

**SACRED HEART COLLEGE (AUTONOMOUS), THEVARA
KOCHI, KERALA, 682013**



CURRICULUM AND SYLLABUS

For

M.Sc. AQUACULTURE AND FISH PROCESSING

CHOICE BASED CREDIT AND SEMESTER SYSTEM (CBCSS)

INTRODUCED FROM 2024 ADMISSION ONWARDS

BOARD OF STUDIES

IN

AQUACULTURE AND FISH PROCESSING

Sacred Heart College, Thevara, Kochi, Kerala

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SACRED HEART COLLEGE (AUTONOMOUS), THEVARA, KOCHI,
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11	Anna A.T.	Faculty member
12	Mrs. Sreelakshmi A. M.	Faculty member
13	Dr. V.C. George	Special Invitee

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CONTENTS

1. Introduction

**2. Regulations for Post Graduate Programmes
(CSS- PG)**

3. POs and PSOs

4. Programme structure

5. Syllabus

6. Pattern of Question Papers

1. INTRODUCTION

M.Sc Aquaculture and fish processing is a PG programme focusing on two major areas in fisheries science, Aquaculture and Fish Processing. As the new trend is to have multitasked personnel, the students completing this programme will be competent to share managerial/ research responsibilities either in Aquaculture /Fish processing enterprises at the national and international level. With the above objectives in view, the programme consists of four semesters. Apart from the above, in order to make the programme student centric and experiential learning in the commercial fish farm, and fish processing factories, training in National Laboratories are incorporated in the 4th semester.

Eligibility for Admission

Graduation in Zoology or Botany/Biotechnology with zoology as complementary subject/ BFSc / B Sc Aquaculture/ B. Sc. Industrial Fisheries with not less than CGPA of 5.00 out of 10.00 in the Core Group (Core + Complementary + Open Courses) OR B. Voc. Commercial Aquaculture or B. Voc. Fish Post Harvest Technology and Management

2. REGULATIONS FOR POST GRADUATE PROGRAMMES UNDER CREDIT SEMESTER SYSTEM (CSS) – 2024

2.1 TITLE

These regulations shall be called ‘**SACRED HEART COLLEGE REGULATIONS FOR POST GRADUATE PROGRAMMES UNDER CREDIT SEMESTER SYSTEM (CSS) – 2024.**

2.2 SCOPE

Applicable to all Post Graduate (PG) programmes of the college with effect from 2024-25 admissions. The provisions herein supersede all the existing regulations for the post graduate programmes of the college.

2.3 DEFINITIONS

2.1 ‘Programme’ means the entire course of study and examinations.

2.1.2 ‘Duration of Programme’ means the period of time required for the conduct of the programme. The duration of post graduate programme shall be of four semesters spread over two academic years.

2.1.3 ‘Semester’ means a term consisting of a minimum of ninety working days, inclusive of examination, distributed over a minimum of eighteen weeks each having five working days, each with five contact hours of one hour duration.

2.1.4 ‘Course’ means a segment of subject matter to be covered in a semester. Each course is to be designed variously under lectures/ tutorials / laboratory or fieldwork/ study tour /seminar / project / practical training / assignments / evaluation etc., to meet effective teaching and learning requirements.

2.1.5 ‘Credit’ (Cr) of a course is the numerical value assigned to a course according to the relative importance of the content of the syllabus of the programme.

2.1.6 ‘Extra credits’ are additional credits awarded to a student over and above the minimum credits required for a programme.

2.1.7 ‘Programme Credit’ means the total credits of the PG Programmes. For PG programmes the total credits shall be eighty.

2.1.8 ‘Programme Elective Course’ means a course, which can be chosen from a list of electives and a minimum number of courses is required to complete the programme.

2.1.9 ‘Elective Group’ means a group consisting of elective courses for the programme.

2.1.10 ‘Programme Project’ means a regular project work with stated credits on which the student undergoes a project under the supervision of a teacher in the parent department / any appropriate institute in order to submit a dissertation on the project work as specified.

2.1.11 'Internship' is on-the-job training for professional careers.

2.1.12 'Plagiarism' is the unreferenced use of other authors' material in dissertations and is a serious academic offence.

2.1.13 'Seminar' means a lecture by a student, expected to train the student in self-study, collection of relevant matter from the books and internet resources, editing, document writing, typing and presentation.

2.1.14 'Evaluation' is the process by which the knowledge acquired by the students is quantified as per the criteria detailed in the regulations.

2.1.15 'Repeat Course' is a course that is repeated by a student for having failed in that course in an earlier registration.

2.1.16 'Audit Course' is a course for which no credits are awarded.

2.1.17 'Department' means any teaching department offering a programme of study approved by the college / institute as per the Act or Statute of the University.

2.1.18 'Department Council' means the body of all teachers of a department in a college.

2.1.19 'Faculty Advisor' is a teacher nominated by a Department Council to coordinate the continuous evaluation and other academic activities undertaken in the department.

2.1.20 'College Coordinator' means a teacher from the college nominated by the College Council to look into the matters relating to CSS-PG system.

2.1.21 'Letter Grade' or simply '**Grade**' in a course is a letter symbol (A+, A, B+, B etc.) which indicates the broad level of performance of a student in a course.

2.1.22 'Grade Point' (GP), is an integer indicating the numerical equivalent of the broad level of performance of a student in a course.

2.1.23 'Grade Point Average' (GPA) is an index of the performance of a student in a course. It is obtained by dividing the sum of the weighted grade points obtained in the course by the sum of the weights of the course ($GPA = \frac{\sum WGP}{\sum W}$).

2.1.24 'Weighted Grade Point' (WGP) is obtained by multiplying the grade point by its weight ($WGP = GP \times \text{weight}$).

2.1.25 'Credit Point' (CP) of a course is the value obtained by multiplying the grade point (GPA) by the credit (Cr) of the course ($CP = GPA \times Cr$).

2.1.26 'Semester Grade Point Average' (SGPA) is the value obtained by dividing the sum of credit points (CP) obtained by a student in the various courses taken in a semester by the total number of credits of the courses taken by him/her in that semester. The SGPA shall be rounded off to two decimal places and it determines the overall performance of a student at the end of a semester.

2.1.27 'Cumulative Grade Point Average' (CGPA) is the value obtained by dividing the sum of credit points in all the courses taken by the student for the entire programme by the total number of credits and shall be rounded off to two decimal places.

2.3.28 'Grace Grade Points' means grade points awarded to a student for course(s), in recognition of meritorious achievements in NSS/Sports/Arts and cultural activities, as per the orders issued by the college from time to time.

2.4 ATTENDANCE

Being a regular college, physical presence in the regular activities, especially, classes and exams, is mandatory for the students. However, if a student secures 75% of attendance he/she is eligible to appear for the exams, provided there are no other impediments like disciplinary proceedings, malpractice record etc.

2.4.1 Absence: A student found absent for one hour in the forenoon or afternoon session is deprived of the attendance for the entire session as far as eligibility for final exam is concerned.

2.4.2 Leave: A student has to formally report his/her absence with reasons either in advance, or immediately after the absence for obtaining an approved leave. This applies to all sorts of leave – medical, on duty or similar cases.

2.4.3 The student has to retain a copy/section of the approved leave form and produce the same as proof, in case there is any confusion regarding the leave sanctioning. In the absence of such proof, the claims will not be entertained.

2.4.4 Duty Leave: A student representing the college in sports, arts, social service or academic matters, has to get sanction from the class teacher concerned and submit the leave application form duly endorsed by the class teacher and the Head of the Department, and submit it to the Vice Principal. The same will be forwarded by the Vice Principal for attendance entry. The approval of the Department of Physical Education and the class teacher is required for granting attendance related to sports. The time limit for submission mentioned above is applicable in the case of duty leave as well.

2.4.5 Condonation: A student may have the privilege of condonation of attendance shortage (up to a maximum of ten days) on the basis of genuineness of the grounds of absence (medical reasons or college duty), duly recommended by the department. This is not a matter of right. It is a matter of privilege based on Principal's discretion and the good conduct of the student on the campus. A student of PG programme may have only one such opportunity.

2.4.6 Re-admission: A student whose attendance is inadequate will have to discontinue the studies. Such students, whose conduct is good, may be re-admitted with the approval of Governing Body, on the basis of recommendation from the department, and assurance from the student and the guardian regarding good conduct and compliance in academic and discipline matters. For this the prescribed re-admission fee has to be paid.

2.4.7 Unauthorised absence & removal from rolls: A student, absent from the classes continuously for ten consecutive working days without due intimation or permission, shall be removed from the rolls, and the matter shall be intimated to the student concerned. On the basis of recommendation of the department concerned, re-admission process may be permitted by the principal.

2.5 PROGRAMME REGISTRATION

2.5.1 A student shall be permitted to register for the programme at the time of admission.

2.5.2 A PG student who registered for the programme shall complete the same within a period of eight continuous semesters from the date of commencement of the programme.

2.6 PROMOTION

A student who registers for the end semester examination shall be promoted to the next semester. However, in extreme circumstances, a student having sufficient attendance who could not register for the end semester examination may be allowed to register notionally by the Principal with the recommendation of the Head of the Department concerned and by paying the prescribed fee.

2.7 EXAMINATIONS

All the end semester examinations of the college will be conducted by the Controller of Examinations. The principal will be the Chief Controller of Examinations. An Examination Committee consisting of the Chief Controller of Examinations, Controller of Examinations, Additional Chief Superintendent, Deans, IQAC Coordinator and other faculty members nominated by the principal will act as an advisory body on the matters relating to the conduct of examinations.

2.8 EVALUATION AND GRADING

2.8.1 Evaluation

The evaluation scheme for each course shall contain two parts:

a. Continuous Internal Assessment (CIA)

b. End Semester Examination (ESE)

25% weightage shall be given to internal evaluation and the remaining 75% to external evaluation and the ratio and weightage between internal and external is **1:3**, for the courses with or without practical (except the courses offered by the School of Communications). In the case of courses offered by the School of Communications, the internal-external assessment ratio shall be **1:1**. In their case, the components for evaluation and their respective weightage shall be determined by their Board of Studies. Both internal and external evaluation shall be carried out in the grading system and the GPAs are to be rounded to two places of decimals.

2.8.2 Direct Grading: The direct grading for the components of CIA shall be based on six letter grades (A+, A, B, C, D and E) with numerical values of 5, 4, 3, 2, 1 and 0 respectively as per the following scale of accuracy/level of quality. The questions for internal test papers and the end semester examination shall be prepared in such a way that the answers can be awarded A+, A, B, C, D and E grades.

