19
	8. AQCT06	Biochemistry and Nutrition	3	3	
	9. AQCT07	Physiology and pathology of fin fish and shell fish	4	4	
	10. AQCT08	Genetics and Biotechnology	4	4	
	11. AQCP03	Aquatic Biology, Physiology, Pathology and Genetics, Biochemistry and Nutrition.	5	2	
	12. AQCP04	Genetics, Biochemistry and Nutrition.	5	2	
	CSE P2				
	<b>Total</b>		<b>25</b>	<b>19</b>	
III	13. AQCT09	Culture of fin fishes, molluscs, and sea cucumbers	4	4	19
	14. AQCT10	Aquariculture, aquaculture economics and Administration	4	4	
	15. AQCT11	Culture of crustaceans, sea weeds and Post harvest technology	3	3	
	16. AQCP05	Culture of fin fishes, molluscs, and sea cucumbers, crustaceans and sea weeds	5	3	
	17. AQCP06	Aquariculture and aquaculture economics	5	3	
	18. AQCP07	Post harvest technology and Quality Evaluation	4	2	
	CSE P3				
	<b>Total</b>		<b>25</b>	<b>19</b>	
IV	19. AQCT12	Fishing Technology	4	4	23
	20. AQCT13	Fish Processing Technology	4	4	
	21. AQCT14	Fish Microbiology and Quality Assurance	4	4	
	22. AQCP08	Fishing Technology	4	2	
	23. AQCP09	Fish Processing Technology	5	2	
	24. AQCP10	Microbiology and Quality assurance	4	2	
	CSE P4				
	Project			3	
	Comprehensive viva voce			2	
	<b>Total</b>		<b>25</b>	<b>23</b>	<b>80</b>

Semester	Course	Teaching	Credit	Total Credit
I	AQCT01	4	4	19
	AQCT02	4	4	
	AQCT03	4	4	
	AQCT04	3	3	
	AQCP01 PRACTICALS	5	2	
	AQCP02 PRACTICALS	5	2	
	CSE P1			
II	AQCT05	4	4	19
	AQCT06	4	4	
	AQCT07	4	4	
	AQCT08	4	4	
	AQCP03 PRACTICALS	5	2	
	AQCP04 PRACTICALS	5	2	
	CSE P2			
	Total			
III	AQCT09	4	4	19
	AQCT10	4	4	
	AQCT11	3	3	
	AQCP04 PRACTICALS	5	3	
	AQCP05 PRACTICALS	5	3	
	AQCP06 PRACTICALS	4	2	
IV	AQCT12	4	4	23
	AQCT13	4	4	
	AQCT14	4	4	
	AQCP07 PRACTICALS	4	2	
	AQCP08 PRACTICALS	4	2	
	AQCP09 PRACTICALS	5	2	
	Project		3	
	Comprehensive Viva voce		2	
	Total			80

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**P1 AQC T 01 (ACT 101) Taxonomy and Biology of Commercial and cultivable fin fishes and shell fishes.**

72hrs.

**Module 1 : Morphology & Taxonomy of fin fish and shell fish**

32hrs.

Study of external morphology of a typical elasmobranch, teleost, prawn, lobster, crab, bivalve, gastropod and cephalopod.

4hrs.

Study of scales, skin, teeth, mouth and fins and their use in taxonomy of fin fishes.

8hrs

Taxonomy of commercially important fin fishes of families of the orders: Clupeiformes, Perciformes, Cypriniformes, Siluriformes, Pleuronectiformes.

15hrs.

Taxonomy of commercially important shell fishes of prawns, crabs, lobsters, bivalves, gastropods and cephalopods in India.

5hrs.

**Module 2. Biology of fin fishes and shell fishes**

30hrs.

Digestive system: Structure, function and physiology of digestive system and associated glands.

Food and feeding habits of fin fishes and shell fishes.

5hrs.

Respiratory system: Structure and function of respiratory system and accessory respiratory organs in fin fishes. Respiration in prawns and bivalves.

5hrs.

Circulatory systems: Structure and function of circulatory system, Blood, blood cells, plasma, plasma proteins.

3hrs.

Excretory system: structure and functions, osmoregulation in fishes and prawns.

2hrs.

Nervous system: Brain and nerves.

5hrs.

Endocrine system: Structure and function of endocrine glands of fishes. Neuroendocrine system of prawns. Role of hormone in relation to reproduction in fishes and prawns.

5hrs.

Reproductive system: Structure and function of reproductive systems of fin fishes, prawns and bivalves. Gametogenesis- spermatogenesis and oogenesis, ovulation and fertilization.

5hrs.

Gonadosomatic index. Parental care in fin fishes.

**Module 3: Distribution of commercially important fin fishes and shell fishes in Indian waters**

Definition of mud banks, wedge bank and parr. Upwelling and its importance to fisheries.

10 hrs.

Distributional shifts of fishery stock, climate change.

P1 AQC T 01 (ACT 101) Taxonomy and Biology of Commercial and cultivable fin fishes and shell fishes. 72hrs.

**Module 1 : Morphology & Taxonomy of fin fish and shell fish** 32hrs.

Study of external morphology of a typical elasmobranch, teleost, prawn, lobster, crab, bivalve, gastropod and cephalopod. 4hrs.

Study of scales, skin, teeth, mouth and fins and their use in taxonomy of fin fishes. 8hrs

Taxonomy of commercially important fin fishes of families of the orders: Clupeiformes, Perciformes, Cypriniformes, Siluriformes, Pleuronectiformes. 15hrs.

