



ST. ALBERT'S COLLEGE (AUTONOMOUS), ERNAKULAM

Affiliated to Mahatma Gandhi University, Kottayam, Kerala

SYLLABUS FOR UNDERGRADUATE PROGRAMME

BACHELOR OF VOCATION IN COMMERCIAL AQUACULTURE

(UNDER CREDIT SEMESTER SYSTEM
WITH EFFECT FROM 2023 ADMISSIONS)

Syllabus of B.Voc. Commercial Aquaculture

Proposed by the Board of Studies on 10th February 2023

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Approved by the Academic Council on 14th March 2023

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FOR TRUTH AND SERVICE

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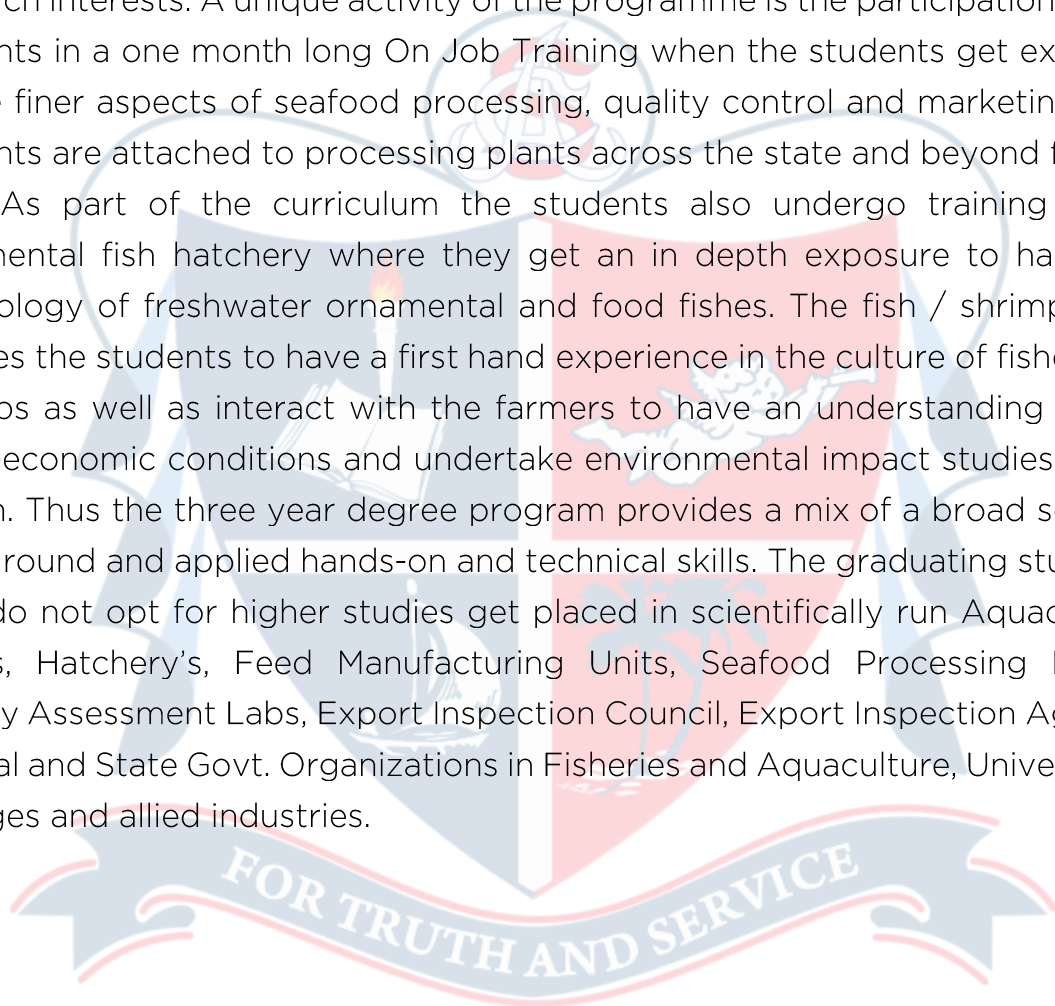


Preface

As envisaged in the recent regulations of Autonomous colleges in India by University Grants Commission, autonomous colleges enjoy the academic freedom to enrich the curriculum by incorporating recent trends and needs. Curriculum and syllabus of each academic program has to be revised periodically to impart major objectives like global competency, skill component, values and regional relevance. Academicians and scholars in the respective area of knowledge have to express a missionary zeal for this great purpose.

Aquaculture has been an area of specialization in St. Albert's College (Autonomous) with the commencement of the degree programme in Aquaculture as a regular programme in 1995. The three year degree programme is run under the CBCSS stream. This is the only degree program in Aquaculture under Mahatma Gandhi University presently offered by the Research Department of Fisheries and Aquaculture, St. Albert's College (Autonomous). UGC sanctioned the B.Voc. Programme in Commercial Aquaculture in 2019. In the same year the Board of Studies in Fisheries and Aquaculture through several rounds of deliberations proposed the syllabus for B.Voc. in Commercial Aquaculture which was approved by the Academic Council and Governing Council of the College. The facilities of the department include a 1ha farm for the culture of fishes and shrimps, aquarium and hatchery complex for breeding and rearing of aquarium fishes and plants, Aquaculture lab for morphometric and anatomical studies of finfishes and shellfishes as well as analytical studies of fish pond water and soil, Microbiology Lab for isolation and identification of bacterial strains and Biochemistry lab for biochemical studies on fish samples. In addition the department has an instrumentation room and museum preserving samples of different species of fishes, shrimps, molluscs, cephalopods, seaweeds etc. The 50 seater aquaculture lab also serves as lab for fish processing technology and fishing gear technology. The Lab of the Conservation Research Group is located adjacent to the department and the faculty members are actively involved in the research activities of the group through which the college was recognized in 2012 as one among the ten best colleges in the world undertaking conservation research aimed at conservation of endangered species on the IUCN Red list. In 2012 the Aquarium and Hatchery Complex of the department was the venue for the International Internship on "Empowerment through Aquaponics", for the students of the University of Wisconsin, Madison USA. The students of Wisconsin along with the students of the department installed the

first demonstrable aquaponics system in the state which led to the spread of this technology across the state and beyond. The closeness of the Vembanad Lake which is the largest brackish water lake in the country as well as to the ocean and estuaries, allows fieldwork in these habitats to be a central part of students' education. The proximity of Central Government Institutes like CMFRI, NIO, CIFNET, NIPHATT and CIFT enable the students to use the excellent library facilities as well as the assistance of scientists and technical staff of these institutes to broaden their horizon of knowledge in the subject and pursue their research interests. A unique activity of the programme is the participation of the students in a one month long On Job Training when the students get exposed to the finer aspects of seafood processing, quality control and marketing. The students are attached to processing plants across the state and beyond for the OJT. As part of the curriculum the students also undergo training in an ornamental fish hatchery where they get an in depth exposure to hatchery technology of freshwater ornamental and food fishes. The fish / shrimp farm enables the students to have a first hand experience in the culture of fishes and shrimps as well as interact with the farmers to have an understanding of the socio-economic conditions and undertake environmental impact studies in the region. Thus the three year degree program provides a mix of a broad science background and applied hands-on and technical skills. The graduating students who do not opt for higher studies get placed in scientifically run Aquaculture Farms, Hatchery's, Feed Manufacturing Units, Seafood Processing Plants, Quality Assessment Labs, Export Inspection Council, Export Inspection Agency, Central and State Govt. Organizations in Fisheries and Aquaculture, Universities, Colleges and allied industries.



