

MAHATHMA GANDHI UNIVERSITY

**PRIYADARSHINI HILLS
KOTTAYAM-682560**

**RESTRUCTURED CURRICULUM
FOR POSTGRADUATE PROGRAMME
UNDER CREDIT AND SEMESTER
SYSTEM**

**POSTGRADUATE PROGRAMME
IN
AQUACULTURE AND FISH
PROCESSING
(EFFECTIVE FROM 2012 ADMISSION
ONWARDS)**

Mahatma Gandhi University

PG Programme For Credit Semester System 2011 (MGU-CSS-PG)

Scope, Definition, Programme Structure, Registration, Admission Requirement, Examination, Direct Grading System, Grade card, Award of Degree etc, are given in the PG Programme Regulations for Credit Semester System 2011 as per U.O.No. 53861/L/Acad PGCSS(R) 2011/.Dated 30th September and U.P.No.6581/AC. A1X/2011.P.G.Dated 7th December 2011. Available at -www.mgu.ac.in.

Evaluation and Grading in Zoology

1. Evaluation

The evaluation scheme for each course shall contain two parts (a) internal evaluation (b) external evaluation 25% weight shall be given to internal evaluation and the remaining 75 % to external evaluation and the ratio and weight between internal and external 1:3. Both internal and external evaluation shall be carried out using direct grading system.

A) Internal evaluation

The internal evaluation shall be based on predetermined transparent systems involved periodic written tests, assignment, seminars and attendance in respect of theory courses and based on written tests, lab skill/records/viva and attendance in respect of practical course. The weights assigned to various components for internal evaluation are as follows :-

Theory Internal Evaluation- Total weight :10

Components	Weight
Attendance	1
*Two test papers	2+2
**Assignment	3
***Seminar	2

Attendance

% of attendance	Grade
>Or 90%	A
Between 85 & 90	B
Between 80 & 85	C

Between 75 & 80	D
< 75	R

*The test paper must be minimum of two hour duration

**Assignment – One assignment for each course .The assignment must be a written or typed 4-6 paper document with paper introduction pertaining to the topic ,at thoroughly referred subject matter ,conclusion and all cited references in the bibliography .While assigning grade take into account the six , points viz. punctually introduction ,content ,conclusion ,language and references(0.5 weight for each point).

During the first semester ,for course 2(ZyICT02)instead of the course content based assignment students may submit of review of any popular book in biology as an assignment .The format and grading will be the same as given above.

***Seminar- The grading of seminar shall be based on punctually, content ,style of presentation and response to questions (0.5 weight for each component)

Practical Internal Evaluation-Total weight :

Components	Weight
Attendance	1
Punctuality & Lab performance	1
Test	2
Record	1

Best of two tests/one model per semester

Project internal evaluation -Total weight:5

Sl.No.	Assigned Work	Time
1	Topic selection and review of literature	2 nd semester
2	Introduction and methodology presentation and evaluation	3 rd semester first month
3	Lab and field experiment(project work)	3rd sem 1 st month to 4 th sem 2 nd month
4	Results presentation report writing	4 th sem 3 rd month
5	Final project presentation with powerpoint	4 th sem 4 th month

Components	Weight
Punctuality	1
Introduction & methodology	1
Report and presentation	2
Viva	1

Theory External Evaluation -Total Weight:30

Theory examination conducted at the end of every semester will be Three hours duration

Pattern of question papers

Section	Type	No. to be Answered	Eight	Total weight
A	Short answer	10 out of 12	1	10
B	Short essay	5 out of 8	2	10
C	Essay	2 out of 3	5	10

Directions for question setting

While preparing the question papers for each course make sure that the questions proportionately cover all units. Earmark 10% of the questions from the prerequisite topics suggested in each course.

Section A – question should be answered in 5 minutes duration

Section B - question should be answered in 10 minutes duration

Section C - question should be answered in 30 minutes duration

Practical External Evaluation-Total Weight :15 ,Duration 4 hours

External practical examination shall be conducted at the end of each semester. There will be external examiners and one internal examiner for the conduct of the examination records will also be evaluated by the examiners for which the assigned weight is 1(one). The division of the remaining 14 weights (15-1=14) will be decided by the chairman of the Board of the Examination in consultation with the Chairman of Board of Studies.

Project Evaluation and Viva voce – shall be conducted by a Board of three examiner at the end for the fourth semester ,after the conduct of the practical examination .The project viva board shall have two external examiners and one internal examiner (the HOD) or nominee). It can be done on the same day as per the schedule prepared by the Chairman of the Board of Examiners.

Abstract of the CSS PROGRAMME OF M.Sc Aquaculture and Fish Processing

Semester	Course code	Course titles	Hours/ WEEK	TOTAL /HOURS	credit
I	ACT01	Taxonomy and Biology of commercial and cultivable fin fish and shell fishes	5	90	4
	ACT02	Biophysics, Instrumentation, Micro techniques and research methodology	5	90	4
	ACT03	Biostatistics and computer application	5	90	4
	ACT04	Aquaculture engineering	5	90	4
	ACP105	Practical I Taxonomy and Biology , Instrumentation, micro techniques, Biostatistics & Computer application and Aquaculture engineering	5	90	3
	Total		25	450	19
II	ACT201	Ecology of culture systems and Aquatic biology	5	90	4
	ACT202	Biochemistry and Nutrition	5	90	4
	ACT203	Physiology and pathology of fin fish and shell fish	5	90	4
	ACT204	Genetics and Biotechnology	5	90	4