Grade	Grade points	Scale of accuracy/Level of quality
A+	5	Greater than or equal to 90%
A	4	80% to less than 90%
B	3	60% to less than 80%
C	2	40% to less than 60%
D	1	20% to less than 40%
E	0	Less than 20%

2.8.3 Grade Point Average (GPA): Internal and external components are separately graded and the combined GPA shall be calculated for each course with weightage **1** for internal and **3** for external.

2.8.4 Components of Continuous Internal Assessment (CIA): Grades shall be given to the evaluation of theory/practical/project/comprehensive viva-voce and all internal evaluations are based on the Direct Grading System.

The Board of studies of the respective subject is permitted to make changes, if necessary, with regard to the weightages for the components of CIA without changing the total weightage of 5

a. Components of Internal Evaluation (for theory)

Sl.No	Components	Weightage
i.	Assignments	1
ii.	Seminar	1
iii.	Quiz/Field study/Industrial Visit/Viva Voce/Study Tour	1
iv.	Test Paper 1	1
v.	Test Paper 1	1
vi.	Total	5

b. Components of Internal Evaluation (for practical)

Components	Weightage
Lab involvement	1
Written/ Lab test	2
Record	1
Viva voce	1
Total	5

c. Components of Internal Evaluation (for project)

Components	Weightage
Relevance of the topic and analysis.	2
Project content and presentation	2
Project viva voce	1
Total	5

d. Components of Internal Evaluation (for comprehensive viva voce)

Components	Weightage
Comprehensive viva voce (all courses from first semester to fourth semester).	5
Total	5

2.8.5 Components of End Semester Examination (ESE):

a. For Theory

Evaluation shall be based on the following pattern of questions:

Sl. No.	Type of Questions	Weight	*Number of questions to be answered
1	Short answer type questions	1	8 out of 10
2	Short essay/problem solving type questions	2	6 out of 8
3	Long essay/problem solving type questions	5	2 out of 4

*Board of studies of respective subjects can decide on the number questions in each of type of questions.

b. For Practical

Components of External Evaluation (for practical)

Components	Weightage
Lab involvement	3
Written/ Lab test	6
Record	3
Viva voce	3
Total	15

The Board of studies of the respective subject is permitted to make changes, if necessary, with regard to the weightages for the components of Practical Examinations (External) without changing the total weightage i.e. 15. The pattern of questions for external evaluation of practical examinations can also be prescribed by the respective Board of Studies.

c. Components of External Evaluation (for project)

Components	Weightage
Relevance of the topic and analysis	3
Project content and presentation	7
Project viva voce	5
Total	15

d. Components of External Evaluation (for comprehensive viva voce)

Components	Weightage
Comprehensive viva voce (all courses from first semester to fourth semester)	15
Total	15

2.8.6 Project: Project work is a part of the syllabus of most of the programmes offered by the college. The guidelines for doing projects are as follows:

- i. Project work shall be completed by working outside the regular teaching hours.
- ii. Project work shall be carried out under the supervision of a teacher in the concerned department or an external supervisor.
- iii. A candidate may, however, in certain cases be permitted to work on the project in an industrial / Research Organization/ Institute on the recommendation of the Supervisor.
- iv. There should be an internal assessment and external assessment for the project work in the ratio 1:3
- v. The external evaluation of the project work consists of valuation of the dissertation (project report) followed by presentation of the work and viva voce.

2.9 PERFORMANCE GRADING

2.9.1 Students are graded based on their performance (GPA/SGPA/CGPA) at the examination on a 7-point scale as detailed below

Range	Grade	Indicator
4.50 to 5.00	A+	Outstanding
4.00 to 4.49	A	Excellent
3.50 to 3.99	B+	Very Good
3.00 to 3.49	B	Good (Average)
2.50 to 2.99	C+	Fair
2.00 to 2.49	C	Marginal (Pass)
Up to 1.99	D	Deficient (Fail)

2.9.2 No **separate minimum** is required for internal evaluation for a pass, but a minimum a ‘C’ grade is required for a pass in an external examination. However, a minimum ‘C’ grade is required for pass in a course and the programme as well.

2.9.3 A student who fails to secure a minimum grade ‘C’ for a pass in a course shall be permitted to write the examination along with the next batch.

2.9.4 Improvement of GPA: The candidates who wish to improve the GPA of the external examinations of a course/courses can do the same by appearing in the external examination of the semester concerned along with the immediate junior batch. The facility is restricted to first and second semesters of the programme.

2.9.5 Computation of SGPA and CGPA: For the successful completion of a semester, a student should pass all the courses and score at least the minimum SGPA grade ‘C’. After the successful completion of a semester, Semester Grade Point Average (**SGPA**) of a student in that semester is calculated as the ratio of the sum of the credit points of all courses taken by a student in the semester to the total credits of that semester.

Thus, $SGPA = TCP/TCr$, where **TCP** is **Total Credit Point of that semester** ($\sum_{i=1}^n CP_i$) and **TCr** is **Total Credit of that semester** ($\sum_{i=1}^n Cr_i$) where ‘n’ is the number of courses in that semester.

Cumulative Grade Point Average (**CGPA**) of a programme is calculated as the ratio of the sum of the credit points of all the courses of the programme to the total credits of the programme.

$$\text{CGPA} = \frac{\sum(\text{SGPA} \times \text{TCr})}{\sum \text{TCr}}$$

The SGPA/CGPA shall be rounded off to two decimal places.

For the successful completion of a programme, a student should pass all the courses and score at least the minimum CGPA grade 'C'. However, a student is permitted to move to the next semester irrespective of her/his SGPA.

To ensure transparency of the evaluation process, the internal assessment grade awarded to the students in each course in a semester shall be published on the notice board/website at least one week before the commencement of external examination. There shall not be any chance for improvement for internal assessment grade.

The course teacher and the faculty advisor shall maintain the academic record of each student registered for the course which shall be forwarded to the controller of examinations through the Head of the Department and a copy should be kept in the department for at least two years for verification.

2.10 REGISTRATION FOR THE EXAMINATION

- a. All students admitted in a programme with remittance of prescribed fee are eligible for the forthcoming semester examinations.
- b. Online application for registration to the various End Semester Examinations shall be forwarded to the CE along with prescribed fee for each course in prescribed format.
- c. The eligible candidates who secure the prescribed minimum attendance of the total duration of the course and possess other minimum qualification prescribed in the regulations for each course shall be issued the hall tickets. The hall ticket shall be downloaded by the students from the college website.

The mode of fee remittance shall be through the prescribed bank.

2.11 SUPPLEMENTARY EXAMINATIONS

Candidates who failed in an examination can write the supplementary examination conducted by the College along with regular examinations.

2.12 PROMOTION TO THE NEXT HIGHER SEMESTER

A candidate shall be eligible for promotion from one semester to the next higher semester if,

- a. He / she secures a minimum 75 % attendance and registered for the End Semester Examination of the programme for which he/she is studying.
- b. His / her progress of study and conduct are satisfactory during the semester completed, as per the assessments recorded by the course teachers and the Head of the Department concerned.

2.13 CERTIFICATES

1. Diploma and Degree certificates are issued by the Mahatma Gandhi University, Kottayam as per the act and statues of the University on the submission of the consolidated mark / score cards of the students by the College.
2. A consolidated mark / scored card shall be issued to the candidates after the publication of the results of the final semester examination taken by the candidate.
3. A Course Completion Certificate with classification shall be issued to students till the provisional certificate is issued by the university.

2.14 RANK CERTIFICATE

Candidates shall be ranked in the order of merit based on the CGPA secured by them. Grace grade points awarded to the students shall not be counted for fixing the rank/positions. Rank certificates shall be issued to the candidates who secure positions from the first to the third in the order of merit. The position certificates shall be issued to the next seven candidates in the order of merit.

2.15 AWARD OF DEGREE

The successful completion of all the courses with 'C' grade shall be the minimum requirement for the award of the degree.

2.16 MONITORING

There shall be a Monitoring Committee constituted by the Principal consisting of faculty advisors, HoD, a member from Teaching Learning Evaluation Committee (TLE) and the Deans to monitor the internal evaluations conducted by college. The course teacher, class teacher and the deans should keep all the records of the internal evaluation, for at least a period of two years, for verification.

Every programme conducted under Credit Semester System shall be monitored by the College Council under the guidance of IQAC Coordinator, Controller of Exams, Academic Deans and HoDs. An

academic committee consisting of the vice principal, deans and teachers nominated by the Principal shall look after the day-to-day affairs of these regulations.

2.17 GRIEVANCE REDRESSAL MECHANISM

In order to address the grievance of students regarding Continuous Internal Assessment (CIA) a three-level grievance redressal mechanism is envisaged. A student can approach the upper level only if grievance is not addressed at the lower level.

Level 1: Level of the course teacher concerned

Level 2: Level of a department committee consisting of the Head of the Department, a coordinator of internal assessment for each programme nominated by the HoD and the course teacher concerned.

Level 3: A committee with the Principal as Chairman, Dean of the Faculty concerned, HOD of the department concerned and one member of the Academic Council nominated by the Principal every year as members

2.18 TRANSITORY PROVISION

Notwithstanding anything contained in these regulations, the Principal of the college has the power to make changes in these regulations, by due orders, that shall be applied to any programme with such modifications as may be necessary on the recommendations of the Board of Studies of the respective programme.

3. POs and PSOs

PROGRAMME OUTCOME

	Programme Outcome
PO 1	Exercise their critical thinking in creating new knowledge leading to innovation, entrepreneurship and employability.
PO 2	Effectively communicate the knowledge of their study and research in their respective disciplines to their stakeholders and to the society at large.
PO 3	Make choices based on the values upheld by the institution, and have the readiness and know-how to preserve environment and work towards sustainable growth and development.
PO 4	Develop an ethical view of life, and have a broader (global) perspective transcending the provincial outlook.
PO5	Explore new knowledge independently for the development of the nation and the world and are able to engage in a lifelong learning process.

PROGRAMME SPECIFIC OUTCOMES

PSO1	Understand the taxonomy and biology of cultivable fin fishes and other organisms.
PSO2	Understand the ecology and cultural practices of cultivable fin fishes, shell fishes, sea cucumber, seaweeds as well as engineering principles as applied to aquaculture structures.
PSO3	Understand the harvest and post-harvest technology of aquaculture organisms.
PSO4	Awareness on the nutrition, physiology and pathology of aquaculture organisms.
PSO5	Application of statistical and computer tools in the research field.