GRADUATE ATTRIBUTES

The program is designed to develop entrepreneurially oriented aquaculture graduates with an in depth expertise in the pragmatic and academic skills related to aquatic ecology and fishery biology, freshwater aquaculture, brackish water aquaculture, mariculture, culture of ornamental fishes, technological aspects of fish capture, hatchery technology, aquaculture nutrition, soil and water quality management, microbiology and fish pathology, processing technology and value addition, aquaculture engineering and biotechnology, aquaculture entrepreneurship and development planning.

On completion of an Undergraduate Programme from St. Albert's College (Autonomous), students would be able to demonstrate the graduate attributes listed below:

GA 1: Discipline knowledge

Demonstrate comprehensive knowledge and understanding of one or more disciplines that form a part of an undergraduate programme of study.

GA 2: Critical Thinking

Apply analytic thought to a body of knowledge; analyse and evaluate evidence, arguments, claims, beliefs on the basis of empirical evidence; identify relevant assumptions or implications; formulate coherent arguments; critically evaluate practices, policies and theories by following scientific approach to knowledge development.

GA 3: Effective Communication

Capacity to connect with people, ideas, books, media, and technology to make sense of the world. This includes the ability to communicate, read, write, and listen clearly in person and through electronic media in English and in one Indian language.

GA 4: Social Responsibility

Exhibit qualities of an ideal citizen through civic and social responsibilities along with the knowledge of one's environment and the issues faced, and strive towards sustainable development.

GA 5: Digital Competency

Analyze and choose from available data and information sources to communicate, collaborate and network through a range of digital media.

Programme Outcomes

Upon the completion of the B.Voc. Commercial Aquaculture programme, the students would be able to demonstrate the programme outcomes listed below.

PO1: Discipline Knowledge

To demonstrate comprehensive professional knowledge and to gain expertise in economically viable and environmentally sustainable skills and techniques in aquaculture practices.

PO 2: Critical Thinking

To apply analytic thought, critically evaluate practices and policies by following scientific approach to knowledge development and to gain expertise on different steps and procedures involved in the preparation and the management of nursery and rearing systems of fish culture.

PO 3: Effective Communication and Digital Competency

Exchange ideas, thoughts of knowledge through effective communication and digital skills to provide high quality networking and collaboration in the professional field.

PO 4: Social Responsibility

To exhibit social awareness and responsibilities through knowledge about our own environment and to formulate socially relevant projects of aquaculture practices in an environmental friendly manner for sustainable development.

PO 5: Professional Development

Basic knowledge in the biology of aquatic organisms including taxonomy, physiology, anatomy along with the application of biotechnology and microbiology in the processing of seafood products.

PO 6: Build Entrepreneurship Skills

Implement concepts and good management practices for culture and capture fisheries in a sustainable way either as an employee or at the level of an entrepreneur and install/establish different scientifically proven concepts to ensure profitability of own business.

Regulations

1. TITLE

These regulations shall be called "ST. ALBERT'S COLLEGE (AUTONOMOUS), ERNAKULAM - REGULATIONS FOR B. Voc PROGRAMMES UNDER CREDIT SEMESTER SYSTEM 2023". (SACA B.Voc. CSS 2023).

2. SCOPE

This applies to all regular B. Voc. Programme conducted by the College with effect from 2023 admissions. The medium of instruction is English except in the case of language courses other than English unless otherwise stated therein.

3. DEFINITIONS

'Academic Week' is a unit of five working days in which the distribution of work is organized from day one to day five, with five contact hours of one-hour duration on each day / is a unit of six working days in which the distribution of work is organized from day one to day five with 4 hours and day six with 5 contact hours of one-hour duration on each day as decided by the Governing body of the College.

- a) NSQF means National Skills Qualifications Framework'.
- b) 'General components' means a course that provides a general awareness about the discipline.
- c) 'Skill components' means a course in the subject of specialization within a vocational degree programme.
- d) 'Course' means a portion of a subject to be taught and evaluated in a semester (similar to a paper under the annual scheme).
- e) 'OJT' means On-the-job training for a period of 2 weeks.
- f) 'Internship' means a professional learning experience of 2-4 weeks that offers meaningful practical work related student's field of study.
- g) 'Credit' is the numerical value assigned to a paper according to the relative importance of the syllabus of the programme.
- h) 'Department' means any teaching department in a college.
- i) 'Examination Coordinator' is a teacher nominated by a Department Council to coordinate the continuous evaluation undertaken in that department.

- j) 'Department Council' means the body of all teachers of a department in a college.
- k) 'Class Tutor' means a teacher from the department nominated by the Department Council, who will advise the student on academic matters.
- l) Grace Marks shall be awarded to candidates as per the Orders issued from the college from time to time at par with the affiliating University.
- m) 'Grade' means a letter symbol (A, B, C, etc.), which indicates the broad level of performance of a student in a Paper/Course/Semester/Programme.
- n) 'Credit Point' (CP) is the numerical indicator of the percentage of marks awarded to a student in a course.
- o) 'Institutional Average (IA)' means average mark secured (Internal + external) for a course at the college level.
- p) 'Parent Department' means the department which offers the skill course/courses within an undergraduate Programme.
- q) 'Programme' means a three-year programme of study and examinations spread over six semesters, the successful completion of which would lead to the award of a degree.
- r) 'Semester' means a term consisting of 90 working days, inclusive of tutorials, examination days, and other academic activities within a period of five months.
- s) 'Vocational Course' (Skill Enhancement Course) means a course that enables the students to enhance their practical skills and ability to pursue a vocation in their subject of specialization.
- t) Words and expressions used and not defined in this regulation shall have the same meaning assigned to them in the Acts and Regulations of UGC, Department of Higher Education, the affiliating University and regulations of the College.

4. ELIGIBILITY FOR ADMISSION AND RESERVATION OF SEATS

- a) Candidates shall be required to have passed Plus Two or equivalent examination with Biology, as one of the optional subjects, at Plus

Two level.

- b) Eligibility for admissions and reservation of seats for various Undergraduate Programmes shall be according to the rules framed by the Governing Body of the College in this regard, from time to time at par with the UGC norms and regulations of the Government of Kerala and will be published in the prospectus.

5. FACULTY UNDER WHICH DEGREE IS AWARDED

Faculty of Science

6. CURRICULUM

The curriculum in each of the years of the programme would be a suitable mix of general education and skill development components.

7. DURATION

- a) The duration of the U.G. programme shall be 6 semesters.
- b) There shall be two semesters in an academic year, the "ODD" semester commences in June, and on completion, the "EVEN" Semester commences.
- c) There shall be a two month vacation during April/May and internships may be conducted during this months as decided by the departments.
- d) The certification levels will lead to Diploma/ Advanced Diploma/B.Voc Degree and will be offered under the aegis of the College in association with the respective sector skill council of the programme in accordance with the NSQF as outlined in the table given below.

Award	Duration
Diploma	2 Semesters
Advanced Diploma	4 Semesters
B.Voc. Degree Commercial Aquaculture	6 Semesters

8. ELIGIBILITY FOR HIGHER STUDIES

Those who pass B.Voc. Degree programmes are eligible for admission to Department of Fisheries and Aquaculture

higher studies.

9. CREDIT CALCULATION

The following method is used for the conversion of time into credit hours.

One Credit would mean the equivalent of 15 periods of 60 minutes each, for theory, workshops/labs, and tutorials;

For internship/fieldwork/OJT, the credit weightage for equivalent hours shall be 50% of that for lectures/workshops.

10. REGISTRATION

The strength of students for each programme shall be as per the existing orders issued by the College following the UGC guidelines.