Taxonomy of commercially important shell fishes of prawns, crabs, lobsters, bivalves, gastropods and cephalopods in India. 5hrs.

**Module 2. Biology of fin fishes and shell fishes** 30hrs.

Digestive system: Structure, function and physiology of digestive system and associated glands. Food and feeding habits of fin fishes and shell fishes. 5hrs.

Respiratory system: Structure and function of respiratory system and accessory respiratory organs in fin fishes. Respiration in prawns and bivalves. 5hrs.

Circulatory systems: Structure and function of circulatory system, Blood, blood cells, plasma, plasma proteins. 3hrs.

Excretory system: structure and functions, osmoregulation in fishes and prawns. 2hrs.

Nervous system: Brain and nerves. 5hrs.

Endocrine system: Structure and function of endocrine glands of fishes. Neuroendocrine system of prawns. Role of hormone in relation to reproduction in fishes and prawns. 5hrs.

Reproductive system: Structure and function of reproductive systems of fin fishes, prawns and bivalves. Gametogenesis- spermatogenesis and oogenesis, ovulation and fertilization.

Gonadosomatic index. Parental care in fin fishes. 5hrs.

**Module 3: Distribution of commercially important fin fishes and shell fishes in Indian waters**

Definition of mud banks, wedge bank and parr. Upwelling and its importance to fisheries.

Distributional shifts of fishery stock, climate change. 10 hrs.

**P1 AQC T 02 (ACT 102) Biophysics, Instrumentation, Micro techniques and Research methodology**  
**72 hrs.**

**Biophysics:**

**Module 1 Diffusion and Osmosis**

**16hrs.**

Diffusion, concentration gradient and Fick's Law, diffusion coefficient, stocks-Einstein equation, pressure gradient and Graham's Law, Gibbs-Donnam equilibrium.

Osmosis, Vant Hoff's Law, Osmotic concentration and osmotic pressure, Biological significance of osmosis in fishes. **8 hrs.**

**Module II Biophysics of cell membrane:** Physics-chemical properties of cell membrane, membrane receptors, factors affecting the passage of materials across cell membranes. **8hrs.**

**Instrumentation.**

**34hrs.**

**Module III Instrumentation:** Calorimetry, spectrophotometry (U.V. visible, infrared and double beam), pH and, Oxygen probe, conductivity meter, salinometer and refractometer, atomic absorption spectrophotometer, Mass spectroscopy and LC-MS. **10hrs.**

**Module IV Protein purification :** Basic methods involved in protein purification, Chromatography, absorption and partition chromatography, ion exchange and affinity chromatography, high performance (pressure) liquid chromatography, gel filtration chromatography. **8hrs.**

**Module V Electrophoresis :** General principles and different gel materials for electrophoresis, different methods of electrophoretic techniques, Isoelectric focusing. **8hrs.**

**Module VI Microscopy:** Principles of microscopy, bright field, dark field and phase contrast microscopy; fluorescence microscopy, microphotography, electron micrograph, principles of electron microscopy ultra structure studies using electron microscopy. **8 hrs.**

**Micro techniques**

**12hrs.**

Fixation of invertebrates and vertebrates, tissues, organs, larvae and embryos, isolated cells and bacteria. Dehydration methods, embedding, clearing and sectioning, including cryosectioning. Staining of sections, preparation of whole mounts. Histochemical methods for location of carbohydrates, lipids and protein fixation and processing of tissues for electron microscopy studies.

**Module VII: Research methodology:**

10hrs.

Meaning and importance of research, Types of research-selection and formulation of research problem. Research design-need-features, different research designs, concepts relating to research design. Analysis of literature review, primary and secondary sources, web sources-critical literature reviews. 3hr.

**Module II data collection and analysis:**

Collection of primary and secondary data, selection of appropriate methods of data collection, data preparation, important steps, types of analysis.  
2 hrs.

**Module II: Interpretation and report writing.**

Meaning of interpretation, techniques of interpretation, and precautions in interpretation. Significance of report writing, different steps in report writing. Types of reports; technical and popular. Lay out of research reports, preliminary pages, main text, and end matter. Reproduction of published materials-plagiarism-citation and acknowledgement, reproducibility and accountability.  
5hrs.

**P1 AQC T 03 Biostatistics and Computer applications 72 hrs.**

**Biostatistics.**

**42hrs.**

**Module I Collection, compilation and analysis of the data**

**8 hrs**

Primary and secondary data- formation of length and weight frequency distribution, measures of central tendency-Mean, median and mode.

Measures of dispersion – range, quartile deviation, mean deviation and standard deviation.  
Absolute and relative measures of dispersion

**Module II Correlation and Regression analysis**

**8hrs**

Scatter diagram- Karl Pearson's coefficient of correlation- Spearman's Rank Correlation coefficient-coefficient of determination Regression analysis-Linear regression equations and their uses. Length –weight relationship and von Bertalanffy growth equation.

**Module III Probability and Theoretical Distribution**

**10hrs**

Frequency approach and Axiomatic approach to probability - Mutually Exclusive and independent events - Addition and Multiplication theorems - Binomial, Poisson and Normal distribution

**Module IV Statistical quality control**

**6hrs**

Process control and product control – control chart for variables and attributes – mean and range charts, fraction defective chart ('p' chart) and 'c' charts – sampling inspection plans.