4. PROGRAMME STRUCTURE OF M.Sc. AQUACULTURE AND FISH PROCESSING

Semester	Course Title	Course Code	Hours/Week	Credit	Total Credit
1st Semester	24P1AQCT01	Taxonomy and biology of commercial and cultivable fin fish and shell fish.	4	4	19
	24P1AQCT02	Biophysics, Instrumentation, Micro techniques and Research Methodology.	4	4	
	24P1AQCT03	Biostatistics and Computer Application.	4	4	
	24P1AQCT04	Aquaculture Engineering.	3	3	
	24P1AQCP01	Taxonomy and biology of fin fish and shell fish.	5	2	
	24P1AQCP02	Instrumentation, Micro-techniques, Biostatistics, Computer Application and Aquaculture Engineering.	5	2	
CSE P1					
Total			25	19	
2nd Semester	24P2AQCT05	Ecology of culture system and aquatic biology.	4	4	19
	24P2AQCT06	Biochemistry and nutrition of fin fish and shell fish.	3	3	
	24P2AQCT07	Physiology and pathology of fin fish and shell fish.	4	4	
	24P2AQCT08	Genetics and biotechnology of fin fish and shell fish.	4	4	
	24P2AQCP03	Aquatic biology, physiology, pathology and genetics.	5	2	
	24P2AQCP04	Biochemistry and nutrition of fin fish and shell fish.	5	2	
Total			25	19	
3rd Semester	24P3AQCT09	Culture of fin fishes, mollusks and sea cucumbers.	4	4	
	24P3AQCT10	Aquariculture, aquaculture economics, management and administration.	4	4	
	24P3AQCT11	Culture of crustaceans, sea	3	3	

		weeds and fisheries technology.			17	
	24P3AQCP05	Culture of fin fish, mollusks, sea cucumbers, crustaceans and sea weeds.	5	3		
	24P3AQCP06	Aquariculture and aquaculture economics.	5	3		
	Project (Evaluation will be done at the end of the fourth semester)		4			
	Study tour (optional)	Visit to national laboratories, research institutions, universities, aquaculture farms and hatcheries				
			25	19		
4th Semester	24P4AQCT12	Fishing Technology	4	4	25	
	24P4AQCT13	Fish processing Technology.	4	4		
	24P4AQCT14	Fish microbiology and quality assurance.	4	4		
	24P4AQCP07	Fishing Technology	4	2		
	24P4AQCP08	Fish processing Technology.	4	2		
	24P4AQCP09	Fish microbiology and quality assurance.	4	2		
	24P4AQCPJ	Project	1	5		
	24P4AQCCV	Comprehensive Viva Voce		2		
			25	80		

5. SYLLABUS

SEMESTER I

24P1AQCT01- Taxonomy and Biology of Commercial and cultivable Finfish and shellfish

Credit: 4

72hrs

COURSE OUTCOME

CO	CO Statement	PO/ PSO	CL	KC
CO1	Identify the commercially important fin fish and shell fish through taxonomic studies and their distribution in Indian waters	PO4 PSO1	Analyze	C
CO2	Understand the structural, functional and physiological features of digestive system and associated glands in fin fishes and shell fishes	PO4 PSO1	Analyze	C
CO3	Determine food and feeding habits of fin fish and shell fish	PO4 PSO1	Analyze	P
CO4	Understand the structural and functional features of circulatory system in fin fishes and shell fishes	PO4 PSO1	Understand	P
CO5	Understand the structural, functional and physiological features of respiratory system and accessory organs in fin fishes and shell fishes	PO4 PSO1	Understand	P
CO6	Understand the structure, function and role of excretory organs in osmoregulation of fin fishes and shell fishes.	PO4 PSO1	Understand	P
CO7	Understand the structure and function of nervous system and endocrine system in fin fishes and shell fishes	PO4 PSO1	Understand	P
CO8	Understand the structure and function of reproductive system in fin fishes and shell fishes	PO4 PSO1	Understand	P

MODULES

Module I: Morphology & Taxonomy of fin fish and shell fish

34 hrs.

Position of fishes in the Phylum-Chordata. Various trends in the classification of fishes. Major approaches to classification as discussed by Nelson (1994). General characters, evolution and classification of Fishes

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

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

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

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

ModuleII: 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 finfishes and shellfishes.

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

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

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

Nervous system: Brain and nerves.

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 finfishes, prawns and bivalves. Gametogenesis- spermatogenesis and oogenesis, ovulation and fertilization. Gonadosomatic index. Parental care in fin fishes.

Module III : Distribution of commercially important finfishes and shellfishes in Indian water

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

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7. Santhosh Kumar and ManjuTembhre (1996) Anatomy and Physiology of fishes. Vikas Publishing co.
8. Kotpal Mollusca
9. Kotpal. Arthropoda
10. Ekambaranath Iyer. Invertebrate Zoology
11. David, M. H, Craig Moritz and K.M. Barbara.1996. Molecular Systematics. Sinauer, Associates, Inc.
12. Kapoor, V.C. 1991.Theory and Practice of Animal Taxonomy. Oxford and IBH Publishing Co., Pvt. Ltd. New Delhi.
13. Mayr, E .1969. Principles of Systematic Zoology. McGraw Hill Book Company, Inc., NY.
14. Winston, J.E.2000. Describing species: Practical taxonomic procedures for biologists. Columbia University Press, Columbia.
15. FAO species identification key. Ifred J.R.B and Ramakrishna.2004.
16. Collection, Preservation and Identification of Animals. Zoological Survey of India Publications.

**24P1AQCT02- Biophysics, Instrumentation, Microtechniques and Research
Methodology**

Credit: 4

72 hrs.

COURSE OUTCOME

CO	CO Statement	PO/ PSO	CL	KC
CO1	Understand the principles and operation of optoelectric equipment's in biological research	PO1 PSO2	U	P
CO2	Create information on biophysics and instrumentation as applied to aquaculture	PO1 PSO2	U	P
CO3	Evaluate detailed anatomic studies with the help of micro techniques	PO1 PSO2	E	P
CO4	Understand the basic principles of physiology as applied to aquaculture systems	PO4 PSO2	U	P
CO5	Understand introduction to research methods as a prelude to research work at higher level.	PO1 PSO2	U	P

MODULES

1. Biophysics: 16hrs.

Module 1: Diffusion and Osmosis 8 hrs

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

Module II: Biophysics of cell membrane 8 hrs.

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

2. 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 ultrastructure studies using electron microscopy. 8 hrs.

3. Microtechniques 12hrs.

Module VII: Microtechniques: Fixation of invertebrates and vertebrates, tissues, organs. Dehydration methods, embedding, clearing and 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.

4. Research methodology:

10hrs.

Module VIII: 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 IX 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 X: 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.**

REFERENCES:

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

24P1AQCT03- Biostatistics and Computer applications

Credit: 3

72 hrs.

COURSE OUTCOME

CO	CO Statement	PO/ PSO	CL	KC
CO1	Application of statistical tools for experimental practices	PO1 PSO5	Analyze	M
CO2	Basic awareness on statistical tools in research and analysis of biological phenomenon	PO1 PSO5	Analyze	P
CO3	Computer knowledge is imparted as applicable to aquacultural practices	PO2 PSO5	Analyze	M
CO4	Computer knowledge at preliminary level for further studies	PO2 PSO5	Understand	P
CO5	Appropriate use of internet and communication system	PO5 PSO5	Understand	P
CO6	Sampling methods useful in estimation of marine fish landings	PO6 PSO5	Understand	P

MODULES

1. 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', X^2 and F-tests- Analysis of variance Techniques – Single factor – ANOVA

2. 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.Fishbase-org. P.h.stat.

REFERENCES:

1. 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.
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3. Campell R.c. 1978. Statistics for biologists, Blackie and sons Publishers, Bombay.
4. Caswell, F. 1982. Success in statistics, John Murray Publishers Ltd., London.
5. Finney, d.J. 1980. Statistics for Biologists. Chapman and Hall, London.
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7. Jain, V.K., 1993. Computer fundamentals, BPS publishers, New Delhi.
8. Levis A.E. 1971. Biostatistics affiliated East-West Press Pvt. Ltd. Delhi.
9. Loon A and Loon M., 1998. Internet in a nutshell, Loon Techworld, Chennai.
10. Neswin D 1998. Microsoft windows at a glance. BPH publishers, New Delhi.
11. Pillai, R.S.N. and Bhagavathi. 1987. Practical statistics, S. Chand and co., Pvt.Ltd, New Delhi. Rajive Mathews. DOS quick reference Galgottia publications.
12. Saxena, S. 1998. A first course in computers, Vikas Publications House Pvt, Ltd. New Delhi. Sebasta R.W. 1999. Concepts of programming languages, Addison-Wesely, Massachusettes. Sinha, P. Computer fundamental. BPB publishers, New Delhi.
13. Thomas, R.M. 1992. DOS5, BPB publishers, New Delhi.
14. Gupta, S.P. 1998. Statistical method, Sultan Chand and Sons, New Delhi.
15. Gupta, C.B. 1996. An Introduction to Statistical methods. Vikas Publications House Pvt, Ltd. New Delhi.
16. Srestha, H.B. 1989. Elementary statistical methods, Orient Longman Ltd, Calcutta.

24P1AQCT04- Aquaculture Engineering

Credit: 4

72 Hrs

CO	CO Statement	PO/ PSO	CL	KC
CO1	Describe the criteria for selection of site for freshwater, brackish water and mariculture systems.	PO4 PSO2	U	P
CO2	Understand the engineering principles which is helpful in design and construction of aqua farms	PO1 PSO2	U	P
CO3	Evaluate the basic features of soil by sampling method for classification, distribution and strength	PO4 PSO2	U	P
CO4	Understanding the working of different aquaculture equipment including hand tools	PO6 PSO2	U	P
CO5	Understand engineering principles which is helpful in design and construction of hatcheries	PO4 PSO2	U	P
CO6	Understand preparation of aquacultural projects	PO1 PSO2	C	M
CO7	Understanding the management pond and hatcheries	PO1 PSO2	U	P
CO8	Understand the application of feeding systems in aquaculture	PO4 PSO2	U	P

MODULES

Module I: 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 II: Surveying and Estimation of Area

8 Hrs

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

Module III: Design of Farms

8 Hrs

Design and construction of aquafarms – type of ponds, shape, size and their orientation from meteorological 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 IV: Soil

6 Hrs

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 V: 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. Sea farming, site selection and structures. Cage farming

Module VI: Aquaculture Equipment's

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 VII :Aquaculture Automobiles**6 Hrs**

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

Module VIII :Hatcheries**8 Hrs**

Design of shrimp hatcheries – selection of site, source of water, water treatment. Disinfection, heating and cooling equipment 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 IX :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 X :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. Use of AI in aquaculture systems

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. SydaRao*et al.* Cage farming

21P1AQCP01- Taxonomy and Biology of finfish and shell fish

Credit: 2

72hrs.