	ACP205	Practical II Aquatic Biology, Biochemistry and Nutrition, Physiology, Pathology and Genetics.	5	90	3
	Total		25	450	19
III	ACT301	Culture of fin fishes, molluscs, and sea cucumbers	5	90	4
	ACT302	Aquaculture, aquaculture economics and Administration	5	90	4
	ACT303	Culture of crustaceans, sea weeds and Post harvest technology	5	90	4
	ACP304	Practical III Culture of fin fishes, molluscs, sea cucumbers, crustaceans and sea weeds	5	90	3
	ACP305	Practical IV Aquaculture and aquaculture economics and Fisheries TEchnology	5	90	3
	Total		25	450	18
IV	ACT401	Fishing Technology	5	90	4
	ACT402	Fish Processing Technology	5	90	4
	ACT403	Fish Microbiology and Quality Assurance	5	90	4
	ACP404	Practical V Fish Processing and Fisheries Technology	5	90	3
	ACP405	Practical VI Microbiology and Quality Assurance	5	90	3
	ACP406	Project I	-	-	4
	ACV407	Viva voce I	-	-	2
	Total		25	450	24
		Grand Total			80

Semester I

Theory Papers	
ACT 101	Taxonomy and biology of commercial and cultivable fin fish and shell fishes
ACT 102	Biophysics, Instrumentation, Micro techniques and research methodology
ACT 103	Biostatistics and computer application
ACT 104	Aquaculture engineering
Practical	
ACP 105	Practical I Taxonomy and Biology , Instrumentation, micro techniques, Biostatistics & Computer application and Aquaculture engineering

SYLLABUS

ACT 101 Taxonomy and Biology of Commercial and cultivable Fin fish and shellfish.

Biosystematics	90 hrs 10 hrs
Module I: Biosystematics	5hrs.
Hierarchy of categories and higher taxa, Taxonomic Procedure – Collection , preservation. Taxonomic character of different kinds ,quantitative analysis of variation , process typification , different zoological types and their significance.	
Module II: Methods of Biosystematics	5hrs
Classical and modern methods- Typological ,Phenetics ,Evolutionary ,Phylogenetic ,Cladistics and Molecular Taxonomy .International Code of Zoological Nomenclature(ICZN), Rules and formation of scientific names of different taxa concepts of species taxonomic diversity within species.Molecular Phylogeny- use of protein, DNA and RNA Phylogenetic trees.	
Taxonomy and Biology of Commercially important Fin fish and shellfish	70hrs
Module I Taxonomy of Commercially important Fin fish and shellfish	10 hrs
Commercially important fin fishes and shell fishes study of morphological characters and grouping up to	

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

Module II Digestive system

10 hrs

Structure and function of digestive system and associated glands in finfishes and shellfishes .Food and feeding habits of finfishes , prawns and bivalves, relative gut length.

Module III Respiratory system

10 hrs

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

Module I V Circulatory systems

10 hrs

Structure and function of circulatory system, Blood pigments and its functions

Module V Osmoregulation and excretion

Osmoregulation , osmoregulatory organs in finfishes, prawns and bivalves. Excretion and excretory organs .Excretion as means of osmoregulation.

Module VI Endocrine system

10 hrs

Structure and function of endocrine glands of fin fishes, hormones and their role in in fishes and shell fishes. Neuroendocrine system of prawns , **Role of hormone in relation to reproduction in fishes and prawns.**

Module VII Reproductive system

10 hrs

Structure and function of reproductive systems of finfishes and shell fishes. Gametogenesis, ovulation and fertilization. Gonadosomatic index , Phase of sexual maturity in fishes .Sex reversal and hermaphroditism.

Distribution of commercially important finfishes and shellfishes

10 hrs

Module I Distribution of commercially important finfishes and shellfishes

10 hrs

Distribution of commercially important finfishes and shellfishes in India and other parts of the world.

Definition of mud banks, wedge bank and parr. Upwelling and its importance to fisheries. Distributional shifts of fishery stock, climate change

References:

1. J. R. Norman & W.P.C. Tenison. 1963 History of fishes. Asian Publishing Hse, Delhi
2. Karl F. Lagler, John e. bardach, RobertR.Miller1969 Ichthyology. John Wiley & Sons, New York
3. Munro I.S.R. (1982) The Marine and Fresh water fishes of India and Ceylon. Sony Reprints Agency, New Delhi
4. Kapoor V.C.(1991)Theory and practice of Animal Taxonomy. Oxford and IBH Publishing Co. Pvt. Ltd. New Delhi.
5. Santhosh Kumar and ManjuTembhre (1996) Anatomy and Physiology of fishes. Vikas Publishing co.
6. Kotpal Mollusca
7. Kotpal. Arthropoda
8. Ekambaranathlyer. Invertebrate Zoology
9. FAO species identification key.

ACT102 Biophysics, Instrumentation and Microtechniques 90 hrs

Biophysics

Module 1 Diffusion and Osmosis 15 hrs

Diffusion, Kinetics of Diffusion, concentration gradient and Fick's Law, diffusion coefficient, stocks-Einstein equation, pressure gradient, electrical gradient and Graham's Law, Gibbs-Donnan equilibrium, facilitated diffusion, Osmosis, Vant Hoff's Law, Osmotic concentration and osmotic pressure, Biological significance of osmosis in fishes.

Module II Biophysics of cell membrane 10 hrs

Physics-chemical properties of cell membrane, conformational properties of membrane, membrane receptors, factors affecting the passage of materials across cell membranes. Artificial membranes.

Instrumentation. 40 hrs.