**Module V – Theory of sampling and inference**

**10hrs.**

Population of sample, determination of the sample size – sampling techniques – estimation of marine fish landings in India.

Null and alternative hypothesis-two types of errors in testing of hypothesis –large and small sample tests – 'Z', 't',  $\chi^2$  and F-tests- Analysis of variance Techniques – Single factor – ANOVA

**10 hrs**

**Computer Application**

**30hrs.**

**Module VI: Introduction to computers**

**13hrs**

Functions and components, characteristics of computers; generation of computers, types of computers. Computer system organization-Hardware and Software. Types of languages, programming concepts, memory (brief account only); recent developments in input-output devices, commercially used storage devices-hard disc floppy disc, CD, flash memory.

Advances in microprocessor technology, Operating system-a comparative study.

**Module VII -Computer and communications**

17 hrs

MS Office, MS word, MS excel, MS power point, Photoshop, Page Maker

Network, internet, World wide Web, email, [www.Fish Base.org](http://www.Fish Base.org). P.h.stat.



# P1AQC T04 (ACT104) Aquaculture Engineering 72 Hrs

## Module 1 Selection of Site

8 Hrs

Selection of Site for aquaculture – Freshwater, brackish water and mariculture systems. General considerations, water quality, soil characteristics, biological aspects, topography, climatic factors, socio-political factors, infrastructure facilities.

## Module 2 Surveying and Estimation of Area

8 Hrs

Surveying – chain survey, plain table survey, contouring and leveling. Calculation of area of land by trapezoidal and Simpsons rule. Importance of engineering survey.

## Module 3 Design of Farms

8 Hrs

Design and construction of aquafarms – type of ponds, shape, size and their orientation from mereriological point. Design of various components of aquafarms – peripheral dykes, secondary dykes, feeder canals, drainage canals, water intake and outlet systems – seawater intake systems, sluice gate, monks and spillways. Calculation of earthwork for constructing ponds and requirement of water during water exchange.

## Module 4 Soil

6Hrs

Types of soil, different properties of soil, soil sampling methods, structure and textural classification, grain size distribution, bearing strength, prevention of erosion. Methods of soil compaction and seepage reduction.

## Module 5 Design of Modern Aquaculture Systems

6 Hrs

Design and construction of enclosures for mariculture operations, pens, cages, raceways, flow through systems and re-circulatory systems. Selection of materials for mariculture facilities.

## Module 6 Aquaculture Equipments (8 Hrs)

Equipment used for water treatment, filters, ultraviolet light, ozone, heating and cooling and other processes of disinfection. Role of aeration in culture ponds.- paddlewheel aerators, cascade aerators, aspirators, compressors and blowers. Different types of pumps in aquaculture – vertical, centrifugal, jet and propeller pumps

### **Module 7 Aquaculture Automobiles**

**6 Hrs**

weed cutters and harvesters, bulldozers, excavators, rollers, refrigerated vans and mechanized fish harvesters.

### **Module 8 Hatcheries**

**8 Hrs**

Design of shrimp hatcheries – selection of site, source of water, water treatment. Disinfection, heating and cooling equipments in hatcheries. Design of hatchery building, water supply and drainage systems, inlets and outlets, aeration grid, FRP tanks, cement tanks and waste water treatment.

### **Module 9 Aquaculture projects**

**8 Hrs**

Preparation of aquaculture projects, estimation of efficiency, management of pond and hatchery machineries. New technologies in aquaculture engineering. Tank basins and other closed production unit.

### **Module 10 Feeding Systems**

**8 Hrs**

Different types of feeding equipment – automatic and demand feeders, feed control systems, dynamic feeding systems. Adjustment of pH, removal of particles, Ammonia removal.

### **Suggested Readings**

1. Thomas B Lawson Fundamentals of Aquacultural Engineering
2. Wheaton, F.W. Aquacultural Engineering
3. Santhosh Kumar Garg Water supply Engineering
4. Bose et. al. Coastal Aquacultural Engineering
5. Odd-Ivar Lekang Aquaculture Engineering
6. Pillay, TVR and Kutty MN Aquaculture: Principles and Practices
7. Michael BT and Thomas L Aquaculture water reuse systems

**P1AQCP01 Practical: Taxonomy and Biology of fin fish and shell fish 72 hrs.**

- Practical 1. Study on the morphology -scales, teeth, tails and fins of - commercially important finfish.
- Practical 2. Study on the morphology of shell fishes-crustaceans and molluscs.
- Practical 3. Dissection of alimentary canal and internal organs (Viscera) of a typical teleost fish.
- Practical 4. Dissection of alimentary canal of a prawn.
- Practical 5. Identification of commercially important fin fishes of the order Clupeiformes
- Practical 6. Identification of commercially important fin fishes of the order Cypriniformes
- Practical 7. Identification of commercially important fin fishes of the order Perciformes(3 families)
- Practical 8. Identification of commercially important fin fishes of the order Perciformes (3families)
- Practical 9. Identification of commercially important fin fishes of the order Perciformes(3families)
- Practical 10. Identification of commercially important fin fishes of the order Siluriformes(3 families)
- Practical 11. Identification of commercially important fin fishes of the order Siluriformes (3 families)
- Practical 12. Identification of commercially important fin fishes of the order Pleuronectiformes
- Practical 13. Qualitative and quantitative analysis of gut contents. Index of preponderance.
- Practical 14. Identification of commercially important crustaceans
- Practical 15. Identification of commercially important molluscs.
- Practical 16. Determination of gonadosomatic index, fecundity and its relationship with length and weight.