11. SCHEME AND SYLLABUS

- a) The U.G. programmes shall include (a) General components, (b) Skill components.
- b) Credit Transfer and Accumulation system can be adopted in the programme with the concurrence of the Governing Body of the College. Transfer of Credit consists of acknowledging, recognizing and accepting credits by an institution for programmes or courses completed at another institution. The Credit Transfer Scheme shall allow students pursuing a programme in one College/University to continue their education in another College/University without break.
- c) The B.Voc programme should follow credit semester system of St. Albert's College (Autonomous).
- d) A separate minimum of 30% marks each for internal and external (for both theory and practical) and an aggregate minimum of 40% are required for a pass for a course. For the programmes with practical examinations, the practical examinations will be conducted every semester or at the end of even semesters as applicable.
- e) For a pass in a programme, a separate minimum of Grade P is required for all the individual courses. If a candidate secures an F Grade for any one of the courses offered in a Semester/Programme only F Grade will be awarded for that Semester/Programme until he/she improves this to P Grade or

above within the permitted period. The candidate who secures P Grade and above will be eligible for higher studies.

12. PROGRAMME STRUCTURE

The B.Voc. programme shall include the following elements:

- General Education Components
- Skill Components
- Project
- Internships
- OJT
- Soft skills and Personality Development Programmes
- Field Visit / Industrial Visits / Study Tour

	PARTICULARS	B.Voc Programmes
A	Programme Duration	6 Semesters
B	Total Credits required for successful completion of the Programme	180
C	Credits required from Skill Component	108
D	Credits required from General Component	72
G	Minimum attendance required	75%

13. COURSE STRUCTURE

NSQF Level	Credits		Normal Duration	Exit Points / Awards
	Skill Compo nent	General Component		
Level 5 /Year 1	36	24	Two Semesters	Diploma
Level 6 /Year 2	72	48	Four Semesters	Advanced Diploma
Level 7 /Year 3	108	72	Six Semesters	B. Voc. Degree

As per the UGC guidelines, there are multiple exit points for a candidate admitted to this course. If he/she is completing all six semesters successfully, he/she will get a B. Voc. Degree. If he/she is completing the first four semesters successfully, he/she will get an Advanced Diploma. If he/she is completing the first two semesters successfully, he/she will get a Diploma. A B.Voc. Degree holder is expected to acquire the skills needed for a Manager/Entrepreneur/skilled employee.

14. ATTENDANCE

The minimum number of hours of lectures, tutorials, seminars or practicals which a student shall be required to attend for eligibility to appear at the end semester examination shall not be less than 75% of the total number of lectures, tutorials, seminars, or practical sessions and shall have 75% separate attendance during their internship and OJT period also. Internships, OJT and soft skill and personality development programmes are part of the course and students must meet the attendance requirements for these activities to complete a semester.

15. ASSESSMENT AND CERTIFICATION BY SECTOR SKILL COUNCIL (SSC)

The department should make necessary arrangements for the simultaneous assessment and certification of Skill Development Component by aligned SSC having the approval of National Skill Development Corporation of India (NSDC).

16. EXAMINATION

The evaluation of each paper shall contain two parts:

Internal or In-Semester Assessment (ISA) External or End-Semester Assessment (ESA)

The internal to external assessment ratio shall be 1:4.

Both internal and external marks are to be rounded to the next integer.

All papers (theory & practical), grades are given on a 7-point scale based on the total percentage of marks, (ISA+ESA) as given below:-

Percentage of Marks	Grade	Grade Point
95 and above	O - Outstanding	10
90 to below 95	A+ - Excellent	9
80 to below 90	A - Very Good	8
70 to below 80	B+ - Good	7
60 to below 70	B - Above Average	6
50 to below 60	C - Average	5
40 to below 50	P - Pass	4
Below 40	F - Fail	0
	Ab - Absent	0

17. CREDIT POINT AND CREDIT POINT AVERAGE

The Credit Point (CP) of a paper is calculated using the formula:

$CP = C \times GP$, where C is the Credit and GP is the Grade point.

Semester Credit Point Average (SCPA) of a Semester is calculated using the formula:

$SCPA / CPA = TCP / TC$, where TCP is the Total Credit Point of that semester.

Cumulative Credit Point Average (CCPA) is calculated using the formula:

$CCPA = TCP / TC$, where TCP is the Total Credit Point of that programme.

Credit Point Average (CPA) of different categories, of course, is calculated using the formula:

$CPA = TCP/TC$, where TCP is the Total Credit Point of a category of course.

TC is the total credit of that category of course.

Grades for the different courses, semesters and overall programme are given based on the corresponding CPA as shown below:

CPA	Grade	
9.5 and above	O	Outstanding
9 to below 9.5	A+	Excellent
8 to below 9	A	Very Good
7 to below 8	B+	Good
6 to below 7	B	Above Average
5 to below 6	C	Average
4 to below 5	P	Pass
Below 4	F	Failure

18. MARK DISTRIBUTION FOR EXTERNAL AND INTERNAL EVALUATIONS

The external theory examination of all semesters shall be conducted by the college at the end of each semester. Internal evaluation is to be done by continuous assessment. For all courses, the total marks for external examination is 80 and the total marks for internal evaluation is 20.

For the courses having both theory and practical components, the external examination marks would include 60 for theory and 20 for practical. The internal evaluation would remain the same as above.

Mark distribution for external and internal assessments and the components for internal evaluation with their marks are shown below:

a) For all theory courses

Marks of external Examination : 80

Marks of internal evaluation : 20

Components of Internal Evaluation of theory	Marks
Attendance	5
Assignment/ Seminar/Viva	5
Test Paper 1	5
Test paper 2	5
Total	20

b) For practical examinations,

The total marks for external evaluation : 80

The total mark for internal evaluation : 20

Components for internal evaluation of Practical	Marks
Attendance	5
Record	5
Skill Test	5
Lab Performance/Punctuality	5
Total	20

*Marks awarded for Record should be related to the number of experiments recorded and duly signed by the teacher concerned in charge.

All four components of internal assessments are mandatory unless for the courses otherwisementioned in the BoS.

c) For courses having both theory and practical components

a) Marks of theory- external examination : 20

b) Marks of practical- external examination : 60

c) Marks of internal evaluation : 20

d) For internship with project

Marks of external evaluation : 80

Marks of internal evaluation : 20

Components of External Evaluation of Project	Marks
Dissertation (External)	50
Viva-Voce (External)	30
Total	80

*Marks for dissertation may include industrial visit report if proposed in the syllabus.

Components of Internal Evaluation of Project	Marks
Punctuality	5
Experimentation/Data Collection	5
Skill Acquired	5
Report	5
Total	20

*All four components of internal assessments are mandatory unless for the courses otherwisementioned in the BoS

e) For Internships

There will only External evaluation for Internships.

Components of Internal Evaluation- Internships

Components of External Evaluation of Internship	Marks
Dissertation (External)	50
Viva-Voce (External)	30
Marks awarded by the organization/company/institution/agency (External)	20
Total	100

*Marks for dissertation may include report of field visit done as part of internship if proposed in the syllabus.

f) OJT

There will be only internal evaluation for OJT. Components of Internal valuation- OJT

Components of External Evaluation of OJT	Marks
Punctuality	10
Subject Knowledge/Viva	20
Report	50
Marks awarded by the organization/company/institution/agency (External)	20
Total	100

19. Attendance Evaluation for all papers

% of attendance	Marks
90 and above	5
85 - 89	4
80-84	3
76-79	2
75	1

(Decimals are to be rounded to the next higher whole number)

20. ASSIGNMENTS

Assignments are to be done from 1st to VIth Semesters. At least one assignments should be done per course per semester for evaluation.