Module Calorimetry and spectrophotometry 10 hrs

Calorimetry and spectrophotometry (U.V. visible, infrared and double beam), pH and Eh meter, Oxygen and temperature probe, conductivity meter, salinometer and refractometer, atomic absorption spectrophotometer, acoustic and electronic equipments for behavioural studies, fluorimetry, flame photography, NMR.

Module II Protein purification 10 hrs

Basic methods involved in protein purification, Chromatography, absorption and partition chromatography, ion exchange and affinity chromatography, high performance (pressure) liquid chromatography, gel filtration chromatography.

Module III Electrophoresis**10 hrs**

General principles and different gel materials for electrophoresis, different electrophoresis, different methods of electrophoretic techniques.

Module IV Microscopy**10 hrs**

Principles of microscopy , bright field, dark field and phase contrast microscopy; fluorescence microscopy, microphotography, electron micrography, principles of electron microscopy ultrastructure studies using electron microscopy.

Microtechniques**25hrs.****Module I: Microtechniques**

25 hrs

Fixation of invertebrates and vertebrates tissues, organs , larvae and embryos. Isolated cells and bacteria .Dehydration methods, embedding, clearing and sectioning including cryo-sectioning. 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.

References

- Baker, E.J., and Silverion R.F., 1978. Introduction of Medical laboratory techniques ELBS.
- Das, D. 1991. Biophysics and Biophysical chemistry. Academic publishers, Calcutta.
- Ernster, L (ed.). 1985. Bioenergetics, Elsevier, New York
- Foyer, C.H. 1984. Photosynthesis, Wiley, New York Hoppe, W.et al.,(Eds.) Biophysics. Springer Verlag, Berline
- Leninger, A.L. 1971. Bioenergetics. W.A.benjamin, London.
- Narayanan, P. 2000. Essentials of Biophysics, New Age International pvt. Ltd. Publishers, ND.
- Nicholls, D.G. and Ferguson, S.J. 1992. Bioenergetics, Academic Press, New Yok. Pearse A.G.F., 1980. Histochemistry Vol. I & II. Churchill Livingston, New York.
- Roy, A.N. 1996. A test book of Biophysics, New Central Book agency Pvt. Lts. Calcutta. Sadhu, G.S. 1990. Research Techniques in biological Sciences, Anmol Publications, New Delhi. Weesner, F.M., 1960. General Zoological Microtechniques. The Willian and Willians Company, Baltimore.

ACT 103 Biostatistics.

90hrs.

Module I Measures of Central tendencies and dispersion

12hrs

Introduction, Mean and combine arithmetic mean, median and mode. Measures of dispersion. Range, quartile deviation, mean deviation ; standard deviation, variance, Relative measures of dispersion.

Module II Correlation and Regression analysis

13hrs

Correlation , kinds of correlation ,degree of corelation, types of correlation; Graphic method of Correlation analysis ,scatter diagram ,simple graph (correlation). Mathematical methods , Karl Pearson's coefficient of correlation- Spearman's rank correlation. Regression- Types of regression; methods of regression , study of basic statistic softwares like SPSS & RSM.

Module III Concepts in Sampling

35hrs

Probability ; measures of Probability ,theorems , probability distribution- binominal, piossion and normal .Tests of significance ; normal ,t, chi square and F tests ,Analysis of variance and Co-variance .Basic concepts in sampling and estimation off marine fish landings. Basic concepts in design of experiments .Introduction to bioassay. Fundamentals of population dynamics.

Computer Application

30hrs.

Module I: 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 II -Computer and communications

17 hrs

MS Office, MS word, MS excel, MS power point, Photoshop, Page Maker. Network, internet, World Wide Web, email, www.Fishbase-org. P.h.stat.

References.

- Agarwal, W.L. 1986. Basic statistics. New Age International Pvt. Ltd. Publishers, New Delhi.
- Baily, N.T.J. 198. Statistical Methods in Biology. Hodder and Strongton, London.
- Balaguruswamy E, 1986. Programming in Basics, Tata McGraw-Hill Pub.Co. Ltd, New Delhi.
- Campell R.c. 1978. Statistics for biologists, Blackie and sons Publishers, Bombay. Caswell, F. 1982. Success in statistics, John Murray Publishers Ltd., London.
- Finney, d.J. 1980. Statistics for Biologists. Chapman and Hall, London.
- Gupta S.P. 1996. Statistical methods, Sultan Chand and sons publishers, New Delhi.
- Jain, V.K., 1993. Computer fundamentals, BPS publishers, New Delhi.
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- Neswin D 1998. Microsoft windows at a glance. BPH publishers, New Delhi.
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- Rajive Mathews. DOS quick reference Galgottia publications.
- Saxena, S. 1998. A first course in computers, Vikas Publications House Pvt, Ltd. New Delhi.
- Sebasta R.W. 1999. Concepts of programming languages, Addition-Wesely, Massachesettes.
- Sinha, P. Computer fundamental. BPB publishers, New Delhi.
- Thomas, R.M. 1992. DOS5, BPB publishers, New Delhi.
- Gupta, S.P. 1998. Statistical method, Sultan Chand and Sons, New Delhi.
- Gupta, C.B.1996. An Introduction to Statistical methods. Vikas Publications House Pvt, Ltd. New Delhi.
- Srestha, H.B.1989. Elementary statistical methods, Orient Longman Ltd, Calcutta.

ACT 104 Aquaculture Engineering

90 hrs

Module I Water sources, supply and control

25 Hrs

Water hydrology , run-off and utilization ,factors affecting run-off ,qualitative and quantitative water requirements.