**PLAQCPO Practical: Instrumentation, Microtechniques, Biostatistics, Computer application and Aquaculture engineering.**

**Module I Instrumentation:**

Chromatography (Paper/TLC) for the separation and identification of amino acids.  
polyacrylamide gel electrophoresis/paper electrophoresis for the separation of proteins.  
Conductivity meter, salinometer, refractometer demonstration

**Module II Microtechniques.**

Micrometry, Phase contrast microscope, Camera Lucida, Micro photographic equipment  
Preparation of micro slides including whole mounts for evaluation during practical examination covering fixation, dehydration, clearing, embedding of tissues and preparation of blocks ,sectioning, affixing the section, staining and mounting, preparation of whole mounts.

**Module III Biostatistics and computer applications.**

Problems in tests of significance normal 1x2 and F. Basic concepts of sampling and estimation of marine fish landings, basic concepts in design of experiments.

Study of computer components: Microsoft Disk Operating system, MS word letter drafting and mail merging in computer. Use of internet and communication system.

**Module V Aquaculture Engineering**

- 1) Visit to aquafarms and drawing the layout of ponds,dikes and sluices.
- 2) Earthwork Calculations
- 3) Calculation of daily and monthly water requirements.
- 4) General design for the construction of raceways, cages and pens.
- 5) General design of shrimp hatcheries.
- 6) Working of different aquaculture equipments
- 7) Grain size analysis of the soil.

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**P2 AQCT 05 (ACT 201)- Ecology of culture systems and Aquatic Biology 72 hrs.**

**Module I: Physical and chemical characteristics of water:** Role of physical parameters like depth, temperature, salinity, light, turbidity and wind in ponds. Circulation and mixing patterns in ponds. Physical characteristics in relation to open sea farming.

Effect of monsoon on pond physical conditions. Seasonal and diurnal variation in pond. Chemical characteristics with reference to carbon dioxide system, dissolved oxygen distribution.

15 hrs.

**Module II Aquatic Microbiology**

Classification of Aquatic micro organisms. Sampling, isolation and purification of major groups of microbes from culture ecosystems. Identification and enumeration of major microbial groups, types of bacteria, fungi, actinomycetes in culture systems. Growth and reproduction in bacteria, microbial population in relation to physical, chemical and biological characteristics in ponds.

Pathogenic bacteria in culture systems. Role of microbes in regeneration of nutrients and hydrogen sulphide production in ponds, special groups of bacteria relevant in culture systems.

22hrs.

**Module III Aquatic Biology.**

Aerobic and anaerobic degradation of organic matter in pond bottom. Sludge accumulation, water quality management, culture system management. Primary and secondary productivity in ponds, benthic productivity. Macro and micro benthos including benthic algae in ponds. Ecological energetic of ponds. Effect of organic/inorganic fertilizers on pond productivity. Carrying capacity of culture systems. Lotic and lentic aquatic systems. Mud banks and monsoon trawling. Eutrophication and impoundments.

15hrs.

**Module IV Aquatic environment and Fisheries Oceanography.**

Physico chemical characteristics of freshwater, classification of freshwater bodies, thermal stratification, freshwater communities, adaptations. Rivers of Kerala. Characteristics of estuaries, classification, horizontal stratification, estuarine communities, adaptation. Major estuaries of India. Physico-chemical characteristics of marine environment, classification thermal stratification, marine communities. Objective, scope and relation to fishery science, major oceans, chemical composition of sea water.

20hrs.

P2 AQC T 06 (ACT 202) Biochemistry and Nutrition of finfish and shellfish. 72 hrs.

Biochemistry

**Module I: Prerequisites:** Atoms, bonds, concepts of PH and buffers.

32hrs.

**Carbohydrates:** classification, monosaccharides, reaction of monosaccharides with acid and alkali. Disaccharides, Oligosaccharides and Polysaccharides.

6hrs.

**Module II: Lipids.** Classification, General properties, Oxidation, iodine number. Fatty acids: Classification of saturated and unsaturated, PUFA, MUFA, Simple lipids, Compound lipids phospholipids, Glycolipids, Spingolipids. Steroids, Cholesterol, Prostaglandins. Metabolism of lipids: fatty acid break down, fatty acid synthesis.

6hrs

**Module III: Proteins.** Amino acids, structural organisation of proteins. Globular and fibrous proteins. Metabolism of proteins; metabolism of phenyl alaine, sereine and glycine. Urea cycle.

7hrs.

**Module IV: Enzymes.** Enzyme classification. Enzyme kinetics. Types of enzyme inhibition. Isoenzymes, co-enzymes.

7hrs.

**Module V: Nucleic acids.** Bases and sugars. Nucleotides. Replication of DNA, transcription and translation process.

6hrs.

**Nutrition**

40hrs.

**Module VI: Nutritional physiology.** Principles of nutrition. Adaptations to various types of feeding in finfish, crustaceans and molluscs. Mechanism of food capture, nutritional bioenergetics in finfish and shellfish.

8 hrs.

**Nutritional requirements:** Gross protein requirements, nitrogen balance; essential and non essential amino acids and their quantitative requirements, protein quality and sources; lipids, their functions; essential fatty acids, phospholipids and sterol requirements; protein sparing action of lipids, negative aspects of lipids, carbohydrates; their sources and utilization, gross energy requirements.

10hrs.