21. SEMINAR

A student shall present a seminar every semester for each course.

22. INTERNAL ASSESSMENT / TEST PAPERS

- a) At least two internal test papers are to be attended in each semester for each course. The evaluations of all components are to be published and are to be acknowledged by the candidates. All documents of internal assessments are to be kept in the

department for five years and shall be made available for verification by the College. The responsibility of evaluating the internal assessment is vested on the teacher(s), who teaches the course.

- b) In case of any grievances regarding internal assessment, students can follow the procedures mentioned below under Grievance Redressal Mechanism - clause number 23 in regulation.
- c) The CoE shall make arrangements for giving awareness of the internal evaluation components to students immediately after the commencement of the 1st semester.
- d) The internal evaluation marks/grades in the prescribed format should reach the office of the Controller of Examinations, St. Albert's College before the commencement of study leave in each semester.

23. GRIEVANCE REDRESSAL MECHANISM WITH RESPECT TO INTERNAL EVALUATION

The internal assessment shall not be used as a tool for personal or other types of vengeance. A student has all rights to know how the teacher arrived at the marks. There is a provision for grievance redressal regarding internal evaluation which operates at four levels. Complaints regarding the internal evaluation shall be brought to the notice of the teacher concerned in the first instance. If the student is not satisfied with the decision of the teacher concerned, he/she may appeal to the Departmental Grievance Redressal Committee which shall have the Head of the department, the class Tutor, and the teacher against whom the complaint is made, as members. The student will also have the freedom to make further appeals to the College Level Grievance Redressal Committee which shall have the Principal, the COE, and the concerned Head of the department, as members. If the student is not satisfied, he may appeal to the Governing Body.

Level 1: Class level: The cell is chaired by the class tutor and the course teacher or a teacher nominated by the Head of the Department.

Level 2: Department level: The department cell chaired by the Head of the Department, Examination Coordinator and teacher-in-charge as members.

Level 3: College level: A committee with the Principal as Chairman,

Examination Coordinator, HOD of concerned Department and a senior teacher nominated by the college council as members.

24. EXTERNAL EXAMINATION (END SEMESTER EXAMINATION)

- a)** The external examination of all semesters shall be conducted by the College at the end of each semester.
- b)** Students having a minimum of 75% average attendance for all the courses only can register for the examination. Condonation of shortage of attendance to a maximum of 10 days in a semester subject to a maximum of 2 times during the whole period of the programme may be granted by the college on valid grounds. This condonation shall not be counted for internal assessment. The benefit of attendance may be granted to students attending University/College union/Co-curricular activities by treating them as present for the days of absence, upon producing participation/attendance certificates, within one week, from competent authorities through the class tutor, HoD and Dean of Student Affairs and endorsed by the Principal. This is limited to a maximum of 10 days per semester and this benefit shall be considered for internal assessment also. Those students who are not eligible even with the condonation of shortage of attendance will not be readmitted.
- c)** The Women students can avail maternity leave as per the M.G.U order No. 490/AC A 1/2023/MGU dated 16/01/2023.
- d)** There shall be special supplementary exams only for the fifth semester. For reappearance/ improvement for other semesters, the students can appear along with the next batch.
- e)** There shall be no provision for supplementary examination for the internal assessment.
- f)** A pass in the internal assessment is mandatory for registering for the End semester examination.
- g)** A student who registers his/her name for the external exam for a semester will be eligible for promotion to the next semester provided he/she meet the academic requirements.
- h)** All courses shall have a unique alphanumeric code.
- i)** There is no provision for betterment of internal evaluation marks as well as marks for Practical/OJT/Internship/Project/Viva.

25. PATTERN OF EVALUATION FOR EXTERNAL EXAMINATION - PRACTICAL / INTERNSHIP WITH PROJECT

The components of End Semester Examination of Practical/Internship with Project have to be set by the Chairman of the Boards of Studies concerned.

All students are required to complete On-job training (OJT), Internship and a project, as directed in the respective syllabus. The project can be done individually or as a group, as decided by the Department. The OJT has to be done during the period as prescribed in the particular semester of the programme. The project, if it is a requisite of the syllabi, has to be done in the final year of the programme. The reports of OJT (in duplicate) have to be submitted to the department during the particular semester prescribed in the programme and the report of the project (in duplicate) is to be submitted to the department in the sixth semester. The project report should be produced before the examiners appointed by the College.

For reappearance/improvement, the students can appear along with the next batch. A student who registers his/her name for the external exam for a semester will be eligible for promotion to the next semester.

26. PATTERN OF QUESTIONS

Questions shall be set to assess knowledge acquired, standard and application of knowledge, application of knowledge in new situations, critical evaluation of knowledge, and the ability to synthesize knowledge. The question setter shall ensure that questions covering all skills are set. She/he shall also upload a detailed scheme of answer type, short essay type/problem-solving type, and long essay type questions to be generated from the question bank. A question paper shall be a judicious mix of short answer type, short essay type /problem-solving type, and long essay type questions and to be generated from the question bank.

a) *Pattern of questions for external examination for theory paper without practical.*

Pattern	Total no. of questions	Number of questions to be answered	Marks of each question	Total marks
Very Short Answer type	12	10	2	20
Short Answer (Not to exceed 60 words)	9	6	5	30
Long essay	4	2	15	30
TOTAL	25	18		80

b) *Pattern of questions for external examination for courses having both theory and practical components.*

Theory assessment – Short Answer Type					
Pattern	Total no. of questions	Number of questions to be answered	Marks of each question	Total marks	
Short essay/ problem	8	5	4	20	
Skill Assessment – Practical					
Record	Theory / Procedure / Design	Activity/ Design/ Performance	Result	Viva	Total
10	10	20	10	10	60
		Total		80	

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c) *Mark division for LAB examination*

Record	Theory/ Procedure / Design	Activity/ Design/ Performance	Result	Viva	Total
10	20	25	15	10	80

22. MARK CUM GRADE CARD

The College under its seal shall issue to the students a MARK CUM GRADE CARD on completion of each programme, which shall contain the following information:

- a) Name of the College
- b) Title & Model of the B.Voc. Programme
- c) Name of the Semester
- d) Name and Register Number of the student Date of publication of result
- e) Code, Title, Credits, and Maximum Marks (Internal, External & Total) of each course opted in the semester.
- f) Internal, External and Total Marks awarded, Grade, Grade point, and Credit point in each course opted in the semester.
- g) The total credits and total credit points in the semester.
- h) Semester Credit Point Average (SCPA) and corresponding Grade.
- i) Cumulative Credit Point Average (CCPA), CPA corresponding to General and skill Courses.
- j) The final Mark cum Grade Card issued at the end of the final semester shall contain the details of all courses taken during the final semester examination and shall include the final Grade (SCPA) scored by the candidate from 1st to 5th semesters, and the overall Grade for the total programme.

23. RANK/POSITION CERTIFICATE

The college publishes a position list of the top 5 candidates for each programme after the publication of 6th-semester results. Position certificate shall be issued to candidates who secure positions from 1st to 3rd in the rank

list. Candidates shall be ranked in the order of merit based on the CCPA scored by them. Grace marks awarded to the students should not be counted in fixing the rank/position. Rank certificate and position certificate shall be signed by the Controller of Examinations.