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

24P1AQCP02- Instrumentation, Micro-techniques, Biostatistics, Computer application and Aquaculture engineering.

Credit: 2

72 hrs.

Module I :Instrumentation

22hrs.

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

30hrs.

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

15hrs.

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 Windows OS, MS word, MS Excel, MS Access, letter drafting and mail merging in computer. Use of internet and communication system.

Module IV : Aquaculture Engineering

15hrs.

- 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 equipment
- 7) Grain size analysis of the soil.

SEMESTER II

24P2AQCT05: Ecology of culture systems and Aquatic Biology

Credit: 4

72 hrs.

COURSE OUTCOME

CO	CO Statement	PO/ PSO	CL	KC
CO1	Understand the basic ecology and aquatic biology as applicable to aquacultural organisms in captivity and controlled conditions	PO4 PSO2	Analyze	C
CO2	Evaluate the ways and means of circumventing, ecological imbalances for production of better aquacultural yield	PO4 PSO2	E	P
CO3	Understanding the basic features of fisheries oceanography	PO4 PSO2	U	C
CO4	Understanding the physico-chemical characteristics of marine environment	PO4 PSO2	U	C
CO5	Describing mud banks in capture fisheries	PO4 PSO2	U	P
CO6	Evaluate the effect of trawl banning in stock enhancement	PO4, PO5 PSO2	E	P
CO7	Enumeration different types of major groups of microbes from culture ecosystems	PO4 PSO2	Analyze	P
CO8	Understand the growth and reproduction of microbes in relation to different physico-chemical conditions in pond	PO4 PSO2	U	U

MODULES

Module I: Physical and chemical characteristics of water

15 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

25hrs.

Fundamental principles of bacteriology, Morphology, size, reproduction and growth. Classification of Aquatic microorganisms. 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. Staining of bacteria, various staining methods. 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.

12hrs.

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

Module IV: Aquatic environment and Fisheries Oceanography.

20hrs.

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.

REFERENCES:

1. Pushpangadhan. P and Nair, K.S.S. 1997. Biodiversity and Tropical forests. State Committee for Science and Environment (STEC), Trivandrum.
2. Verma, P.S and Agarwal, V.K. 2001. Environmental Biology (Principles of Ecology). S. Chand and Co. Ltd. New Delhi.
3. 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.
4. 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
5. Keith Swerdup and Virginia Armbrust. 2008. Introduction to the World's Oceans.
6. Krishna Iyer. 1958. Water Resources of Kerala. P.W.D.Kerala.

24P2 AQCT06: Biochemistry and Nutrition of fin fish and shell fish.**Credit: 3****72 hrs**

CO	CO Statement	PO/ PSO	CL	KC
CO1	Understand the basic principles of biochemistry as applied to aquaculture organisms in relation with environmental factors	PO4 PSO4	U	C
CO2	Understand the application of different additives in aquaculture feeds	PO4 PSO4	U	C
CO3	Describe the nutritional bioenergetics in fin fish and shell fish	PO4 PSO4	U	C
CO4	Understand the classification of feed stuff and anti-nutritional factors present in its	PO4 PSO4	U	C
CO5	Evaluation of quality of feed ingredients and finished feed	PO1 PSO4	E	P
CO6	Analyse the feed formulation strategies and methods	PO1, PO4 PSO4	An	P
CO7	Understand the management of feeding in aquaculture arms and hatcheries	PO1, PO4 PSO4	U	C
CO8	Understand the nutritional requirements of finfishes and shell fishes under culture condition	PO4 PSO4	U	C

MODULES

Biochemistry

32hrs

Module I

6hrs.

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

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

Module II

6hrs

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 breaks down, fatty acid synthesis.

Module III

7hrs.

Proteins. Amino acids, structural organisation of proteins. Globular and fibrous proteins. Metabolism of proteins; metabolism of phenyl alanine, sereine and glycine. Urea cycle.

Module IV

7hrs.

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

Module V

6hrs.

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

Nutrition

40hrs.

Module VI

8 hrs.

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.

Module V**10hrs.**

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.

Module VI**6 hrs.**

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

Module VII**10 hrs.**

Feed ingredients Classification of feed stuff. Anti-nutritional factors in feed ingredients and 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.

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, nutritive value of artemia; their mass culture and cyst production; micro diets for larvae. Recent advances in larval nutrition.

Module VIII**6hrs.**

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

REFERENCES:

1. Das, D. 2000. Biochemistry. Academic Publishers, Calcutta
2. Garrett, R.H. and Grisham, C.M. 1995. Biochemistry. Saunders college of Publishing, New York.
3. Jayaraman, J. 1981. Manual of Biochemistry. Wiley Eastern Ltd. New Delhi.
4. Lehinger, A. I, Nelson D.J., and Cox, M.M. 2000. Principles of Biochemistry. Worth Publishers. Plummer D.T. 1982. An Introduction to Practical Biochemistry, Tata McGraw- Hill Pub. Co. Ltd. New Delhi.
5. Smith. E.I. et al. 1983) Principles of Biochemistry General Aspects McGraw –Hill Book Company, New Delhi.
6. Strayer L. (1995) Biochemistry. W.H. Freeman. Co. New York.
7. Voet D and Voet, I.G. (1990) Biochemistry, John Wiley and sons, New York.
8. Dr. Snahotra, M.K. Shrimp Feed Formulation and Feed Management, CMFRISpl Pub .
9. Jayaraman. J. (1981) Laboratory Manual in Biochemistry, New Age International Ltd.
10. Tom Ovell (1934), Nutrition and Feeding of Fishes, Van No Strand Reinhold, New York.
11. Lakesh and Syed Ahamadhali (1985) Nutritional Quality of Live Food Organism and their enrichment, CMFRI Spl Pub.
12. Seno. S. De Silva and Trevor Anderson, Fish Nutrition in Aquaculture, Chapman and Hall, Pub. Verreth, J. Fish Larval Nutrition, Chapman and Hall, Pub.
13. Stephen Goddard , 1996 Feed Management in Intensive Aquaculture.
14. Farm-made Aquafeeds, FAO, Fisheries Technical Paper 343.
15. Devadasan. K. (Ed.) 1994, Fish Nutrition and Bioactive substances in Aquatic Organism. Kalyer Joh.e. (1972), Fish Nutrition, Academic Press, London.
16. Halyer John. E and Tiews Klaus (1979) Finfish Nutrition and Fish Feed Technology Heinemann, Berlin.
17. Hefher Ballour (1988) Nutrition of Pond Fishes, Cambridge University Press.
18. Tyler Peter and Callow Peter, (1985), Fish Energetic, CroomHelin, London.
19. Winbrege, (1960) Rate of Metabolism and Food Requirements in Fishes. Fisheries Research Board of Canada.
20. Shimeno Sadao, (1982) Studies on Carbohydrate Metabolism in Fish Amerind Publishing Company New Delhi.
21. Cowey, C. B. et al. (Eds) (1985), Nutrition and Feeding in Fishes , Academic Press, London.

24P2AQCT07: Physiology and pathology of fin fish and shell fish

Credit: 4

72 hrs.

COURSE OUTCOME

CO	CO Statement	PO/ PSO	CL	KC
CO1	Understand the basic physiology of fin fish and shell fish and its relation to cultural conditions	PO4 PSO4	U	C
CO2	Identification of pathogens in aquacultural organisms	PO4 PSO4	U	P
CO3	Understand the classification of disease in aquaculture systems	PO4 PSO4	U	C
CO4	Describe the disease control of fin and shellfish, remedial and prophylactic measures	PO4 PSO4	U	C
CO5	Comparative study of physiological characters of fin fish and shell fish	PO4 PSO4	E	P
CO6	Understanding the biological rhythm in aquatic organisms	PO4 PSO4	U	C
CO7	Understand the ecophysiology and environmental requirements for the metabolism of aquatic organisms	PO4 PSO4	U	C
CO8	Understand the principles and application of eye stalk ablation and hypophysation in fin fish and shell fish hatcheries	PO4 PSO4	U	C

MODULES

Physiology. **40hrs**

Module 1: Physiology. **20hrs.**

Physiology of respiratory, digestive system, circulatory system, Physiology of excretion and osmoregulation.

Nervous system. Mechanism and biology of neuron co-ordination.

Sense organs-receptive mechanisms and effector systems, biological rhythm. Ecophysiology, 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-structure of sinus gland complex. 'x' organ, 'y' organ and androgenic gland. Neuroendocrine control of reproduction, parasitic castration, Molting, growth and reproduction in crustaceans. Eyestalk ablation techniques-its principles and application in crustacean hatcheries.

Reproductive systems and secondary sexual characters, hermaphroditism process of gametogenesis. Endocrine system in fishes- their organization, morphology. Pituitary and endocrine organs of fish, pituitary hormones- Their storage, release and control of reproduction. Induced maturation and spawning in finfish, and mollusks, induced ovarian maturation and spawning through physical, chemical and biological method.

New generation drugs, Hypophysation in finfish.

Pathology. **32hrs.**

Module I: Introduction. Definition of terms, classification of disease, causes of diseases, 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 antibodies; types of antibodies produced in fish. Immunization in fish and vaccination.

Basic vascular and cellular alterations, 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. Parasitic diseases and their control

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

REFERENCES:

1. Biswas.K.P (1992) ,Prevention and Control of Fish and Prawn Diseases, Narendra Publishing House,Delhi.
2. Carl.J. Sinderman. (1997), Diseases Diagonosis and Control in North American Marine Aquaculture, Scientific Publishing co. New York.
3. Santhosh Kumar and Manju (1996) Anatomy and Physiology of Fishes, Vikas Publishing House,Pvt Ltd.
4. Rstogy,S.C. (1981) Experimental Physiology Eastern Ltd.
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12. Valerie Inglis, Ronald J. Roberts and JALL.r. Bromage (1993) Bacterial diseases of fish. Mlackwellscientific publication, London.
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24P2AQCT 08: Genetics and Biotechnology of Fin fish and Shell fish**Credit: 4****72 hrs.****COURSE OUTCOME**

CO	CO Statement	PO/ PSO	CL	KC
CO1	Understand Induced breeding, genetic improvement of the stock for better strains of cultural organisms	PO1 PSO1	An	C
CO2	Genetic engineering and biotechnological principles for crop improvement	PO1 PSO1	An	P
CO3	Understand the principles of genetic technique in cytogenetics	PO1 PSO1	U	C
CO4	Describing different hybridization techniques	PO4 PSO1	U	C
CO5	Describing different types of probiotics and its application in aquaculture	PO4 PSO1	U	C
CO6	Introduction to tools and techniques in modern biotechnology	PO1 PSO1	U	P
CO7	Analyze the developments of fish cell lines and their application in aquaculture	PO4 PSO1	An	P
CO8	Understanding the different types of vaccination in fish genetics	PO4 PSO1	U	C

MODULES

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. Types of mutations and mutagens. Recent trends in genetic mutations

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.