Water and fat soluble vitamins; their positive functions, minerals, recommended dietary allowances, deficiency and hyper dosage syndromes.

6 hrs.

**Module VII: Feed integration.** Classification of feed stuff and international feed information system. Antinutritional factors in feed ingredients, their effect on finfish and shell fish. Additives in fin fish and shell fish.

Feed formulation strategies and methods. Feed manufacture process; storage and quality control of feeds, management of fish feed mills.

Larval nutrition-Nutritional requirements of finfish, crustacean and molluscan larvae.

Nutritive value of phytoplankton and their mass culture. Nutritive value of cladocerans and rotifers; their mass culture. Live and artificial feed, economic formulated feeds nutritive value of artemia, their mass culture and cyst production; micro diets for larvae. Recent advances in larval nutrition.

10 hrs.

**Module VIII: Feed management.** Feeding strategies. Chemical methods of evaluation; biological methods of evaluation. PER, BV, NPU, NPR, FCR/ECR. Feed dispensing methods. Artificial feeding and pond sanitation.

6hrs.

**P2 AQCT 07(ACT 203) Physiology and pathology of fin fish and shell fish 72 hrs.**

**Physiology.**

40hrs

**Module 1: Physiology.**

20hrs.

Physiology of respiratory, digestive, excretory and circulatory system. Osmoregulation. Hormonal control of osmotic and ionic regulation. Organisation of neurons and neuromuscular system. Mechanism and biology of neuron coordination.

Sense organs-receptive mechanisms and effector systems, biological rhythm. Ecophysiology, environmental requirements, effect of salinity, oxygen and other abiotic factors for metabolism. Molting and growth. Effect of environmental factors on acid base regulation and biotic interactions.

**Module II: Endocrinology.**

20hrs

General morphology, structure and function of neurosecretory system of crustaceans. Reproductive systems and secondary sexual characters, process of gametogenesis, neuroendocrine control of reproduction, hermaphroditism, parasitic castration, Neurosecretory and endocrine systems in fishes and shell fishes- their organization, morphology, structure of sinus gland complex. 'x' organ, 'y' organ and androgenic gland in crustaceans. Neurosecretory cells in mollusks. Pituitary and endocrine organs of fish, pituitary hormones- Their storage, release and control of reproduction.

The chemical aspects of hormone actions, molting, growth and reproduction in crustaceans, induced maturation and spawning in finfish, crustaceans and mollusks, induced ovarian maturation and spawning through physical, chemical and biological method. New generation drugs, hypophysation in finfish. Eyestalk ablation techniques-its principles and application in crustacean hatcheries.

32hrs.

**Pathology.**

**Module I:** Introduction. Definition of terms, classification of disease, causes of diseases, aetiology, role of abiotic and biotic factors, Intrinsic factors, generic, species and strain; extrinsic factors environment, nutritional status, role of stress in disease process.

Nonspecific immunity: agglutinin and precipitins, C-reactive protein, complement in fish, phagocytosis: acquired immunity; cell mediated immunity-Role of thymus, T-cell; receptors. Mechanism of cell mediated immunity, cytokines, T-helper function, role of macrophages, recirculation and ecotaxis of T-cell; T-cell markers.



Humoral immunity-origin of B cell, differentiation of B-cells into plasma cells, T and B-cell interaction, antigenic stimulation; memory cells, structure of antibody; types of antibody; types of antibodies produced in fish. Immunization in fish and vaccination.

Basic vascular and cellular alterations, disturbances in circulation, cell metabolism and cell growth, necrosis, inflammation; defenses of the body against injury, healing and neoplasms.

Microbial disease- viral, bacterial and fungal diseases and their control. Parasitology- protozoan and metazoan parasites.

Nutritional disease, toxic diseases, prophylactic and control measures, biological and chemical treatment of disease.

Integrated disease management.

## **P2 AQC T 08 Genetics and Biotechnology of Finfish and Shell fish 72 hrs.**

### **Module I: Genetics.**

40hrs

Introduction to Genetics. Practical application of Mendelian Genetics. Fish cytogenetics, principles of genetics techniques in cytogenetics. Evolution of fish Karyotypes sex linked genes and sex. Limited phenotypes, quantitative phenotypes, pleiotropy, recent trends in genetic mutations. Types of mutations and mutagens.

Gene expression and regulation.

Genetic improvement. Need for genetic improvement inheritance, inbreeding and cross breeding selection methods, basis of selection and its effects.

Hybridisation: Types of hybridisation, naturally occurring and artificially produced cyprinid hybrids. Cultural traits of hybrids.

Genetic manipulation: Sex-reversal and sex control, role of steroids in sex reversal, chromosomal manipulate, polyploidy. Androgenesis and Gynogenesis, cryopreservation of gametes, gametic manipulation.

Genetic engineering: General principles of genetic engineering, recombinant DNA and gene cloning methods, restriction. Modification enzymes, PCR, sequencing, DNA, fingerprinting, recombinant vaccines, transgenic fish, gene transfer.

### **Module II: Biotechnology.**

32hrs

Biotechnology in aquaculture. Introduction to tools and techniques in modern biotechnology.

Different types of probiotics. Use of probiotics and biofertilization in aquaculture. Immunostimulants used in aquaculture. Bioremediation in aquaculture systems. General principles of cell and tissue culture, culture of primary cells secondary culture (subcultures) and cell lines, Fish cell culture development of cell lines and their applications.

Solid state Fermentation, disease diagnosis using PCR.