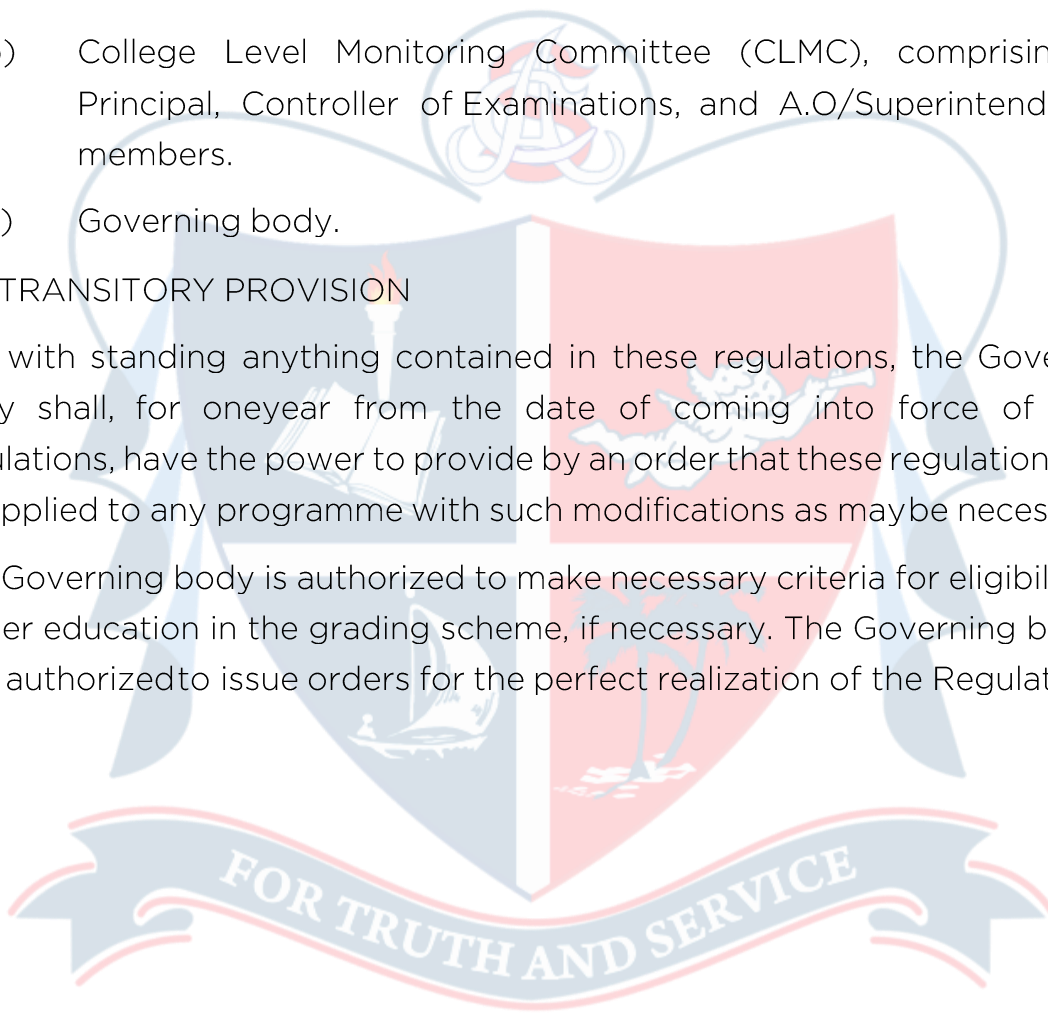
24. There shall be 3 level monitoring committees for the successful conduct of the programme. They are -

- a) Department Level Monitoring Committee (DLMC), comprising the HOD and two senior-most teachers as members.
- b) College Level Monitoring Committee (CLMC), comprising the Principal, Controller of Examinations, and A.O./Superintendent as members.
- c) Governing body.

25. TRANSITORY PROVISION

Notwithstanding anything contained in these regulations, the Governing body shall, for one year from the date of coming into force of these regulations, have the power to provide by an order that these regulations shall be applied to any programme with such modifications as may be necessary.

The Governing body is authorized to make necessary criteria for eligibility for higher education in the grading scheme, if necessary. The Governing body is also authorized to issue orders for the perfect realization of the Regulations.



Annexure I: Model Mark Cum Grade Card



St. Albert's College (Autonomous)

Ernakulam-682 018, Kerala, India.

Accredited by National Assessment and Accreditation Council (NAAC)

at A Grade ISO 9001: 2315 Certified

Affiliated to Mahatma Gandhi University, Kottayam, Kerala

GRADE CARD

NAME OF THE CANDIDATE								Student Photo			
PERMANENT REGISTER NUMBER(PRN):											
DEGREE											
PROGRAMME											
STREAM											
NAME OF THE EXAMINATION											
DATE OF ISSUE											
COURSE CODE	COURSE TITLE	MARKS						GP	GRADE	CGP	RESULT
		INTERNAL		EXTERNAL		TOTAL					
		CREDITS AWARDED	MAXIMUM	CREDITS AWARDED	MAXIMUM	CREDITS AWARDED	MAXIMUM				
General Component											
Skill Component											
	TOTAL										
	SEMESTER RESULT	SCPA:						SG:			

Controller of Examinations

Principal

Annexure II: Consolidated Model Mark cum Grade Card



St. Albert's College (Autonomous)

Ernakulam-682 018, Kerala, India.

Accredited by National Assessment and Accreditation Council (NAAC) at A Grade ISO 9001: 2315 Certified

Affiliated to Mahatma Gandhi University, Kottayam, Kerala

CONSOLIDATED MARK CUM GRADE CARD

NAME OF THE CANDIDATE		Student Photo					
PERMANENT REGISTER NUMBER (PRN)							
DEGREE							
PROGRAMME							
STREAM							
		SEMESTER RESULTS					
SEMESTER	MARKS AWARDED	MAXIMUM MARKS	CREDITS	SCPA	GRADE	MONTH AND YEAR OF PASSING	RESULT
SEMESTER 1							
SEMESTER 2							
SEMESTER 3							
SEMESTER 4							
SEMESTER 5							
SEMESTER 6							
TOTAL							
		PROGRAMME PART RESULTS					

PROGRAMME PART	MARKS AWARDED	MAXIMUM MARKS	CREDIT POINTS	CREDITS	CCPA	GRADE
GENERAL COMPONENTS						
SKILL COMPONENTS						
TOTAL						
FINAL RESULT						
CREDITS		CCPA		GRADE		RESULT

COURSE CODE	COURSE TITLE	MARKS							RESULT
		CREDITS	AWARDED	INTERNAL MAXIMUM	AWARDED	EXTERNAL MAXIMUM	AWARDED	TOTAL MAXIMUM	
SEMESTER 1									
General Components									
Skill Components									
SEMESTER RESULT									
SEMESTER RESULT				SCPA:				SG:	
SEMESTER 2									
General Components									
Skill Components									
SEMESTER RESULT									
SEMESTER RESULT				SCPA:				SG:	
SEMESTER 3									

General Components											
Skill Components											
SEMESTER RESULT	SCPA:							SG:			
SEMESTER 4											
General Components											
Skill Components											
SEMESTER RESULT	SCPA:							SG:			
SEMESTER 5											
General Components											
Skill Components											
SEMESTER RESULT	SCPA:							SG:			
SEMESTER 6											
General Components											
Skill Components											
SEMESTER RESULT	SCPA:							SG:			

Controller of Examination

Principal

Annexure III: Reverse side of the mark cum Grade Card (Common to all Semesters) DESCRIPTION OF EVALUATION PROCESS

Grade and Grade Point

The evaluation of each course comprises Internal and External components with the ratio 1:4 for all courses. Grade and grade points are given on a 7-point scale based on the percentage of marks (internal + external) as given in table I. Decimals are corrected to next higher whole number.