Canal water and tide water comparisons ,conditions of stability of bunds ,dykes etc.

Fluid pressure and its measurements ,hydrodinematics ,rate of discharge and types of flows .Bernoulli's equation and its applications.

Discharge measurements notches , weirs flumes and related measuring devices ,flow through pipe and nozzles, flow through open channels of different shapes .

Principles of waves and currents ,water flow and control structures ; monks ,spillways ,sluice gates ,water flow and level measurements.

Storgae tanks ,types ,fittings and accessories ,water requirement calculations.

Module II Properties of physical and mechanical soil

15 hrs

Types of soil, structure and textural classification , grain size distribution , bearing strength , methods of physical and mechanical analysis and their impact on qualitative appraisal of soils.

Physico-chemical properties and their impact on construction and maintenance of ponds.

Module III Equipments and selection of materials

20 hrs

Selection of materials for enclosures ,support ,retention and other structures based on their physical ,mechanical , thermal and chemical properties .

Principles ,operation and maintenance of pumps ,blowers compressors ,wind and solar energy systems, principles , operation and maintenance of filters and aerators .

Earth moving equipment , work ,power ,energy efficiency , elastic properties ,hand tools ,manually mechanically operated equipment

Types of corrosion including stress cracking and development of brittleness , fouling and their control.

Module IV Site selection , survey and farm layout

15 hrs

Analysis of sites and factors important in site selection , importance of engineering survey in layout and construction , methods of survey necessity of topographic map , micro level surveys and their comparison lay out of different farms and their relative and advantage. Pond dimension orientation access ways and structures .

Site selection for hatcheries : survey and location of suitable sites for fish and shrimp hatcheries

Farm design ,estimation construction and maintenance

Ponds ,rafts ,racks ,long lines ,**cages** ,pens and their designs

Completed information system and fisheries , global positioning system

Module V Design consideration for farms for various ecosystems

15 hrs

Design and construction of hatcheries and nurseires , design and lay out , material selection and construction , rearing facilities ,aeration.

References.

1. Thomas B Lawson. Fundamentals of Aquaculture Engineering
2. Wheaton, F.W. Aquaculture Engineering
3. Santhosh Kumar Garg. Water supply Engineering
4. Bose *et. al.* Coastal Aquaculture Engineering
5. Odd-IvarLekang . Aquaculture Engineering
6. Pillay, TVR and Kutty. M N. Aquaculture: Principles and Practices
7. Michael B.T and Thomas L. Aquaculture water reuse systems
8. Syda Rao *et al.* Cage farming

ACT 105 Practical I

90 hrs

Taxonomy and Biology , Instrumentation ,Micro techniques ,Biostatistics

,Computer Application and Aquaculture Engineering .

Module I Taxonomy and Biology

30 hrs

Collection and identification of commercially important fresh water , brackish water and marine fishes and shell fishes

Dissection of alimentary canal of economically important fishes and determination of its RGL and feeding habits

Dissection of alimentary canal of economically important crustaceans and molluscs and determination of hepatosomatic index.

Determination of gonadosomatic index , fecundity and its relationship with length and weight .

Collection of eggs , larvae and post larvae of commercially , important fishes and crustaceans

Module II Instrumentation

15 hrs

Chromatography (paper / TLC) for the separation and identification of aminoacids .

Polyacrylamide gel electrophoresis / paper electrophoresis for the separation of proteins

Oxygen ,salinity analysis , temperature probe ,conductivity meter , salinometer and

refractometer demonstration .

Module III Microtechniques

15 hrs

Micrometry , Phase Contrast Microscope , Camera Lucida , Micro Photographic equipment

.Preparation of microslides including whole mounts for evaluation during practical examination

covering fixation ,dehydration ,clearing ,embedding of tissues and preparation of blocs ;

sectioning ,affixing the section ,staining and mounting ,preparation of whole mounts.

Module IV Biostatistics and Computer Application

15 hrs

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

Study of computer components ; Microsoft Disk Operating System ,MS Word letter drafting and

mail merging in computer , use of internet and communication systems.

Module V : Aquaculture Engineering

15 hrs

Field work on sample collection ,recording of soil typography ,physical features of slopes ,plain

and beaches .Visit to different types of farms and other places of coastal areas to collect data on

various topographic features .

Exercises related to design of farms and bunds ; Exercises related to design of channels and

sluice gates; Exercises related to design of rafts ,pens and cages.

Semester II

Theory Papers	
ACT 201	Ecology of Culture Systems and Aquatic Biology
ACT 202	Bio-chemistry and Nutrition of Fin Fish and Shell Fish
ACT 203	Physiology and pathology of Fin Fish and Shell Fish
ACT 204	Genetics and Bio-technology of Fin Fish and Shell Fish

Practical	
ACP 205	Aquatic Biology, Bio-chemistry, Nutrition , Pathology and Genetics

ACT201 Ecology of culture systems and Aquatic Biology.

90 hrs.

Module I: Physical and chemical characteristics of water

25 hrs

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.

Module II Aquatic Microbiology

20 hrs

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.

Module III Aquatic Biology.

25 hrs

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.

Module IV Aquatic environment and Fisheries Oceanography.

20 hrs

Physico-chemical characteristics of fresh water ,classification of fresh water bodies, thermal stratification, fresh water communities , adaptations.

Rivers of Kerala. Characteristics of estuaries, classification, horizontal stratification, estuarine communities, adaptations. 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.

References.