**Module I. Aquatic Biology**

Estimation of oxygen

Estimation of salinity

Determination of primary production.

**Module II Aquatic microbiology**

Isolation and cultivation of pathogenic bacteria in aquatic environment

**Module II. Pathology**

Study of various diseases finfish and shell fishes. Bacterial, fungal, viral and parasitic.

Identification of parasites. Treatment methods for fish diseases.

**Module III Physiology**

Dissection of neuroendocrine organs of a candidate species.

**Module IV Genetics.**

Preparation of chromosome from a fish.

*Practical assignment of fish*

Module I Biochemistry

Estimation of protein in ~~fishes and prawns~~

*fin fish, shell fish and fish heads*

Estimation of fish lipids

*biscuits and lowry's milk*

Estimation of ~~carbohydrate~~ in fishes

*glycogen + glucose*

*colours metric*

Module II Nutrition

Preparation of purified diet for a prawn/fish to determine protein/lipid requirements. Identification of common feed ingredients, determination of lipid quality, determination of moisture, lipid and ash in certain feed ingredients. Determination of crude protein, determination of gross energy of a few ingredients; feed formulation exercise; preparation of a compounded feed; grinding, sieving, pelleting and drying.

Preparation of purified diet for a prawn/fish

p3AQCT09 Culture of fin fishes, mollusks, and sea cucumbers 72 hrs.

Module I Fin fish culture 30hrs

Overview of fin fish culture in the world – major species cultured, common technologies, countrywise production. . Fin fish culture in India- historical background and recent advances.

Marine, brackish water and fresh water species cultured, characteristics and criteria for selection of species for mariculture.

See production, natural seed resources, their distribution, abundance, collection and transportation. Hatchery technology , brood stock management and breeding under controlled conditions. Induced breeding, egg incubation, larval rearing, and production of seed, nursery phase.

Different kinds of grow out culture systems, their advantages and disadvantages. Traditional and improvement farming practices in different maritime states and production trends. Operational details of monoculture and polyculture.

Fin fish culture in pens and cages, raceways, running water systems, sea ranching of fin fish, integrated farming. Aquaponics.

Module II Sea cucumber culture. 10hrs.

Present status of sea cucumber culture in the world. Natural resources and recent advances in breeding. Seed production and culture of sea cucumbers in India. Processing of sea cucumbers.

Module III Mollusc culture. 32hrs.

Overview of culture of Molluscs in the world. Major species of oysters, mussels, clams, cockles, scallops, gastropods in aquaculture.

Culture systems and principles. Modern development , their distribution and abundance, collection techniques.

Hatchery production of seed, brood stock management, induced maturation and spawning, larval rearing techniques, spat settlement and spat collection, water quality, disease control and transportation of seed.

Oyster farming-site selection, farm structure, farming techniques monitoring growth and condition index, control of predators and harvesting of edible oyster and pearl oysters.

Techniques of pearl sac theory and pearl production. Inventory of an edible oyster and a pearl oyster farm; befouling in oyster farms and control measures. Mussel culture methods. Monitoring growth and condition index. Harvest methods and sea ranching . Abalone culture.

**P3 AQC T 09 (ACT 302) Aquariculture, Aquaculture Economics, Management and Administration.**

**72 hrs.**

**Module I. Construction and maintenance of aquarium. 10hrs.**

Present status of ornamental fish culture. Aquarium construction and setting up and maintenance of marine and fresh water systems. Aquarium plants and filters.

**Module II. Culture of aquarium fishes and management. 30hrs.**

Marine aquarium fish culture. Marine ornamental fishes and ornamental invertebrates.

Breeding of Gold fish, Koi, Angel fish, barb, Fighter, Gourami, Livebearers, clown fish, Damsels, Butterfly fish, Seahorse. Live feed culture.

**Module III. Economics. 20hrs.**

Application of production economics in aquaculture. Law of diminishing returns; definition and application, marginal analysis-total products, average product, marginal product curves and formulae. Producer decision criteria, profit maximisation.

Cost fractions-determining maximum profit level of production, opportunity costs, fixed costs, variable costs, full costs, revenue function, total average marginal-production function in aquaculture. Investment financial planning and market analysis; investment-definition, autonomous and induced investment; choice and formulation of aquaculture investment projects, factors influencing investments and decisions, enterprise budget and partial for aquaculture enterprises.

Income cash flow and statements. Ration analysis; supply and demand functions for aquaculture products. Consumer surveys for aquaculture products; market analysis and questionnaire design.

**Module IV Aquaculture management. 12hrs.**

Management of hatcheries and farms. Availability of manpower and skilled labour in India. Personal requirements and management. Material management. Financial management. Poaching and natural calamities. Water quality control for hatcheries and farms.

Criteria and nature of data input needed for preparation of feasibility reports on hatcheries and on fish feed mill.

# p3 AQC T 10 (ACT 303) Culture of crustaceans, sea weeds and fisheries technology.

72 hrs.

## Module I crustacean culture

Overview of crustacean culture in the world.

Major species used production trends, technologies and problems of crustacean culture in India.

Historical background and recent advances; species cultured, potential species and characteristics of their suitability for aquaculture.

shrimp/prawn seed production-natural seed resources, their distribution and abundance, collection and transportation, hatchery production of seed, brood stock management and breeding under controlled conditions, larval rearing techniques and mass production of seed.

Recent advances in seed production technology for crabs and lobsters, nursery phase.