Table I

% of Marks	Grade	Grade Point
95 and above	O - Outstanding	10
90 to below 95	A+ - Excellent	9
80 to below 90	A - Very Good	8
70 to below 80	B+ - Good	7
60 to below 70	B - Above Average	6
50 to below 60	C - Average	5
40 to below 50	P - Pass	4
Below 40	F - Fail	0
	Ab (Absent)	0

Credit Point and Credit Point Average

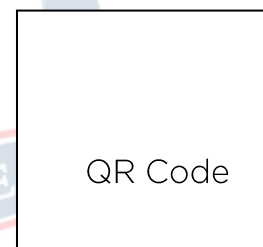
Credit point (CP) of a course is calculated using the formula $CP = C \times GP$
Where C = Credit, GP = Grade Point

Credit Point average of a semester (SCPA) or Cumulative Credit Point Average (CCPA) for a programme is calculated using Total Credit point,
 $TC = \text{Total Credit}$

CCPA	Grade
9.5 and above	O- Outstanding
9 to below 9.5	A+ - Excellent
8 to below 9	A - Very Good
7 to below 8	B+ - Good
6 to below 7	B - Above Average
5 to below 6	C - Average
4 to below 5	P - Pass
Below 4	F - Failure

Note: A separate minimum of 30 % marks each for internal and external (for both Theory and practical) and an aggregate minimum of 40 % is required for a pass in a course. To pass in a programme, a separate minimum of Grade P for all the individual courses and an overall grade P or above is mandatory. If a candidate secures Grade F for any of the courses offered in a semester or a programme only grade F will be awarded to that semester/Programme until the candidate improves this to Grade P or above within the permitted period.

Read By	
Verified By	



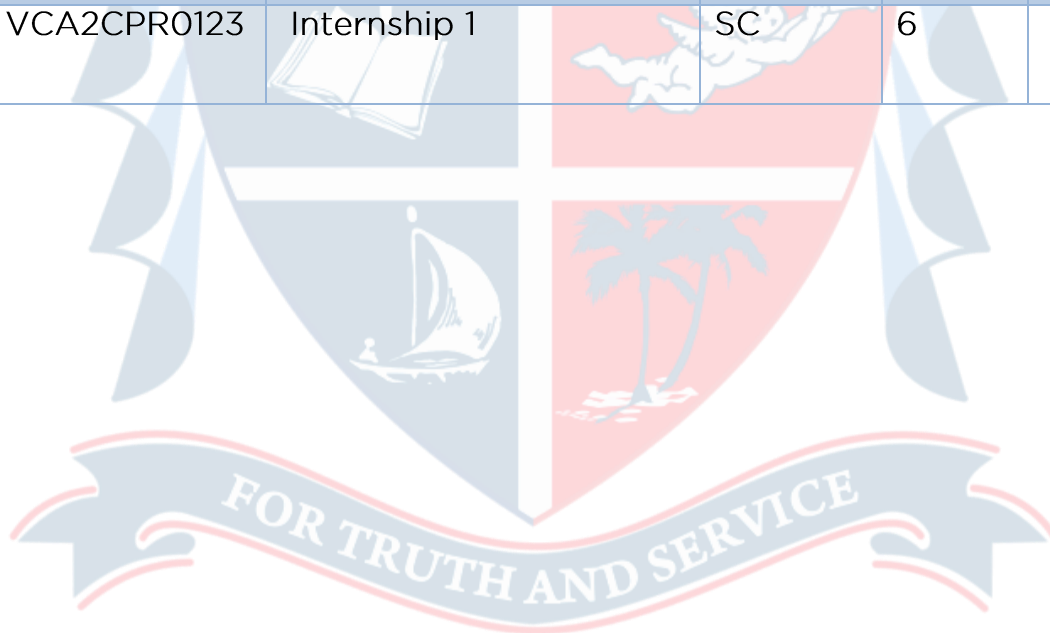
Programme Design

SEMESTER I

No.	Course Code	Course Title	Course Category	Credits	Hours per week
1	ENG1CCT0323	Basic English Skills	GC	4	4
2	VIE1CMT0123	Introductory Environmental Studies	GC	5	4
3	VCA1CMT0223	Chemical Interactions in the Aquatic Environment	GC	6	5
4	VCA1CRT0123	Principles of Aquaculture and Hatchery Technology	SC	4	4
5	VCA1CRT0223	Biology of fishes	SC	4	4
6	VCA1CRP0123	Principles of Aquaculture, Ecology and Biology of Fishes	SC	4	4
7	VCA1OJT0123	OJT 1	SC	3	

SEMESTER II

No.	Course Code	Course Title	Course Category	Credits	Hours per week
1	ENG2CCT0323	Advanced English Skills	GC	4	4
2	VCA2CMT0123	Inland and Marine Fisheries	GC	5	5
3	VCA2CRT0123	Fishing Methods	SC	5	5
4	VCA2CRT0223	Freshwater and Brackish water Aquaculture	SC	5	6
5	VCA2CRP0123	Fishing Methods and Hatchery Technology	SC	5	5
6	VCA2CPR0123	Internship 1	SC	6	



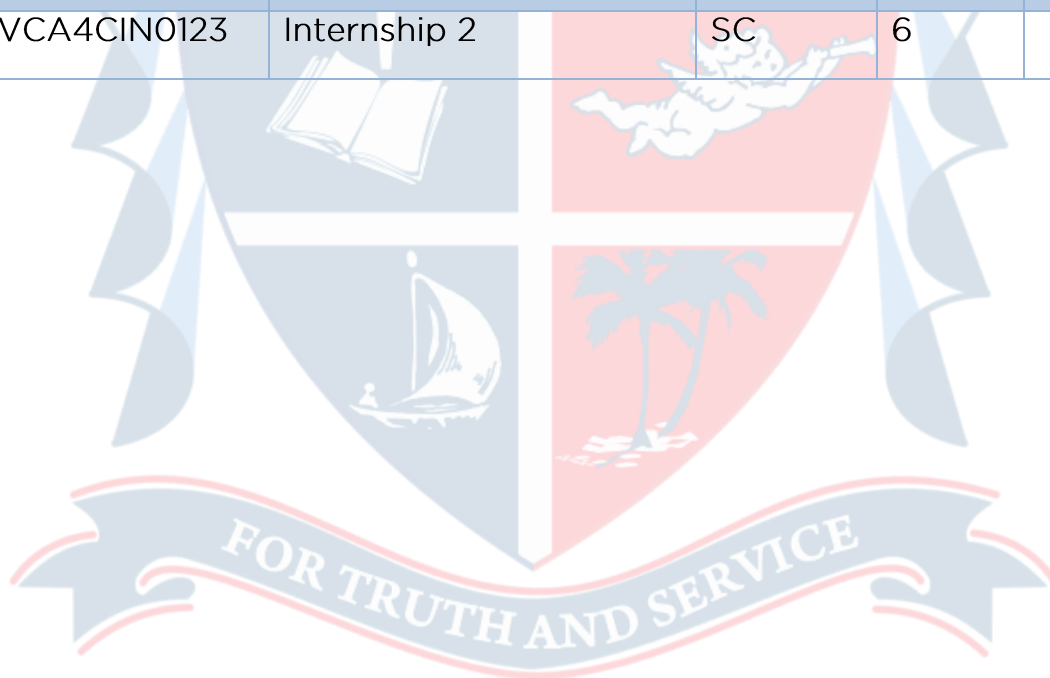
SEMESTER III

No.	Course Code	Course Title	Course Category	Credits	Hours per week
1	VCA3CMT0123	Business Entrepreneurship	GC	4	4
2	VCA3CMT0223	Environmental Science & Human Rights	GC	5	5
3	VCA3CMT0323	Sustainable Aquaculture	GC	5	4
4	VCA3CRT0123	Bio-Statistics and Computer Application	SC	4	4
5	VCA3CRT0223	Aquaculture Nutrition	SC	4	4
6	VCA3CRP0123	Bio-statistics, Aquaculture Nutrition and Soil and Water Quality	SC	4	4
7	VCA3OJT0123	OJT 2	SC	3	