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

Gene expression and regulation.

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.

REFERENCES:

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2. Singh, R. P 1990. Introductory Biotechnology, Central Book Depot, Allahabad.
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4. Gall G.A.E and Busack, C.A. (Eds.) 1986. Genetics in Aquaculture 2Elsevier.
5. Collin E. Purdom 1993. Genetics and Fish Breeding. Chapman and Hall.
6. Menon and Pillai (Eds.) 2001 Perspectives in mariculture. The marine Biological Association of India.
7. Thomas, P.C. 1998. Shrimp Seed Production and Farming. Cosmo Publication.

24P2AQC P03: Aquatic Biology, Pathology, Physiology and Genetics.

Credit: 5

72hrs.

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.

Demonstration of Preparation of chromosome from a fish.

24P2 AQC P04: Biochemistry & Nutrition of Fin Fish and Shell Fish

Credit: 2

72hrs.

Module I: Biochemistry (Demonstration)

Colorimetric estimation of glycogen and glucose.

Estimation of fish lipids- estimation of total fat, free fatty acid value

Proximate composition of fin fish and shell fish.

Estimation of soluble proteins, Biurete and Lowry's method

Estimation of non-protein nitrogen, volatile nitrogen and Tri methyl nitrogen in fish

Module II: Nutrition

Identification of common feed ingredients, Demonstration of determination of lipid quality and 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

Preparation of purified diet for a prawn/fish (Demonstration).

SEMESTER III

24P3AQCT09: Culture of fin fishes, molluscs, and sea cucumbers

Credit: 4

72 hrs.

COURSE OUTCOME

CO	CO Statement	PO/ PSO	CL	KC
CO1	Understand the commercial practices on culture of fin fishes and mollusk	PO4 PSO2	U	C
CO2	Analyse the food and feeding of fin fishes, mollusc and sea cucumbers	PO4 PSO2	An	P
CO3	Understanding the characteristics and criteria for selection of species for mariculture	PO4 PSO2	An	C
CO4	Understanding the seed collection and transportation techniques	PO4 PSO2	U	C
CO5	Describe the culture and conservation of sea cucumbers in India	PO4 PSO2	U	C
CO6	Understanding the processing of sea cucumbers	PO4 PSO2	U	C
CO7	Describing different types of grow out culture systems	PO4 PSO2	U	C
10CO8	Study of ecolabelling and organizations related to it.	PO4 PSO2	U	C

MODULES

Module I: Fin fish culture

30hrs

Overview of fin fish culture in the world – major species cultured, 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- Induced breeding, egg incubation, larval rearing, and production of seed, nursery phase, brood stock management and breeding under controlled conditions.

Different kinds of grow out culture systems of fin fishes their advantages and disadvantages.

Fin fish culture in pens and cages, raceways, RAS, sea ranching of fin fish, integrated farming

Traditional and improvement farming practices. Operational details of monoculture and polyculture.

Aquaponics, Biofloc.

Aquaculture Stewardship Council, Ecolabelling, Marine Stewardship council.

Module II: Sea cucumber culture.

10hrs.

Present status of sea cucumber culture in the world. Natural resources and recent advances in breeding. Seed production, culture and conservation 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 from natural environment, water quality parameters, disease control in hatchery. 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 Mabe or image pearl production, pearl sac theory and pearl production.

Biofouling in oyster farms and control measures. Mussel culture methods. Harvest methods and sea ranching. Abalone culture. Depuration of bivalves, principles and methods.

REFERENCES:

1. Pillai T.V.R. (1988), Aquaculture Principles and Practices. Fishing News Books.
2. Naresh Kumar Agarwal (1996) Fish Reproduction, APH Publishing Corporation, New Delhi.
3. Pillai.T.V.R.(2005) Aquaculture Principles and Practices, Blackwell Publishing Ltd.
4. Menon. N.G. and Pillai.P.P (eds)(2001). Perspectives in Mariculture. The Marine Biological Association of India Publication.
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8. CMFRI, Hatchery Techniques and Culture of the Sea Cucumber *Holothuria scabra* (1994) CMFRI Spl Pub, Cochin.
9. Sebastian C D and George Patani, Fish Culture in Ponds. Pookote Fisheries Kerala.
10. Dvey E B and M Graham Eds (1982) Bivalve Culture in Asia and Pacific. IDRC Asia Regional office, Singapore. Aquaculture in Asia (1990) Asian Fisheries Forum Indian Branch Mangalore
11. Pillai T V R (1972) Coastal aquaculture in the Indo Pacific Region, Fishing News.
12. Bardach J E W (1972) Aquaculture Farming and Husbandary of Fresh Water and Marine Organisms.
13. Beveridge M C M (1987) Cage Aquaculture Fishing News
14. Miline P H (1972) Fish and Shell Fish Farming in China, Fishing News.
15. Santhanam R (1990) Coastal aquaculture in india CBS publications.
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17. Pillai T V R (1994) Aquaculture Development Progress and Prospects.Halsted press. Artificial Reefs and Sea Farming Technologies (1996) CMFRI Bulletin no. 48
18. Transportation of live fish and shell fishes (1997) CMFRI Spl Pub. No.66
19. Boyd. C E and Pillai V K Water quality management in aquaculture 1985 CMFRI. Spl. Pub. 22.

**24P3AQCT10: Aquariculture, Aquaculture Economics,
Management and Administration.**

Credit: 4

72hrs.

COURSE OUTCOME

CO	CO Statement	PO/ PSO	CL	KC
CO1	Identification and breeding of ornamental fin fishes	PO4 PSO2	U	C
CO2	Understand the basic principles of economic theories applied to farm management, entrepreneurships and small-scale industries	PO1 PSO2	U	C
CO3	Identification of aquarium plants and invertebrates	PO4 PSO2	U	C
CO4	Study of construction and maintenance of aquarium	PO4 PSO2	C	P
CO5	Setting up of aquarium tanks	PO4 PSO2	C	P
CO6	Identification of common diseases in aquarium fishes and management	PO4 PSO2	U	C
CO7	Application of production economics in aquaculture	PO1 PSO2	E	P
CO8	Analyse market demand for aquaculture products by conducting consumer surveys	PO2 PSO2	An	P

MODULES

Module I: Construction and maintenance of aquarium.

10hrs.

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 maximization.

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.

REFERENCES:

1. Lackey, RLTA Nielson 1980. Fisheries management Balckwell Sci. Pub. Oxford.
2. Panayotou, T. 1982. Management concept for small scale fisheries economic and social aspects. Fish. Technical paper No. 228 RME.
3. Peter W.Scot 1966. Complete Aquarium. Dorling Kindestey, London.
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6. T.V. Anna Mercy *et al.*, 2007. Ornamental Fishes of the Western Ghats of India. NBFGR publication, Lucknow.
7. T.V. Anna Mercy 2000. An Aquairum at your Home (Malayalam).
8. Dey V.K.A. 1997. A hand book on Aquafarming ornamental fishes. MPEDA, Cochin.
9. Herber J Axelrod, Leonard P. Schultz. Handbook of Tropical Aquarium fishes, TFH, USA

24P3AQCT11: Culture of crustaceans, sea weeds and fisheries technology**Credit: 3****72 hrs.****COURSE OUTCOME**

CO	CO Statement	PO/ PSO	CL	KC
CO1	Understand the culture of the economically important crustaceans and seaweeds	PO5 PSO2	U	C
CO2	Identification of economically important sea weeds	PO2 PSO2	E	C
CO3	Describe the methods of processing and extraction of different seaweed products	PO2 PSO2	U	C
CO4	Understanding the fundamental principle of bacteriology	PO2 PSO3	U	C
CO5	Describe spoilage causing microorganisms of fish and fishery products	PO2 PSO3	U	C
CO6	Sensory evaluation of fresh fish and fish products	PO2 PSO3	E	P
CO7	Analysing post mortem changes in fish	PO2 PSO3	U	C
CO8	Describing handling of fish onboard, landing centres, retail outlets and pre-processing centers	PO2 PSO3	U	C

MODULES

Module I: Crustacean culture

37 hrs

Overview of crustacean culture in the world.

Major species cultured, 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, cages, pens and recirculating systems. Sea ranching of prawns. Specific Pathogen Free shrimp, culture of *Fenneropenaeus vannamei*. Culture practices and potentials for crabs and lobsters.

Potential diseases and management in hatcheries and farms

Module II: Sea weed culture

17hrs

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

Seaweed culture in India- site selection, determining growth pattern and environmental monitoring; causes of mortality; small scale and commercial scale culture operations. Recent advances in culture methods.

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: Microbiology

8 hrs.

Classification of bacteria. Bacterial spores, staining of bacteria, various staining methods.

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.

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

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

Sensory evaluation of fresh fish

Iced storage- different types of ice and their production, iced storage methods, containers, flow

ice and gel ice.

Chilled storage- in ice, CSW, CFW, RSW, 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 centres, retail outlets and pre-processing centres.

Transportation of fish and containers used for transportation.

REFERENCES:

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3. Hard Notman. F. and Simpson, Benjamine, K (2000) Seafood Enzymes, New York, Marcel Dekker
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16. Sacharow, S. and Griffin. R.C.1998. Principles of Food Packaging-2ndEdition AVI Pub. Co. Connecticut.
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18. Marine Fishery Resources –India Khan 1999, Raj pat Publications ,4/32, Gaeta Colony Delhi 110031. Technological Change and the Development of Marine Fishing Industry in India 1994 Daya Publishing House 1123/74, Deva Ram Park Tri Nagar, New Delhi.
19. The Marine Products Exports Development Authority Hand Book on Aqua Farming Shrimp, Lobsters, Mud crab 1993.
20. MPEDA. Hand Book on Aqua Farming Seaweed, seaurchin seacucumber 1993.
21. MPEDA. Hand Book on Aqua Farming Seafishes.
22. MPEDA. hand Book on Aqua Farming Indian Lobsters.
23. Srivastava. U.K., Dholakia, B.H. and Vathsala, S. (1987) Brackish water Aquaculture Develop in india ,New Delhi concept Publishing Company.
24. TakecImain (1977) Aquaculture in Shallow Seas. Progress in Shallow Sea Culture Amerind Publication Pvt. Ltd, New Delhi.