Different kinds of grow out culture systems, traditional prawn culture practices and modern farming techniques; extensive, semi-intensive, super intensive shrimp farming in different maritime states and production details. Prawn culture in salt pan reservoirs, raceways, cages, pens and recirculating systems. Sea ranching of prawns.

Culture practices and potentials for crabs and lobsters.

35 hrs

## Module II Sea weed culture

Taxonomy of economic seaweeds, seaweed morphology, reproduction and life cycle; growth of seaweeds and factors affecting it.

Seaweed culture; present status of seaweed culture in the world.; seaweed culture in India- site selection, design of culture plots and transplanting, determining growth pattern and environmental monitoring; causes of mortality; small scale and commercial scale culture operations.

Utilization of seaweeds; post – harvest technology of cleaning, washing and storage; chemical composition of seaweed; processing and extraction of algin, alginic acid and alginates, processing and extraction of agar ,mannitol and carrageen.

15hrs

## Module III Microbiology

12 hrs.

Fundamental principles of bacteriology,-Morphology, size, reproduction and growth.  
Bacterial spores, staining of bacteria, various staining methods Effect of environment on growth of bacteria-classification of bacteria.

Intrinsic and extrinsic parameters affecting microbial growth in food. Spoilage microorganisms of fish and fishery products. Psychrophilic and mesophilic microbes in processed fish and fishery products.

#### **Module IV Fisheries Technology**

**10hrs.**

Post mortem changes in fish –glycolysis, nucleotide degradation, catheptic enzymes, Principle changes following death of fish- autolysis, rigor mortis, autolytic enzymes.

Chemical composition of fish-lipids, protein, vitamins, minerals, non protein nitrogen compounds, carbohydrates, decarboxylation and deamination compounds.

Sensory characteristics of fresh fish: Ice- different types of ice and their production flow ice and gel ice.

Chilled storage- in ice, CSW, CFW, RSW, chilled storage shelf life. Changes in fish during iced storage: physical, chemical, microbial and sensory changes.

Modified atmospheric packaging (MAP) and controlled atmospheric packaging (CAP).

Handling of fish on board, landing centers, retail outlets and pre processing centers.

Transportation of fish and containers used for transportation.



### Module I

Identification of economically important aquarium fishes, aquarium plants and invertebrates.

Construction and maintenance of aquarium, setting up of aquarium tanks.

### Module II

Breeding and rearing of commercially important ornamental fishes in hatcheries and tanks.

Live feed culture.

### Module III

Preparation of schedule for collecting data on market survey, field level data collection, sampling examples of PCM/IRT/NPD. *analysis and interpretation of data*

# P3AQCP06 Post harvest technology and quality evaluation of sea food.(Practical)

## Module I

Chemical evaluation of fresh fish and fish products-

Estimation of moisture, total nitrogen, non protein nitrogen, alpha amino nitrogen, trimethyl amine nitrogen and total volatile nitrogen. Ash.

Estimation of total fat. Free fatty acids, <sup>peroxide</sup> peroxide value.

Microbial quality of fresh fish and changes in microbial quality on storage.

Laboratory techniques to detect and identify pathogens in fish-E.coli, Staphylococcus aureus, Streptococcus, Clostridium, Salmonella, Vibrio sp.

Sensory evaluation of fish and fish products.

## Module II Post harvest technology

Handling of fresh fish,

Killing methods

Changes during chill storage- chemical, microbiological and sensory.

Containers for fish transportation

P4 AQC T 12 (ACT 401)- Fishing Technology (Edited) 72 hrs.

**Module 1: Fishing crafts.**

Types of fishing crafts: traditional, motorized; different types in India and principles of operation.

Outline of the method of construction of fishing boats in wood, fiber glass and Ferro cement and steel. 20hrs.

**Module II Marine Fouling**

Marine Fouling: Painting schedule, Maintenance of fishing boats.

Classification of corrosion; Marine corrosion and its control

Recent advances in fishing craft technology. 20 hrs.

**Module III Fishing Gear**

Classification of fishing gear system, Fishing gear materials and their properties.

Estimation of weight of netting.

Basic principles of gear design and capture mechanism. Fishing gear for closed water systems.

Nets: drag nets, shore sciences and light fishing. 22 hrs

**Module IV Low energy fishing**

Low energy fishing- Hooks and Lines, gillnets and Tangle nets, cast nets, Trammel nets and traps.

Responsible fishing: IUU, by catch reduction,  
Turtle Exclusion Device. 5hrs.

**Module V Basic Principles of Navigation.**

Basic principles of navigation.

Fish finding devices- conventional and modern fish aggregation devices

Recent advance in fishing gear technology. 5hrs.



**Module I - Freezing Technology of fish**

Refrigeration, refrigeration load, refrigerants, cold storage of fish

Crystallization, Freezing curves for pure water and water in fish, physical and chemical changes on freezing, effect of freezing on location and size of ice crystals

Technological aspects of freezing: Slow freezing and quick freezing, Air blast freezing, tunnel freezing, fluidized bed freezing, spiral freezing, immersion freezing, contact plate freezing, cryogenic freezing and high pressure freezing.

Freezing on board fishing vessels, IQF freezers, selection of a freezing method, chemical, physical and sensory changes during freezing and frozen storage.

Chemical treatment of fish prior to freezing, TTT and PPP factors, packing of frozen products, processing and freezing of frozen sea food products for export from India.

(25 Hrs.)