SEMESTER IV

No	Course Code	Course Title	Course Category	Credits	Hours per week
1	VCA4CMT0123	Oceanography	GC	5	5
2	VCA4CMT0223	Aquaculture Biotechnology	GC	5	5
3	VCA4CRT0123	Fish Preservation and Processing Technology	SC	5	5
4	VCA4CRT0223	Ornamental Fish Culture	SC	5	5
5	VCA4CRP0123	Fish Processing and Ornamental Fish Culture	SC	5	5
6	VCA4CIN0123	Internship 2	SC	6	



SEMESTER V

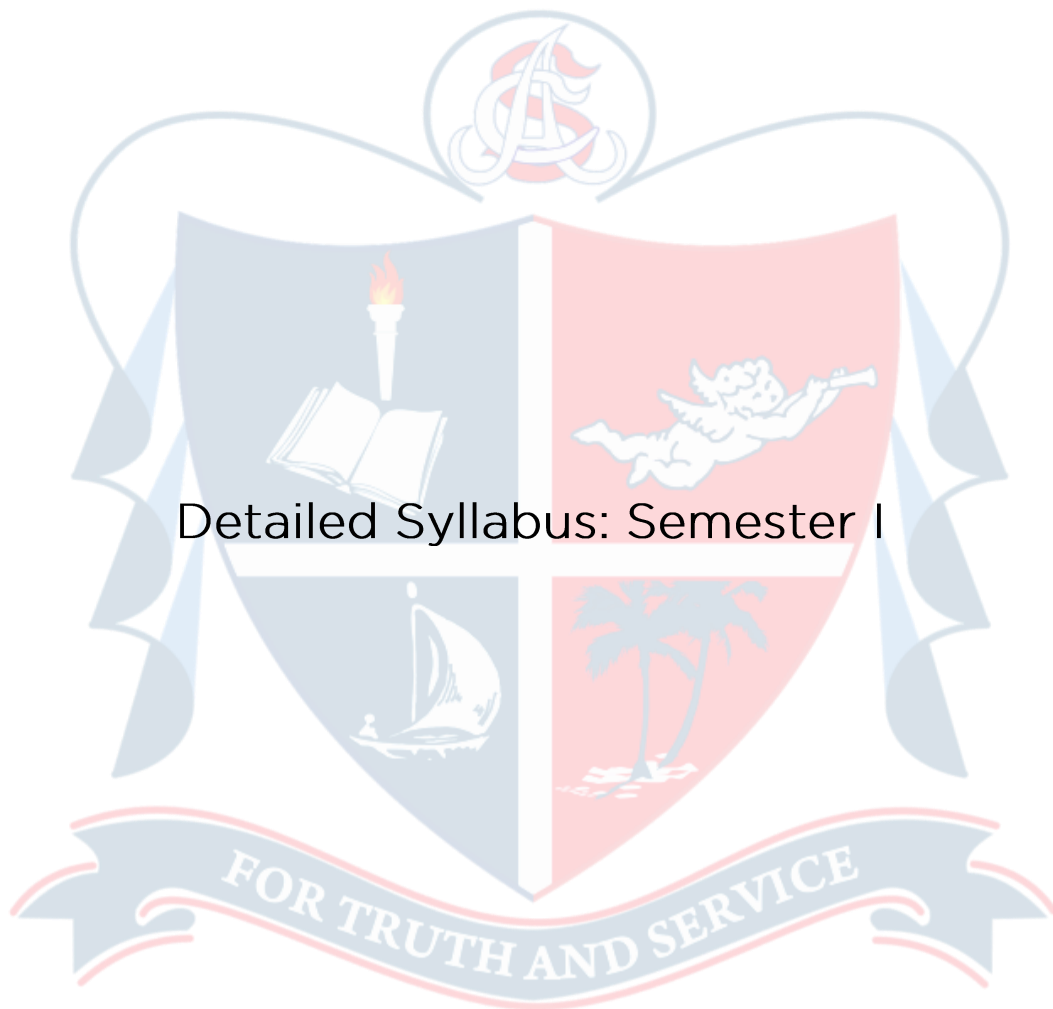
No	Course Code	Course Title	Course Category	Credits	Hours per week
1	VCA5CMT0123	Research Methodology	GC	4	4
2	VCA5CMT0223	Aquaculture Development Planning and Management	GC	5	4
3	VCA5CMT0323	Mariculture	GC	5	5
4	VCA5CRT0123	Value Added Fishery Products	SC	4	4
5	VCA5CRT0223	Microbiology and Health Management	SC	4	4
6	VCA5CRP0123	Value Addition, Microbiology and Pathology	SC	4	4
7	VCA5OJT0123	OJT 3	SC	4	



SEMESTER VI

No	Course Code	Course Title	Course Category	Credits	Hours per week
1	VCA6CMT0123	Corporate readiness programme	GC	5	5
2	VCA6CMT0223	Marketing Management	GC	5	5
3	VCA6CRT0123	Aquaculture Engineering	SC	5	5
4	VCA6CRT0223	Fisheries Governance and Socio-economics	SC	4	5
5	VCA6CRP0123	Aquaculture Engineering and Fisheries Governance and Socio-economics	SC	5	5
6	VCA6CPR0123	Internship with Project	SC	6	





Detailed Syllabus: Semester I

General Component: Basic English Skills (ENG1CCT0323)

60 Hours 4

Credits

Course Outcomes

On completion of the course the students will have attained the following:

- Read texts for overall and in depth comprehension.
- Speak phonetically correct English.
- Confidently use English in both written and spoken forms.
- Use English for formal communication effectively.

Module I: Speech Sounds (12 Hours)

Phonemic symbols – Vowels – Consonants – Syllables – Word stress – Stress in polysyllabic words – Stress in words used as different parts of speech – Sentence stress – Weak forms and strong forms – Intonation

Module II: Accents (12 Hours)

Awareness of different accents: American, British and Indian – Influence of the mother tongue.

General Topics

Parasitic protists (diseases mode of transmission and prophylactic measures) – Entamoeba, Trypanosoma, Plasmodium (detailed account of life cycle), Leishmania.

Module III: Listening (12 Hours)

Active listening – Barriers to listening – Listening and note taking – Listening to announcements – Listening to news on the radio and television.

Module IV: Speaking (12 Hours)

Word stress and rhythm – Pauses and sense groups – Falling and rising tones – Fluency and pace of delivery – Art of small talk – Participating in conversations – Making a short formal speech – Describing people, place, events and things – Group discussion skills and telephone skills.

Module V: Reading

(12 Hours)

Theory and Practice – Scanning – Surveying a textbook using an index – reading with a purpose – Making predictions – Understanding text structure – Locating main points – Making inferences – Reading graphics – Reading critically – Reading for research.