Pushpangadhan.P and Nair, K.S.S. 1997. Biodiversity and Tropical forests. State Committee for Science and Environment (STEC), Trivandrum.

Verma, P.S and Agarwal, V.K. 2001. Environmental Biology(Principles of Ecology). S.chand and Co. Ltd. New Delhi.

Elvira A. Baluyut.1989. Aquaculture systems and Practices. Daya Publication House, New Delhi.
Ramanujam, G.Guidelines Effluent treatments in shrimp farms. Aquaculture Authority, Govt. Of India, Chennai.

Boyd, C.E. 1982.Water quality management for pond fish culture. Elsevier Science Publication.
Santhanam R. Ramanathan, N., Venketaramanujan, K., and Jagatheesan, G. 1987. Phytoplankton of the Indian seas. Daya Publishing House, Delhi

Keith Swerdup and Virginia Armbrust.2008. Introduction to the World's Oceans.

Krishna Iyer. 1958. Water Resources of Kerala. P.W.d.Kerala.

ACT202: Biochemistry and Nutrition of fin fish and shell fish. 90 hrs

Biochemistry **40hrs**

Prerequisites: Atoms, bonds, concepts of PH and buffers.

Module I: Carbohydrates **7 hrs**

Classification : monosaccharides, reaction of monosaccharides with acid and alkali. Disaccharides, Oligosaccharides and Polysaccharides, structural and functional polysaccharides.

Module II: Lipids. **10 hrs**

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

Module III: Proteins. **8 hrs**

structural organisation of proteins, Amino acids : essential, semiessential and non-essential , Globular and fibrous proteins. Metabolism of proteins; amino and break down and synthesis ,ammonia

formation and excretion.

Module IV: Enzymes.

8 hrs

Enzyme classification. Enzyme kinetics. Types of enzyme inhibition. Isoenzymes, co-enzymes.

Module V: Nucleic acids.

7hrs

Bases and sugars. Nucleotides. Replication of DNA, transcription and translation process.

Nutrition

50hrs.

Module I: Nutritional physiology.

15hrs

Principles of nutrition and historical background. Adaptations to various types of feeding in finfish, crustaceans and molluscs. Mechanism of food capture, nutritional bioenergetics in finfish and shellfish.

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.

Factors altering energy requirements, Water and fat soluble vitamins; their positive functions, minerals, recommended dietary allowances, deficiency and hyper dosage syndromes. Nutritional requirements of broodstock; factors influencing nutritional requirements.

Module II: Feed ingredients

20hrs

Classification of feed stuff and international feed information system. Conventional and non-conventional sources of feed ingredient. Anti-nutritional factors in feed ingredients and their effect on finfish and shell fish. Binders, antioxidants, mould inhibitors; their use in feeds; anabolic agents in fin fish and shell fish.

Feed formulation strategies and methods. Feed manufacture process; storage and quality control of feeds, management of fish feed mill. 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 forms of feed, economic formulated feeds, nutritive value of artemia; their mass culture and cyst production; micro diets for larvae. Recent advances in larval nutrition.

Feeding strategies. Chemical methods of evaluation; biological methods of evaluation. PER, BV, NPU, NPR, FCR/ ECR. **Feed dispensing methods.**

References

- Das, D. 2000. Biochemistry. Academic Publishers, Calcutta
- Garrett, R.H. and Grisham, C.M. 1995. Biochemistry. Saunders college of Publishing, New York
- Jayaraman, J. 1981. Manual of Biochemistry. Wiley Eastern Ltd. New Delhi.
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- Dr.Snahotra,M.K. Shrimp Feed Formulation and Feed Management,CMFRISpl Pub .
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- Seno. S. De Silva and Trevor Anderson , Fish Nutrition in Aquaculture ,Chapman and Hall ,Pub.
- Verreth,J. Fish Larval Nutrition , Chapman and Hall ,Pub.
- Stephen Goddard ,1996 Feed Management in Intensive Aquaculture .
- Farm-made Aquafeeds ,FAO , Fisheries Technical Paper 343.
- Devadasan .K.(Ed.) 1994,Fish Nutrition and Bioactive substances in Aquatic Organism.
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- ShimenoSadao,(1982) Studies on Carbohydrate Metabolism in Fish Amerind Publishing Company New Delhi.
- Cowey, C. B. et al. (Eds)(1985), Nutrition and Feeding in Fishes ,Academic Press,London.

ACT203: Physiology and pathology of fin fish and shell fish

90 hrs.

Physiology.

55hrs

Module 1: Physiology.

25hrs.

Comparative physiology of respiratory, digestive, excretory and circulatory system.

Osmoregulation. Hormonal control of osmotic and ionic regulation . Organization of neurons and neuromuscular systems, mechanism of neurons and neuromuscular system; Mechanism and biology of neuron co-ordination.

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.

30hrs

General morphology, structure and function of neurosecretory system . 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 and 'x' organ, 'y' organ and androgenic gland in crustaceans. Neurosecretory cells in mollusc, Pituitary

and endocrine organs of fish, neurosecretory hormones- their storage, release and control of reproduction.

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 . Use of hormonal analogues, Hypophysation in finfish. Eyestalk ablation techniques-its principles and application in crustacean hatcheries.

Module I Pathology

35 hrs

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; defences 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.

References.

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Edward Kingsford, M.D. (1975) Treatment of Exotic Marine Fish Diseases. The Palmetto Publishing Company

Valerie Inglis, Ronald J. Roberts and JALL.R. Bromage (1993) Bacterial diseases of fish. Blackwell scientific publication, London.