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Devadasan. K, Mukundan. M. K., Antony. P.D. and Jose Joseph (1974) Nutrients and Bioactive Substances in Aquatic Organism SOFT (1)
26. Bonn ell A.D. (1994) Quality Assurance in Seafood Processing Chapman and Hall, USA. T.S. GopalakrishnaIyer., Kandoran M.K., Mary Thomas and Mathew P.T. (2000) Quality Assurance in Sea Food processing CIFT

24P3AQCP05: Culture of fin fishes, molluscs, sea cucumber, crustaceans and sea weeds

Credit: 3

72 hrs.

Module I

Identification of cultivable fin fish, Collection and identification of fish seed from nature, 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

Setting up of spat collectors, identification of nanoplanktors, estimation of growth and condition index in oysters. 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

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.

24P3AQCP06: Aquariculture and aquaculture economics

Credit: 3

72 hrs.

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 hatchery. Live feed culture.

Module III

Preparation of schedule for collecting data on:

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

SEMESTER IV**24P4AQCT12: Fishing Technology****Credit: 4****72 hrs.****COURSE PUTCOME**

CO	CO Statement	PO/ PSO	CL	KC
CO1	Understand the basic principles of capture of fin fishes and crustaceans from inland, marine as well as from closed water system	PO4, PO5 PSO3	U	C
CO2	Describe different types of fishing crafts	PO4 PSO3	U	C
CO3	Describe different types of fishing gears	PO4, PO5 PSO3	U	C
CO4	Understand the different materials used for the construction of fishing crafts	PO4, PO5 PSO3	U	C
CO5	Understand different materials used for the construction of fishing gears	PO4 PO5 PSO3	U	C
CO6	Understand the marine fouling and corrosion in fishing boats and their maintenance	PO4 PO5 PSO3	U	C
CO7	Understand the basic principles of navigation	PO4 PO5 PSO3	U	C
CO8	Understand the different fish finding devices	PO4 PO5 PSO3	U	C

MODULES

Module I: Fishing crafts.

20hrs

Types of fishing crafts: traditional, motorized; different types in India

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

22 hrs.

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

Basic principles of gear design and capture mechanism. Fishing gear for closed water systems. Nets: drag nets, shore sciences and light fishing.

Module IV: Low energy fishing

5hrs.

Low energy fishing- Hooks and Lines, gillnets and Tangle nets, Cast nets, Trammel nets and Traps. Responsible fishing: IUU, Bycatch reduction, Turtle Exclusion Device.

Module V: Basic Principles of Navigation.

5hrs.

Basic principles of navigation.

Fish finding devices- conventional and modern: fish aggregation devices

Recent advance in fishing gear technology.

REFERENCES:

1. M.Shahul Hameed and Boopendranath. M. R. 2000. Modern fishing gear technology. Daya Publishing, New Delhi.
2. K.P. Biswas. 1990.A text book of fish, fisheries and technology. Narendra Publishing house, N.Delhi.
3. John C. Sainbur. 1971. Commercial fishing methods. – An introduction to Vessels and Gears. H. Krista Johnson. 1971. Modern Fishing Gear of the world. PART I, II, III.
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13. F.A.O. 1947. Otter board design and performance. FAO.Fishing manuals.

24P4AQCT13: Fish Processing Technology

Credit: 4

72 hrs.

COURSE OUTCOME

CO	CO Statement	PO/ PSO	CL	KC
CO1	Understand the handling of fishes both culture and capture	PO4 PO5 PSO3	U	C
CO2	Understand the changes in the fish composition in relation to spoilage	PO4 PSO3	U	C
CO3	Understand the freezing technology of fish	PO4 PO5 PSO3	U	C
CO4	Understand the canning of fish	PO4 PO5 PSO3	U	C
CO5	Understand the curing and drying of fish	PO4 PO5 PSO3	U	C
CO6	Understand the value-added fish products	PO4 PO5 PSO3	U	C
CO7	Understand the Fishery By-products	PO4 PO5 PSO3	U	C
CO8	Understand the Packaging of fish products	PO4 PSO3	U	C

MODULES

Module I: Freezing Technology of fish

25 Hrs.

Refrigeration, refrigeration load, refrigerants. Crystallization, freezing curves for pure water and water in fish, 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.

Module II: Canning of fish.

15 Hrs

Principles of canning: Heat transfer in canned fish, thermal destruction of bacteria, D and D₀ value, F₀ value, Z value, determination of process time, cook value, 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 product

Module III: Curing and drying of fish

8Hrs

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.

Module IV: Fish Bye- products.

8 Hrs

Mince and surimi – Processing, packaging, freezing and storage. Fish protein concentrate, fish meal and oil, fish liver oil, fish hydrolysate, fish silage, Caviar, gelatin, glue, pearl essence, dehydrated jelly 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, mannitol, and carrageenan.

Module V: Value added fish products**8 Hrs.**

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.

Module VI: Other methods of preservation**8 Hrs**

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

Radiation preservation, principles of radiation, ionizing radiations and their sources, units, applications of radiation, Shelf-life extension, radappertization, rederivation, rededication and radiation doses for irradiation of different fish products. Safety of irradiated fish. Hurdle technology.

REFERENCES:

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6. Larousseg and Brown Bruce E. 1997. Food canning Technology, Wiley, BCH, New York
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11. Gopakumar, K. 1997. Tropical fishery products, Oxfoford and HBH publishing co. New Delhi.
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24P4AQCT14: Fish Microbiology and Quality Assurance**Credit: 4****72 hrs.****COURSE OUTCOME**

CO	CO Statement	PO/ PSO	CL	KC
CO1	Understand the trace metals in fins fish and shell fish	PO4 PSO3	U	C
CO2	Understand the general aspects of seafood quality and quality problems	PO4 PSO3	U	C
CO3	Understand the biological hazards in seafoods	PO4 PSO3	U	C
CO4	Analyse the fish spoilage and quality assessments	PO4 PSO3	An	P
CO5	Understand the Good manufacturing practices in seafood processing	PO4 PSO3	U	C
CO6	Understand the Hazard analysis and critical control points in seafood industry	PO4 PSO3	U	C
CO7	Understand the National and international standards for fish and fish products	PO4 PSO3	U	C
CO8	Understand the Waste management in seafood plants	PO4 PSO3	U	C

MODULES

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. Faecal 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. 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 **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.

REFERENCES:

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2. Devadasan K, Mukundan, M.K, Antony P.D and Jose Joseph. 1997. Nutrients and bioactive substances in aquatic organisms. SOFT(I)
3. Bonnell, A.d. 1994. Quality assurance in sea food processing. Chapman and Hall, USA.
4. T.S. GopalakrishnaIyer ,Candoran M.K, Mary Thomas and Mathew P.T 2000. Quality assurance in sea food processing CIFT
5. M.P. Doyle, L.K. Beuchat and T.J. Montyille (Eds.) 1997. Food Microbiology, fundamentals and frontiers. ASM press, Washington DC.
6. Hobbs B.C. Christian JHB, (Eds.) 1973 The microbiological safety of fish. Academic press, London. ICMSE 2006. Microorganisms in food. Their significance and methods of evaluation, University of Toronto Press, London.
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11. Surendran P.K., Thampuran N, Nambiar V.N. and Lalitha K.V 2003. Laboratory manual on microbiological examination of sea food. CIFT, Cochin
12. James, J.M., Loessner, Martin J, and Golden D.A., (Eds.) 2005. Modern food microbiology 7th edition. Springer , New York.

24P4 AQCP07: Fishing Technology

Credit: 2

72 hrs.

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.

24P4AQCP08: Fish Processing technology

Credit: 2

72 hrs.

Module I

Handling and chilled storage, Salting methods, drying methods.

Determination of salt content.

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

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

Containers for fish transportation

Sensory evaluation of fishery products

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 by products. Fish meal, fish oil, chitin, chitosan, shark fin rays. Fish pickle, smoked fish products,

24P4AQCP09: Microbiology and quality assurance

Credit: 2

72 hrs.

Evaluation of fish/fishery products for microbiological qualities.

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

Laboratory techniques to detect and identify pathogens in fish – *E. coli*, *Streptococcus*, *Staphylococcus aureus*, *Vibrio* sp. *Listeria monocytogenes*, *Salmonella*.

Evaluation of sanitary condition of fish processing plants.

Sensory evaluation of fish products.

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

Effluent treatment (on site). Visit to Processing plant (ETP).

24P4AQCPJ: Project

Credit: 5

Total weightage for Project =15

The split up of the marks is as follows.

Sl. No	Components	Weightage
1.	Relevance of the topic and analysis	3
2.	Project content and presentation	7
3.	Project viva voce	5
	Total	15

24P4AQCCV- Comprehensive Viva Voce

Credit 2

Total weightage= 15

Sl. No	Components	Weightage
1.	Comprehensive viva voce (all courses first semester to fourth semester)	15
	Total	15

6.PATTERN OF QUESTION PAPERS

QP Code

Reg. No.

Name

M Sc Degree (C.S.S) Examination,

First Semester

Faculty of Science- Aquaculture and Fish Processing

PAQC- Aquaculture and Fish Processing

**24P1AQCT01- TAXONOMY AND BIOLOGY OF COMMERCIAL AND CULTIVABLE
FIN FISHES AND SHELL FISHES**
(2024 admissions onwards)

Time: Three hours

Max. Weight: 30

Section- A

(Answer any **eight** questions. Each question carries a weight of 1)

1. Explain the sexual dimorphism in cephalopod.
2. What is the functional importance of neuromast organ?
3. Summarize the air bladder of a fin fish.
4. Give the scientific names of 4 oysters.
5. What are chloride glands?
6. What is crystalline style?
7. Find the adaptive significance of scroll valve.
8. Name 2 bioluminescent of scroll valve.
9. What is urophysis?
10. List the blood pigments of fishes.

(8 x 1 = 8)

Section B

(Answer any **six** questions. Each question carries a weight of 2)

11. Morphology of a crab and emphasize on sexual dimorphism.
12. Analyse branchial formula of a prawn.
13. Explain neurosecretory system of a prawn
14. Examine age determination in fin fishes.
15. Explain Role of hormones in the reproduction of fishes
16. Explain Structure and function of hepatopancreas of a prawn
17. Analyse commercially important lobsters of India.
18. Explain index of Preponderance

(6 x 2 = 12)

Section C

(Answer any **two** questions. Each question carries a weight of 5)

19. Discuss osmoregulation in freshwater and marine fin fishes.
20. Discuss about circulatory system of a prawn.
21. Explain larval forms of commercially important crustaceans.
22. Explain digestive system of a bivalve mollusc.

(2 x 5 = 10)

QP Code

Reg. No.