(23 hr)

**Module II - Canning of fish.**

Principles of canning: Heat transfer in canned fish, thermal destruction of bacteria, D and  $D_0$  value,  $F_0$  value Z value, determination of process time, cook values, Aseptic packing, containers for canning, unit operations, equipment used for canning, canning of sardine, tuna, and prawns. Retort pouch packaging. Waste management in canning industry, defects of canned products.

(15 Hrs.)

**Module III - Curing and drying of fish**

Water content and water activity, water activity and microbial spoilage, drying of fish, constant rate and falling rate drying period, salting and salting methods, drying methods for fish, packaging and storage. Quality problems and solutions. Maillard reaction, lipid oxidation, microbial, fungal and insects infestation. Packaging of dried products.

Smoking: objectives, smoke production, smoke components, quality, safety and nutritive value, processing and equipment,

Freeze drying of fish. Accelerated freeze drying. Packaging of freeze dried products.

(10Hrs.)

#### Module IV - Fish Bye- products.

Mince and surumi – Cryoprotectants, packaging, freezing and storage. Fish protein concentrate, fish meal and oil, fish liver oil, fish hydrolysate, fish silage, Caviar, gelatin, glue, pearl essence, dehydrated gelly fish, squalene, fish maws and isinglass, Ambergris, Beche de mer.

Chitin, chitosan, and glucosamine hydrochloride,

Utilization of prawn waste and fish processing waste.

Processing and extraction of algin, alginic acid, alginates, agar, manitol, and carrangenan.  
(8 Hrs. )

#### Module V Value added fish products

Coated fish products, batter, bread crumbs, general procedure for preparation of battered and breaded products, objectives, packaging and storage, equipment for making coated products, quality of coated products.

Types of coated products: coated fish fillets, fish fingers, coated shrimp products, moulded products, fish cutlets, fish balls, fish burger (patties).

Seafood analogues and imitation products. (8 Hrs.)

#### Module VI - Other methods of preservation

Fermented fish products, fish sauce, fish paste, fish sausage.

Radiation preservation, principles of radiation, ionizing radiations and their sources, units, application of radiation, Shelf life extension, radappertization, radurisation, radacidation and radiation doses for irradiation of different fish products. Safety of irradiated fish.

Hurdle technology.

(8 Hrs.)

## **p4 AQCT 14 (ACT 403) Fish Microbiology and Quality Assurance 72 hrs.**

### **Module I - Fish Microbiology.**

**25hrs.**

Native bacterial flora of fish, Microbes causing fish spoilage, Effect of low temperature, high temperature, salting, drying and hurdle technology on bacteria. Fecal indicator organisms and bacterial pathogens viz. Pathogenic E.coli, S. aureus, Salmonella, Shigella, Pathogenic Vibrios, L. monocytogenes, Clostridium etc. in fish and fishery products. Microbial analysis of water. Fish contact surfaces, fish and fishery products including isolation and identification of various bacterial pathogens. Biological hazards in seafood.

### **Module II - Quality Control.**

**20hrs.**

General aspects of seafood quality and quality problems

Fish spoilage and quality assessment. Bacteriology of spoilage of fish and shellfishes

Fecal indicator bacteria in fish and bacteria of public health significance.

Salmonella in sea foods. Seafood toxins

Quality of water and ice for seafood processing

Trace metals in fish and shellfish

Good manufacturing practices in seafood processing.

### **Module III - Quality assurance in seafood trade**

**27hrs.**

Safety foods. End product quality and process control.

Hazards analysis and critical control points in sea food industry.

National and International standards for and fish products

Quality management and ISO 9000 series of standards. Waste management

Prerequisite programmes, SOP, SSOP, GMP, BUREAU OF INDIAN STANDARDS (BIS), Product traceability and recall. Sanitizers, Detergents, Cleaning agents and Disinfectants.

P4 AQCP09 Fishing Technology- Practicals

(724)

**Module I**

Visit to net making factory-report

Netting twines, rope, netting, cutting, tailoring, mounting, design of nets

**Module II**

Visit to boat building yard- report

Boat building materials, back bone assembly, planking, maintenance of fishing boats, traditional and modern fishing vessels.

P4 AQCP07 Fish Processing technology practicals

72 hrs

Module I

Production of salted and dried fish.

Salting methods, drying methods.

Determination of moisture and salt content.

Production of frozen fishery products- dressed fish, fillets, minced fish, surumi,

Production of prawn products- whole prawns, HL, PUD, PD, Butterfly prawns.

Module II

Packaging of frozen prawns,. Block frozen products, IQF products.

Freezing of marine products. Plate freezing, IQF freezing.

Production of canned products.

Product development. Fish cutlet, fish balls, fish burger.

Fishery byproducts. Fish meal, fish oil, chitin, chitosan, shark fin rays.

Fish pickle, smoked fish products,



PHAS.0707

( 7.2 hrs )

**P3AQCP08 Microbiology and quality assurance. Practicals**

Evaluation of fish/fishery products for organoleptic, chemical and microbiological qualities.

Methods for analysis of bacterial quality and chemical parameters.

Water quality analysis. Colour, turbidity, odour, pH, dissolved solids, alkalinity, hardness, sulphate, chloride, metals like iron.

Bacteriological quality of water. Total plate count, coli forms, salmonella.

Evaluation of sanitary condition of fish processing plants. Analysis of typical hazards.

Sensory evaluation of fish products.

Quality Evaluation of dried fish, canned fish and frozen products.

Visit to processing plant - (E.T.P) and Report with special refer to E.T.P..