Austin B and Austin D A (1987) Bacterial fish pathogens (Diseases in Farm and Wild), Lilies Horwood Limited.

ACT 204: Genetics and Biotechnology of Fin fish and Shell fish 90 hrs.

Genetics

50 hrs

Module I: Introduction to Genetics.

Introduction : 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 manipulation, 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.

Biotechnology in Aquaculture

40 hrs

Module I: Biotechnology in aquaculture.

40 hrs

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.

References.

- Yadav, B.V. 1995. Fish Endocrinology, Daya Publishing House, New Delhi Singh, R.P. 1990. Introductory Biotechnology, Central Book Depot, Allahabad.
- Tiews, K (Eds.) Selection, Hybridisation and Genetic Engineering in Aquaculture. Heenemann, Berlin.
- Das, P. and Jhingran A.G. (Eds.) Fish Genetics in India.1989. Today and Tomorrows printers and publishers, new Delhi.
- Gall G.A.E and Busack, C.A. (Eds.) 1986. Genetics in Aquaculture 2Elsevier.
- Collin E.Purdom 1993. Genetics and Fish Breeding. Chapman and Hall.
- Menon and Pillai(Eds.) 2001 Perspectives in mariculture. The marine Biological Association of India.
- Thomas, P.C. 1998. Shrimp Seed Production and Farming. Cosmo Publication.

**AC P205: Aquatic Biology, Biochemistry ,Nutrition , Pathology,
Physiology and Genetics. 90 hrs**

Module I. Aquatic Biology 30 hrs

Estimation of dissolved oxygen

Estimation of salinity

Determination of primary production.

Identification of plankton

Dissection of digestive system and analysis of gut contents in an omnivorous ,herbivorous and carnivorous fin fish and prawn

Module II Biochemistry 10 hrs

Estimation of protein in fishes and prawns

Estimation of fish lipids

Estimation of carbohydrate in fishes

Module III Nutrition 15 hrs

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 compound feed ; grinding ,sieving ,pelleting and drying.

Module IV. Pathology

25 hrs

Study of various diseases finfish and shell fishes. Identification of parasites. Isolation and cultivation of pathogenic bacteria, Treatment methods in fish diseases.

Module V Physiology

5 hrs

Dissection of neuroendocrine organs of a candidate species.

Module VI Genetics.

5 hrs

Preparation of chromosome from a fish.

Semester III

Theory Papers	
ACT 301	Culture of finfishes ,mollusc and seacucumbers
ACT 302	Aquariculture,Aquaculture Economics ,Management and Administration
ACT 303	Culture of crustaceans , seaweeds and fisheries technology
Practical	
ACP 304	Practical III Culture of finfishes ,mollusc, seacucumber ,crustaceans and seaweeds
ACP 305	N Practical IV Aquariculture , Aquaculture Economics and Fisheries Technology

ACT301: Culture of fin fishes, molluscs, and sea cucumbers

90 hrs

Module I Fin fish culture

40hrs

Overview of fin fish culture in the world – major species cultured, technologies ,country-wise 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.

Seed 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.

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.

40hrs.

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

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 pearl oyster farm. Biofouling in oyster farms and control measures. Mussel culture methods. Monitoring growth and condition index and harvesting methods and sea ranching. Abalone culture.

References

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Pillai .T.V.R.(2005) Aquaculture Principles and Practices,Blackwell Publishing Ltd. Menon.N.G. and Pillai.P.P (eds)(2001).Prespectives in Mariculture. The Marine Biological Association of india Publication.

James, P.S.B.R and Narasimham ,K.A (1993).A Hand Book on Aqua Farming

Santhanam R Sukumaran.N and Natarajan .A(1987) A Manual of Fresh Water Aquaculture . Oxward and IBH

CMFRI,Hatchery production of Pearl Oyster Spat: Pinctadafucata(1991) CMFRI Spl. Pub.Cochin

CMFRI,Hatchery Techniques and Culture of the Sea Cucumber Holothuriascabra(1994)CMFRI SplPub,Cochin.

Sebastian C D and George Patani,Fish Culture in Ponds .Pookote Fisheries Kerala. Dvey E B and M

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Bardach J E W (1972) Aquaculture Farming and Husbandary of Fresh Water and Marine Organisms.

Beveridge M C M (1987) Cage Aquaculture Fishing News

Miline P H (1972) Fish and Shell Fish Farming in China,Fishing News.

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Larid L M and T Needham (Eds) (1988) Salmon and Trout Farming John Wiley and Sons

Sedgewick.S D (1990) Trout Farming Hand Book .Fishing News

Pillai T V R (1994) Aquaculture Development Progress and Prospects.Halsted press.

Artificial Reefs and Sea Farming Technologies (1996)CMFRI Bulletin no. 48

Transportation of live fish and shell fishes (1997)CMFRISpl Pub. No.66

Boyd. C E and Pillai V K Water quality management in aquaculture 1985 CMFRI .Spl. Pub. 22.

ACT302: Aquariculture, Aquaculture Economics, Management and Administration. 90 hrs

Module I. Construction and maintenance of aquarium.

20hrs.

Present status of ornamental fish culture

Aquarium construction and maintenance of marine and fresh water systems. Aquarium plants and filters.

Module II. Culture of aquarium fishes and management.

30hrs.

Fresh water aquarium fish culture. 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.

Bulk production of ornamental fishes

Nutrition and feeds of aquarium fishes.
Establishment of a commercial ornamental fish culture unit.
Common diseases of aquarium fishes and management.