Name

M Sc Degree (C.S.S) Examination,

First Semester

Faculty of Science- Aquaculture and Fish Processing

PAQC- Aquaculture and Fish Processing

24P1AQCT02: BIOPHYSICS, INSTRUMENTATION, MICRO TECHNIQUES AND RESEARCH METHODOLOGY

(2024 admissions onwards)

Time: Three hours

Max. Weight: 30

Section- A

(Answer any **eight** questions. Each question carries a weight of 1)

1. What is concentration gradient.
2. Define kinetic theory of osmosis
3. Explain osmoregulation in marine fishes
4. Label structure of cell membrane.
5. Explain the functions of membrane receptor.
6. What is two-dimensional chromatography.
7. Name stain used in proteins.
8. What is conceptual research?
9. What is unstructured approach in research?
10. What Is a technical report?

(8 x 1 = 8)

Section B

(Answer any **six** questions. Each question carries a weight of 2)

11. Differentiate between Osmotic pressure and Osmotic concentration.
12. What are the factors effecting the passage of materials across cell membrane?
13. Explain the process of phagocytosis.
14. Outline pinocytosis.
15. What is an Echo sounder and how does it work?
16. How is mercury detected in a fish / water sample?
17. Discuss the principle and application of TLC.
18. Explain different separation techniques for protein

(6 x 2 = 12)

Section C

(Answer any **two** questions. Each question carries a weight of 5)

19. Discuss the biological significance of osmosis in fishes.
20. Elaborate remote sensing and its application in Fisheries.

21. Discuss the basic methods involved in protein purification. How will you check the criteria of protein purity?
22. Compile the method of primary data collection after a research problem has been defined.
(2 x 5 = 10)

QP Code

Reg. No.

Name

M Sc Degree (C.S.S) Examination,

First Semester

Faculty of Science- Aquaculture and Fish Processing

PAQC- Aquaculture and Fish Processing

24P1AQCT03- BIostatistics AND COMPUTER APPLICATION

(2021 admissions onwards)

Time: Three hours

Max. Weight: 30

Section- A

(Answer any **eight** questions. Each question carries a weight of 1)

1. What is poisson distribution.
2. What is spearman's rank correlation.
3. What is harmonic mean.
4. What is variance.
5. What is scatter diagram.
6. What is super computer.
7. What is ANOVA.
8. What is Linux.
9. What is Machine code.
10. What is MS WORD.

(8 x 1 = 8)

Section B

(Answer any **six** questions. Each question carries a weight of 2)

11. Identify methods of collection of data.
12. Identify the networking topologies?
13. Explain tests of significance.
14. Compare skewness and kurtosis.
15. Differentiate ANOVA and t-test
16. Explain analysis of covariance.
17. Represent the following data by a percentage bar diagram.
18. Classify the given data of total length measurements of 25 fishes and find out the modal length.

7.1	7.3	12.1	12.1	10.9	
7.2	10.6	10.1	15.4	15.4	8.6
10.8	13.2	11.3	16.8	9.5	
10.9	13.9	12.9	12.1	11.6	11.2
13.9	15.9	14.1	12.3	12.3	

(6 x 2 = 12)

Section C

(Answer any **two** questions. Each question carries a weight of 5)

19. Elaborate on measures of central tendencies. Discuss their merits and demerits.
20. Calculate Karl Pearson's coefficient of skewness in the following frequency distribution of total length recorded in 100 fishes.

Class	14-18	19-23	24-28	29-33	34-38	39-43	44-48
Frequency	3	7	33	28	16	11	2

21. Explain the working of the various components of a computer system with specific reference to input and output devices.
22. Analyze the different types of computer memory? Distinguish between them.

(2 x 5 = 10)

QP Code

Reg. No.
Name

M Sc Degree (C.S.S) Examination,

First Semester

Faculty of Science- Aquaculture and Fish Processing

PAQC- Aquaculture and Fish Processing

24P1AQCT04- AQUACULTURE ENGINEERING

(2024 admissions onwards)

Time: Three hours

Max. Weight: 30

Section- A

(Answer any **eight** questions. Each question carries a weight of 1)

1. Define fresh water.
2. What is Dyke?
3. What is Master Sluice Gate?
4. What are monk gates?
5. What is herrguth monk?
6. What is loam?
7. What is total alkalinity?
8. What are the different types of enclosures?
9. Compare Raft and rack culture.
10. What is the significance of ozone in aquaculture?

(8 x 1 = 8)

Section B

(Answer any **six** questions. Each question carries a weight of 2)

11. Explain on tide fed farms.
12. Explain soil sampling techniques.
13. Evaluate factors affecting sedimentation in a pond.
14. Explain on Acid Sulphate Soils.
15. Explain properties of soil.
16. Explain the different types of cages?
17. Mark materials for enclosures in a pond.
18. Comment different aerators

(6 x 2 = 12)

Section C

(Answer any **two** questions. Each question carries a weight of 5)

19. Explain sealing of pond bottom and dike.
20. Explain soil separators, soil samples and quick field test to determine soil texture.
21. Categorize soil parameters to be borne in mind before constructing s shrimp farm.
22. List out aerators? Explain the difference types of aerators.

(2 x 5 = 10)

QP Code

Reg. No.

Name

M Sc Degree (C.S.S) Examination,

Second Semester

Faculty of Science- Aquaculture and Fish Processing

PAQC- Aquaculture and Fish Processing

24P2AQCT05- ECOLOGY OF CULTURE SYSTEM AND AQUATIC BIOLOGY

(2024 admissions onwards)

Time: Three hours

Max. Weight: 30

Section- A

(Answer any **eight** questions. Each question carries a weight of 1)

1. What is autecology.
2. What is xenobiotics.
3. What do you mean by stenohaline Animals.
4. What do you mean by edaphic factors.
5. Define Liebig's law of minimum.
6. Name eight estuaries of India.
7. What is eutrophication.
8. What is ecological niche.
9. Explain secondary production.
10. Explain diurnal migration of zooplankton.

(8 x 1 = 8)

Section B

(Answer any **six** questions. Each question carries a weight of 2)

11. Classify bacteria in aquatic ecosystem.
12. List out the common microbes in culture system.
13. Explain microbial proliferation in relation to ecological conditions in a pond.
14. Explain effects of monsoon on physical condition of culture ponds.
15. Explain carrying capacity of culture ponds.
16. Outline the food web in an aquatic eco system.
17. Explain the thermal stratification in aquaculture ponds
18. Explain the biological significance of eutrophication.

(6 x 2 = 12)

Section C

(Answer any **two** questions. Each question carries a weight of 5)

19. Explain primary productivity in a pond and explain different methods of primary production.

20. Classify estuaries. Describe the physico-chemical and biological characteristics of estuaries.
21. Elaborate circulation and mixing patterns in pond.
22. Discuss about the chemical composition of sea water.

(2 x 5 = 10)

QP Code

Reg. No.

Name

M Sc Degree (C.S.S) Examination,

Second Semester

Faculty of Science- Aquaculture and Fish Processing

PAQC- Aquaculture and Fish Processing

24P2AQCT06 - BIOCHEMISTRY AND NUTRITIONS OF FIN FISH & SHELL FISH

(2024 admissions onwards)

Time: Three hours

Max. Weight: 30

Section- A

(Answer any **eight** questions. Each question carries a weight of 1)

1. What is meant by Osazone reaction?
2. What is carboxymethyl cellulose? Explain.
3. Write down the criteria for purity of lipids.
4. Explain the formula 18:2 n-3.
5. What are fibrous proteins?
6. What is allosteric inhibition?
7. Define mutation.
8. What are the non-essential amino acids?
9. What is metabolisable energy?
10. What are mould inhibitors?

(8 x 1 = 8)

Section B

(Answer any **six** questions. Each question carries a weight of 2)

11. What is glycolysis? Describe the steps involved in glycolysis.
12. Briefly explain the fat digestion in fishes.
13. Explain the functions of proteins.
14. List out the types of enzyme inhibition.
15. Explain Daphnia culture
16. Explain translation.
17. Discuss the role of proteins in fish nutrition.
18. Describe the factors affecting energy requirements in fishes.

(6 x 2 = 12)

Section C

(Answer any **two** questions. Each question carries a weight of 5)

19. Elaborate the classification of lipids and its role in aquaculture.
20. Discuss on water- and fat-soluble vitamins and their importance in aquaculture nutrition.

21. Discuss about the common animal protein sources used in aquaculture feed manufacture.
22. Elaborate on feeding devices used in aquaculture

(2 x 5 = 10)

QP Code

Reg. No.

Name

M Sc Degree (C.S.S) Examination,

Second Semester

Faculty of Science- Aquaculture and Fish Processing

PAQC- Aquaculture and Fish Processing

24P2AQCT07- PHYSIOLOGY AND PATHOLOGY OF FIN FISH AND SHELL FISH

(2024 admissions onwards)

Time: Three hours

Max. Weight: 30

Section- A

(Answer any **eight** questions. Each question carries a weight of 1)

1. What is Genital papillae?
2. Explain hair cells.
3. Give an account of the accessory respiratory organs.
4. Define alkalosis
5. Explain rumpfdarm.
6. What is appendix masculine.
7. What is oogenesis.
8. What is corpuscles of stannius?
9. What are principal islets?
10. Name four bacterial diseases in aquaculture.

(8 x 1 = 8)

Section B

(Answer any **six** questions. Each question carries a weight of 2)

11. Comment of the effects of temperature in the reproduction of fishes.
12. Explain the processes of gametogenesis.
13. Identify the role of difference exchanger systems in osmoregulation.
14. Identify major digestive fluids and enzymes in fishes.
15. Comment on common viral diseases in finfishes
16. Identify explain gonochorism.
17. List out the ovulating agents in fishes?
18. Comment of true endocrine gland.

(6 x 2 = 12)

Section C

(Answer any **two** questions. Each question carries a weight of 5)

19. Explain homeostasis in fishes.
20. Elaborate the secondary sexual characters in various fishes.

21. Analyze the hormonal analogues used for induced breeding in fishes.
22. Elaborate the protozoan parasites in fishes, their transmission mode, preventive and control measures.

(2 x 5 = 10)

QP Code

Reg. No.