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 net worth statements. Ratio analysis; supply and demand functions for aquaculture products. Consumer surveys for aquaculture products; market analysis .

Module IV Aquaculture management.

20hrs.

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. Project formulation and evaluation - Criteria and nature of data input needed for preparation of feasibility reports for various types and scales of aquaculture. Criteria and nature of data input needed for preparation of feasibility reports on hatcheries . Criteria and nature of data input needed for preparation of feasibility reports on fish feed mill.

References.

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T.V.Anna Mercy *et al.*, 2007. Ornamental Fishes of the Western Ghats of India. NBFGR publication, Lucknow.
T.V.Anna Mercy 2000. An Aquairum at your Home (Malayalam).
Dey V.K.A. 1997. A hand book on Aquafarming ornamental fishes. MPEDA, Cochin.
Herber J Axelrod, Leonard P. Schultz. Handbook of Tropical Aquarium fishes, TFH, USA

ACT303: Culture of crustaceans, sea weeds and fisheries technology. 90 hrs.

Module I Crustacean culture 40 hrs

Overview of crustacean culture in the world.

Major species cultured ,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, intensive and super intensive shrimp farming in different maritime states and production details. Prawn culture in salt pan reservoirs, cages, pens and recirculating systems. Sea ranching of prawns.

Culture practices and potentials for crabs and lobsters.

Module II Sea weed culture 25 hrs

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; present status of 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.

Module III Fisheries Technology

25 hrs.

Microbs causing food spoilage , pathogenic organisms like –cholera ,salmonella, *Scaphylococcus aureus* etc, microbial analysis of food production and **identification of different microbes of public health significance.**

Spoilage microorganisms of fish and fishery products .Study of Psychrophilic and mesophilic microbes of processed fish and fishery products.

Handling and transportation of fresh fish .Different methods of production of ice ,storage calculation or requirement of ice ,storage of fish in ice .

Different methods of production of ice ,**storage calculation or requirement of ice ,storage of fish in ice,**

Different types of freezing methods like air blast freezing , plate freezing and cryogenics freezing curve , flowchart grading , packing and storage of frozen product. Drip loss and thawing of frozen fish changes during frozen storage.

Different value added products like fish fingers, flakes soup powder , **battered and breaded products and minced products.**

References

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The Marine Products Exports Development Authority Hand Book on Aqua Farming Shrimp ,Lobsters , Mud crab 1993.

MPEDA .Hand Book on Aqua Farming Seaweed, seaurchin ,seacucumber 1993.

MPEDA .Hand Book on Aqua Farming Seafishes.

MPEDA .hand Book on Aqua Farming Indian Lobsters .

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T.S.Gopalakrishnalyer .,Kandoran M.K., Mary Thomas and Mathew P.T. (2000) Quality Assurance in Sea Food processing CIFT

ACP304: Culture of fin fishes, molluscs, sea cucumber, crustaceans and sea weeds. 90 hrs

Module I

30hrs

Identification of cultivable fin fish, Collection and identification of fish seed from nature, determination of maturity stages in fish, observe techniques of induced and larval rearing, field observation on culture operation of fin fish in ponds, Identification of cultivable species of sea cucumbers and their larvae. Visit to a sea cucumber farm. Observation on sea cucumber breeding and larval rearing techniques.

Module II

30hrs

Determination of maturity stages in bivalves, identification of larvae of cultivable molluscs, setting up of spat collectors; identification of nanoplanktons; estimation of growth and condition index in oysters

Setting up of spat collectors, identification of nanoplanktons, estimation of growth and . Pearl oyster surgery for nucleus implantation, depuration of oysters, field visit to a mussel or oyster farm and observe culture practices, collection and identification of foulers and predators in an oyster farm.

Module III

30 hrs

Identification of larvae, post larval and juvenile stages of cultivable prawns, lobsters and crabs. Dissection of the female reproductive system and determination of maturity stages of penaeid prawn.

Observation of induced breeding, spawning and egg hatching and rearing of nauplius to post larvae, observation on prawn filtration practice, participation in modern prawn culture operation and assessing growth and production rates.

Identification of economic sea weed and their reproductive bodies. Field study of distribution and zonation of sea weeds, collection of sea weed material. Visit to small scale sea weed farm.

ACP305: Aquariculture and aquaculture economics and Fisheries Technology.

90 hrs

Module I

30 hrs

Identification of economically important aquarium fishes and invertebrates

Construction and maintenance of aquarium- aquarium tanks, aquarium plants, aquarium filters

Breeding and rearing in hatcheries and tanks

Preparation of schedule for collecting data on:

1. Market survey,
2. Field level data collection
3. Sampling examples of PCM/IRT/NPD.

Module II

30 hrs

Evaluation of fish/ fishery products for organoleptic, chemical and microbial quality

Laboratory techniques to detect and identify pathogens in fish – *E. coli*, *Staphylococcus aureus*, *Streptococcus faecalis*, *Clostridium perfringens*, *Salmonella*, *Listeria*, *Vibrio cholera*, *Vibrio parahaemolyticus*, *Clostridium botulinum*

Module III**30 hrs**

Special subject-Post –harvest technology of finfish and shell fishes

Organoleptic analysis of fish and cans

Semester IV

Theory Papers	
ACT 401	Fishing technology
ACT 402	Fish processing technology
ACT 403	Fish microbiology and quality assurance
Practical	
ACP 404	Practical V Fish processing and Fisheries Technology
ACP 405	Practical VI Microbiology and Quality Assurance
ACP 406	Project work , Factory Training /Farm Attachment
ACP 407	Viva -voce

AC T401: Fishing Technology

90 hrs

Module I Fishing crafts.