Name

M Sc Degree (C.S.S) Examination,

Second Semester

Faculty of Science- Aquaculture and Fish Processing

PAQC- Aquaculture and Fish Processing

24P2AQCT08- GENETICS AND BIOTECHNOLOGY OF FINFISH AND SHELL FISH

(2024 admissions onwards)

Time: Three hours

Max. Weight: 30

Section- A

(Answer any **eight** questions. Each question carries a weight of 1)

1. What is centromere?
2. What is Chemical structure of chromosome?
3. What is Chromosome banding?
4. What is Genetic engineering?
5. Define incomplete dominance
6. What is sequencing?
7. What are supermales?
8. List out tagging methods
9. What is vernalisation of oocytes?
10. Define breeding ingression

(8 x 1 = 8)

Section B

(Answer any **six** questions. Each question carries a weight of 2)

11. Explain chromosome banding Techniques
12. Explain about the approaches to genetic improvement
13. List out the enzymes commonly used in recombinant DNA technology
14. List out the enzymes in genetic engineering
15. Comment of GIFt and Glowfish
16. List out the factors affecting selective breeding programmes
17. Discuss the role of steroids in sex reversal
18. What are the important scientific break-through required to realize the full potential of the transgenic fish technology in aquaculture?

(6 x 2 = 12)

Section C

(Answer any **two** questions. Each question carries a weight of 5)

19. Explain monosex population and strategies adopted to produce the same
20. Inbreeding a boon or a curse? Discuss.

21. Use of genetically modified organism in aquaculture -comment?
22. Fish cell cultures, development of cell lines and their applications

(2 x 5 = 10)

QP Code

Reg. No.

Name

M Sc Degree (C.S.S) Examination,

Second Semester

Faculty of Science- Aquaculture and Fish Processing

PAQC- Aquaculture and Fish Processing

24P3AQCT09-CULTURE OF FIN FISHES, MOLLUSCS AND SEA CUCUMBERS

(2024 admissions onwards)

Time: Three hours

Max. Weight: 30

Section- A

(Answer any **eight** questions. Each question carries a weight of 1)

1. Define monoculture.
2. What is *Etroplus suratensis*.
3. What is monk type sluice gate.
4. What are biofilters.
5. Bentonite clay.
6. Sea cucumber.
7. What is beche de mer.
8. What is on bottom culture.
9. What is shucking.
10. What is spatting.

(8 x 1 = 8)

Section B

(Answer any **six** questions. Each question carries a weight of 2)

11. Discuss biology of Catla.
12. Examine site selection criteria for a fish farm.
13. Analyze ecolebellling.
14. Explain pearl Sac theory
15. List out fish food organisms.
16. Assess sea cucumber brood stock management.
17. Assess seed production of sea cucumbers.
18. Explain grow out system in sea cucumber.

(6 x 2 = 12)

Section C

(Answer any **two** questions. Each question carries a weight of 5)

18. Elaborate induced breeding in fishes.
19. Explain the fish seed collection from natural resources.

20. Explain induced breeding in sea cucumber.
21. Elaborate abalone culture

(2 x 5 = 10)

QP Code

Reg. No.
Name

M Sc Degree (C.S.S) Examination,
Third Semester
Faculty of Science- Aquaculture and Fish Processing
PAQC- Aquaculture and Fish Processing

**24P3AQCT10- AQUARICULTURE, AQUACULTURE ECONOMICS, MANAGEMENT
AND ADMINISTRATION**
(2024 admissions onwards)

Time: Three hours

Max. Weight: 30

Section- A

(Answer any **eight** questions. Each question carries a weight of 1)

1. What are sand filters.
2. What is meant by chemical filtration.
3. What are Feed check tray?
4. Name four ornamental invertebrates.
5. Explain Velvet disease in fish.
6. What is the causative agent of Tail rot?
7. What are the uses of KMnO₄ in Aquarium?
8. Define Law of diminishing returns?
9. What is supply function?
10. What is meant by Sensitivity analysis?

(8 x 1 = 8)

Section B

(Answer any **six** questions. Each question carries a weight of 2)

11. Explain the selection of plants and fishes for aquarium.
12. 14. Write notes any three insitu water quality monitors
13. 15. Analyze breeding of gold fish.
14. Classify Indigenous ornamental fishes.
15. Comment on the steps involved in setting up of a freshwater aquarium
16. Explain sexual dimorphism in live bearers.
17. Explain Parental care in marine ornamental fishes.
18. Explain fixed cost, variable cost ant opportunity cost.

(6 x 2 = 12)

Section C

(Answer any **two** questions. Each question carries a weight of 5)

19. Explain water quality maintenance for hatcheries and farms.

20. Explain in detail about setting up of fresh water aquarium and its maintenance.
21. Fisheries economics can be increased through marketing channels. Comment in detail
22. Role of Fish Consultant in Aquaculture management. Explain.

(2 x 5 = 10)

QP Code

Reg. No.

Name

M Sc Degree (C.S.S) Examination,

Third Semester

Faculty of Science- Aquaculture and Fish Processing

PAQC- Aquaculture and Fish Processing

**21P3AQCT11-CULTURE OF CRUSTACEANS, SEA WEEDS AND FISHERIES
TECHNOLOGY**

(2021 admissions onwards)

Time: Three hours

Max. Weight: 30

Section- A

(Answer any **eight** questions. Each question carries a weight of 1)

1. Name Tiger prawn.
2. Explain the life cycle of penaeid prawn.
3. What is the purpose of icing of fish?
4. What is the purpose of acclimatisation of shimp seed?
5. What is agar agar?
6. Recall *Salmonella*.
7. Explain air blast freezer.
8. How fresh fish is transported?
9. What is carageenan?
10. How does raceways work?

(8 x 1 = 8)

Section B

(Answer any **six** questions. Each question carries a weight of 2)

11. Explain the transportation of prawn seeds.
12. Discuss about *Staphylococcus aureus*.
13. Explain the principle and techniques of eyestalk ablation.
14. Discuss the extraction of manitol.
15. Comment on IMTA
16. Outline the spoilage in fresh fish.
17. Explain the operation in cryogenic freezing.
18. Explain the culture of prawn.

(6 x 2 = 12)

Section C

(Answer any **two** questions. Each question carries a weight of 5)

19. Explain the methods to improve quality of frozen fishery products?

20. Discuss about the hatchery production of edible oyster seed and larval rearing techniques.
21. Elaborate battered fish products.
22. Explain the production of battered and breaded products.

(2 x 5 = 10)

QP Code

Reg. No.
Name

M Sc Degree (C.S.S) Examination,

Forth Semester

Faculty of Science- Aquaculture and Fish Processing

PAQC- Aquaculture and Fish Processing

24P4AQCT12- FISHING TECHNOLOGY

(2024 admissions onwards)

Time: Three hours

Max. Weight: 30

Section- A

(Answer any **eight** questions. Each question carries a weight of 1)

1. What is polyamide (PA).
2. Describe continuous filaments.
3. High Density Floats.
4. Explain head rope.
5. Name 2 types of hooks.
6. What is B-cut.
7. Define horizontal hanging Coefficient.
8. What are tubular traps.
9. Describe fish pumps.
10. What is "Kattamaran"

(8 x 1 = 8)

Section B

(Answer any **six** questions. Each question carries a weight of 2)

11. Write a note on trawlers.
12. Explain the advantage and disadvantages of wood as a boat building material.
13. Sketch midwater trawling.
14. Importance Net braiding.
15. Explain sextant.
16. Discuss firefighting appliances.
17. Write a note on life buoy.
18. Differentiate trolling and trawling fishing operations

(6 x 2 = 12)

Section C

(Answer any **two** questions. Each question carries a weight of 5)

18. Appraise steps in wooden boat construction.
19. Purse seining & classify purse seining.
20. Give an account on various types of preservation methods for nets.
21. Elaborate on different boat building materials.

(2 x 5 = 10)

QP Code

Reg. No.

Name

M Sc Degree (C.S.S) Examination,

Forth Semester

Faculty of Science- Aquaculture and Fish Processing

PAQC- Aquaculture and Fish Processing

24P4AQCT13- FISH PROCESSING TECHNOLOGY

(2024 admissions onwards)

Time: Three hours

Max. Weight: 30

Section- A

(Answer any **eight** questions. Each question carries a weight of 1)

1. What are the antioxidants in smoke?
2. Name the essential amino acids in fish.
3. Explain belly burst phenomenon in sardine.
4. Outline the principle of manufacturing fish meal.
5. What is gaping in fish?
6. Define the D- value of an organism.
7. What is three pieces can?
8. What is the saponifiable matter of oil.
9. How is dried prawn pulp prepared?
10. Name the composition of fish muscle.

(8 x 1 = 8)

Section B

(Answer any **six** questions. Each question carries a weight of 2)

11. Explain construction and working of contact plate freezer.
12. Compare various refining methods for fish oil.
13. Explain the application of fish packaging in plastic.
14. Comment on wet rendering and dry rendering
15. Identify the technique of gamma irradiation for extending shelf life of fish products.
16. Explain the construction and operation of a can seamer.
17. Explain the applications of chitosan.
18. Discuss the various changes that take place in fish after death that lead to spoilage.

(6 x 2 = 12)

Section C

(Answer any **two** questions. Each question carries a weight of 5)

19. Explain the principle of preservation by freezing.
20. Examine the theoretical aspects of air blast freezing.
21. Elaborate on battered and breaded products.
22. Explain the method of preparing fermented products.

(2 x 5 = 10)

QP Code

Reg. No.

Name

M Sc Degree (C.S.S) Examination,

Forth Semester

Faculty of Science- Aquaculture and Fish Processing

PAQC- Aquaculture and Fish Processing

24P4AQCT14- FISH MICROBIOLOGY AND QUALITY ASSURANCE

(2024 admissions onwards)

Time: Three hours

Max. Weight: 30

Section- A

(Answer any **eight** questions. Each question carries a weight of 1)

1. What are thermophiles? Give examples.
2. What is differential staining?
3. Explain the structure of bacterial endospores.
4. Define water activity.
5. What are halophiles?
6. Explain the importance of *Aspergillus flavus*.
7. What is indicator organisms?
8. What is selective medium? Give examples.
9. Explain botulism.
10. What is flat sour?

(8 x 1 = 8)

Section B

(Answer any **six** questions. Each question carries a weight of 2)

11. Explain bacterial growth curve.
12. Explain autoclaving.
13. Explain the intrinsic factors affecting growth of microbes in foods.
14. Explain the microbiology of fish spoilage.
15. Comment on pathogenic microorganisms present fresh fish
16. Discuss metal poisoning in fishes.
17. Elaborate on HACCP in sea food industry.
18. Discuss food infections.

(6 x 2 = 12)

Section C

(Answer any **two** questions. Each question carries a weight of 5)

19. Elaborate on the various methods of fish preservation.
20. Discuss the quality assurance in sea food trade.

21. Differentiate between faecal coliforms a non-faecal coliform. Describe the various methods of detection of total coliforms, faecal coliforms and E. Coli in fish samples.
22. Elaborate on the international standards for fish and fishery products

(2 x 5 = 10)