20 hrs

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, fibre glass and Ferro cement and steel.

Module II Marine Fouling

20 hrs

Marine Fouling: Painting schedule, Maintenance of fishing boats.

Classification of corrosion; Marine corrosion and its control

Recent advances in fishing craft technology.

Module III Fishing Gear

30 hrs

Classification of fishing gear system, Fishing gear materials. Estimation of weight of netting.

Basic principles of gear design and capture mechanism. Fishing gear for closed water systems. gillnets , cast nets, Trammel nets , drag nets, shore seines, traps and light fishing

Module IV Low energy fishing

10 hrs

Low energy fishing- Hooks and Lines, gillnets and Tangle nets,
Responsible fishing, Bycatch reduction,
Turtle Exclusion Device.

Module V Basic Principles of Navigation.

10 hrs

Basic principles of navigation.
Fish finding devices- conventional and modern: fish aggregation devices
Recent advance in fishing gear technology.

References.

M.Shahul Hameed and Boopendranath. M. R. 2000. Modern fishing gear technology. Daya Publishing, New Delhi.

K.P.Biswas. 1990. A text book of fish, fisheries and technology. Narendra Publishing house, N.Delhi.

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Brandt. A. V. 1984. Fishing Catching Methods of the World. Fishing news books printed, London 418pages. John. C.Sainbur 1971. Commerical Fishing methods, and Introduction to vessels and gear fishing. New books.

F.A.O. 1947. Otter board design and performance. FAO.Fishing manuals.

ACT402: Fish Processing Technology	90 hrs
Module I – Biochemical aspects	10Hrs.
Fundamentals of fish biochemistry	
Biochemical composition of fish	
Postmortem changes in fish	
Module II Fish Handling and Storage	20hrs
Preservation of fish	
Chilling of fish, iced storage of fish	
Transportation of fish and development of containers for transport for transport of fish	
Handling of fish on board vessels	
Preservation and processing of fish	
Salting / curing/drying of fish- freeze drying of fish	
Module III Freezing Technology of Fish	35hrs

Freezing technologies and equipments , methods of processing , storage and distribution of frozen fish

Frozen fishery products of commerce.

Canning of fish

Can materials , principles of canning ,Heat penetration characteristics, spoilage in canned products

Heat processing of fish in flexible pouches

Irradiation preservation of fish

Packaging of fish and fishery products

Module IV Fishery Products

10hrs

Traditional products cured and dried products

Diversified feed to value added products- **minced fish** ,IQF products ,Freeze dried products , **battered and breaded fish products**, extruded fish products.

Module V Fishery by products

15hrs

Fish meal ,Fish oil ,Fish maws ,**Chitin ,Chitosan** ,Glucosamine Hydrochloride their production and industrial application , Utilization of Krill, Squilla prawn waste

Fish hydrolysates and **fish silage**.

References.

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Sacharow, S.and Griffin R.C. 1998. Principles of food package- second edition AVI publication, co. Connecticut.

ACT403: Fish Microbiology and Quality Assurance

90 hrs

Module I Fish Microbiology

30hrs.

Fundamental principles of bacteriology

Bacteria morphology , size of bacteria, reproduction, growth of bacteria.

Bacterial spores - staining of bacteria , differential staining

Effect of environment on growth of bacteria of fishes- **Bacteria of public health significance** ,health-microbiological hazards in fish. Effect of salting , thermal processing , drying and freezing on bacteria

Module II Quality Control

30hrs

General aspects of seafood quality and quality problems

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

Faecal 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

30hrs.

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.

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ACP404: Practical V
Fish Processing and Fisheries Technology

90 hrs

Module I

70 hrs

Estimation of moisture ,Total nitrogen , non-protein nitrogen – L- amino nitrogen , trimethyl amine nitrogen, total volatile nitrogen ,**ash** and sodium chloride in fish

Estimation of total fat (lipids) in fish

Estimation of free fatty acids and peroxides values in fish lipids

Production of salted and dried fish

Production of frozen fishery products- Block frozen prawns, IQF prawns/ fish

Filleting of fish and production of frozen fish fillets

Production of canned shrimp and fish.

Storage of fish and shell fish in ice and estimation of shelf-life of fish in ice.

Laboratory scale production of fishery by-products- **fish meal , sardine oil ,chitin ,chitosan** ,shark fin rays.

Module II

10 hrs

Visit to net making factory-report

Netting twines, ropes, netting, cutting, tailoring, mounting, **design of nets**

Module III

10 hrs

Visit to boat building yard- report

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

ACP 405 Practical -VI
Microbiology and quality assurance

90 hrs

Module I

90hrs

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

Methods for analysis of bacterial quality and chemical parameters.

Water analysis- physical and chemical changes in fishes- colour, turbidity, odour, pH, dissolved solids, alkalinity, hardness, sulphate, chloride, metals like iron.

Bacteriological parameters of water- standard plate count-coli form bacteria, salmonella and other pathogen. Evaluation of sanitary

condition in fish processing units. Analysis of typical hazards.

Detection and identification of food poisoning bacteria.

Analysis of fish for heavy metals and pesticides

Sensory evaluation of fish .

Evaluation of fishery products by chemical , bacteriological and organoleptic tests .

- a) Dried fish,
- b) Canned fish / prawn
- c) Frozen shrimp

ACPt 406: Project work ,Factory Training / Farm Attachment /Net Making Factory /Boat Building Yard

ACVv 407 : Viva voce