References

- V. Sasikumar, P Kiranmai Dutt and Geetha Rajeevan. Communication Skills in English. Cambridge University Press and Mahatma Gandhi University.
- A Course in Listening and Speaking I & II, Sasikumar, V., Kiranmai Dutt and Geetha Rajeevan, New Delhi: CUP, 2007
- Study Listening: A Course in Listening to Lectures and Note-taking Tony Lynch New Delhi: CUP,
- Study Speaking: A Course in Spoken English for Academic Purposes. Anderson, Kenneth, Joan New Delhi: OUP, 2008



General Component: Introductory Environmental Studies (VIE1CMT0120)

75 Hours

5 Credits

Course Outcomes

On completion of the course the students will have attained the following:

- Illustrate core concepts of ecological resources, their exploitation and explain how to solve environmental problems.
- Summarise a coherent philosophy of the environment & consider ethical bases for responding to environmental questions.
- Recognize the spheres that make up our ecosystem, examples of biodiversity and describe the conservation within these systems
- Explain the relationship between human activity (natural resource exploitation, waste production, etc.) and the natural environment (biotic and abiotic).
- Discuss mitigation and remediation strategies to counteract these environmental impacts.

Module I: Introduction to Environmental Studies (15 Hours)

Environmental studies, Definition, Scope and Importance – Need For Public Awareness –Forest Resources:- Use and Over - Exploitation, Deforestation, Mining, Dams and their Groundwater, Floods, Drought, Conflicts Over Water, Dams – Benefits and Problems – Mineral Resources:- Use Effects on Forests and Tribal People – Water Resources:- Use and Over-Utilization of Surface and Exploitation, Environmental Effects of Extracting and Using Mineral Resources.

Module II: Food Resources (15 Hours)

World Food Problems, Changes caused by Agriculture and Overgrazing, Effects of Modern Agriculture, Fertilizer- Pesticide Problems, Water Logging, salinity, – Land Resources:-Land as a Resource, Land Degradation, Man Induced Landslides, Soil Erosion and Desertification – Role of an Individual in Conservation of Natural Resources – Equitable use of Resources for Sustainable Lifestyles.

Module III: Concepts of an Ecosystem (10 Hours)

Structure and Function of an Ecosystem – Producers, Consumers and Decomposers – Energy Flow in the Ecosystem – Ecological Succession –Food

Chains, Food Webs and Ecological Pyramids - Introduction, Types, Characteristic Features, Structure and Function of the Forest Ecosystem
Grassland Ecosystem Desert Ecosystem Aquatic Ecosystems -

Module IV: Introduction to Biodiversity (15 Hours)

Definition: Genetic, Species and Ecosystem Diversity - Bio-geographical Classification of India - Value of Biodiversity: Consumptive Use, Productive Use, Social, Ethical, Aesthetic and Option Values - Biodiversity at Global, National and Local Levels - India as a Mega-Diversity Nation - Hot-Spots of Biodiversity - Threats to Biodiversity: Habitat Loss, Poaching of Wildlife, Man Wildlife Conflicts - endangered and Endemic Species of India - Conservation of Biodiversity: In-Situ and Ex-Situ conservation of Biodiversity.

Module V : Environmental pollution (10 Hours)

Definition of pollution; pollutants; classification of pollutants - Causes, Effects and Control Measures of different types of pollutions :-Air Pollution- sources and types of pollutants (primary and secondary), Water Pollution - Sources of surface and groundwater pollution, organic waste and water pollution; eutrophication, Soil Pollution, Marine Pollution- sources of marine pollution; oil spill and its effects, Noise Pollution- sources and permissible ambient noise levels , Thermal Pollution,

Module VI : Environmental Hazards (10 Hours)

Nuclear Hazards - Soil Waste Management:- Causes, Effects and Control Measures of Urban and Industrial Wastes - Role of an Individual in Prevention of Pollution -Pollution Case Studies - disaster Management:- Types of disasters, Major causes for disasters, Floods, Earthquake, Cyclone and Landslides. Agencies working on disaster management.

References

- Masters, G.M., "Introduction to Environmental Engineering and Science", Pearson Education Pvt., Ltd., 2nd Edition, 2004.
- Miller, T.G. Jr., "Environmental Science", Wadsworth Pub. Co.
- Townsend C., Harper, J. and Begon, M., "Essentials of Ecology", Blackwell Science, 2003.
- Trivedi, R.K., and Goel, P.K., "Introduction to Air Pollution", Techno- Science

General Component: Chemical Interactions in the Aquatic Environment
(VCA1CMT0223)

90 Hours

6 Credits

Course Outcomes

On completion of the course the students will have attained the following:

- Define the basic concepts of chemical kinetics, equilibria and processes controlling elemental cycling
- Information on physical and chemical properties of water and soil, soil structure, texture, as well as gather knowledge in their nutrient quality and quantity
- Know the basis of pollutant dynamics
- Relate the soil-nutrient interactions their transport in relation to the productivity of aquatic ecosystems
- Explain the major processes controlling elemental cycling

Module I: Basic chemistry principles

(15 Hours)

Chemical equilibrium and redox chemistry- Basic concepts of redox chemistry- Oxidation-reduction (redox) reactions, types of redox reactions- Decomposition Reaction, Combination Reaction, Displacement Reaction, Disproportionation Reactions. Metal displacement Reaction and Non-metal displacement Reaction. Direct Redox Reactions and Indirect Redox Reactions. Reductants and Oxidants. Processes controlling elemental cycling in the earth's crust, oceans and atmosphere.

Module II: Properties of soil and water

(15 Hours)

Physical properties of soil- soil density, porosity, permeability of soil, soil temperature, soil water-types of soil water (gravitational water, capillary water, hygroscopic water, water vapour) Field capacity, water holding capacity and soil atmosphere. Chemical properties of soil- Inorganic elements and compounds, organic matter, colloidal Properties and Soil pH. Soil organisms. Composition of soil- Inorganic and organic components of soil. Soil profile- O-horizon, A-Horizon, B-horizon, C-horizon and R-Horizon. Types of soil- top soil, subsoil. Classification of soil on the basis of texture (sandy soil, loam soil and

clay soil), Classification on the basis of the site of soil formation and the composition of soil profile. Physical and chemical properties of water.

Module III: Soil weathering

(15 Hours)

Definition of soil weathering; types of weathering processes- Physical or Mechanical weathering of rocks, chemical (solubilisation into water, hydrolysis, hydration, oxidation, reduction and carbonation), Organic chemical weathering and biological weathering. Silicate weathering, Basic concepts in ion exchange phenomenon- Ion exchange, Adsorption and Desorption. Site for ion exchange Ion exchange. Kinds of exchangeable ions. Factors affecting ion exchange. Cation Exchange Property of soil (CEC) and the factors affecting the CEC. Anion exchange reactions of the soil (ACE).

Module IV: Humus and Fertilizers

(15 Hours)

Humus- definition of humus. Properties of humus-physical and colloidal properties. Clay-humus complex. Cation Exchange reaction of Humus. Organic substances - biological processes in the degradation and conversion of organic matter; Benefits of organic matter and its benefits-physical, chemical and biological. Humus and nutrient availability. soil and water quality standards; monitoring and management of soil and water quality. Application of fertilizers and manures: Different kinds of fertilizers and manures, fertilizer grade, source, rate and frequency of application, Biofertilizers, Use of treated sewage for pond fertilization,

Module V: Nutrient dynamics

(15 Hours)

Cycling of nutrients- Nutrient cycles and it's types- sedimentary and gaseous cycles- Nitrogen cycle (Nitrogen fixing, Nitrification, Ammonification, Denitrification), Oxygen cycle, Carbon cycle, Phosphorous cycle. The role of aquatic microorganisms role in different nutrient cycles and impact on aquatic habitats and species. Productivity of an aquatic ecosystem-Definition and concepts of productivity- Standing crop, Materials removed and Production rate. Types of productivity-primary and secondary productivity. Classification of primary productivity- gross primary productivity and net primary productivity. Gross primary production (GPP). Net primary production (NPP). Availability of nutrients in an ecosystem. Major nutrients in the soil and its sources.

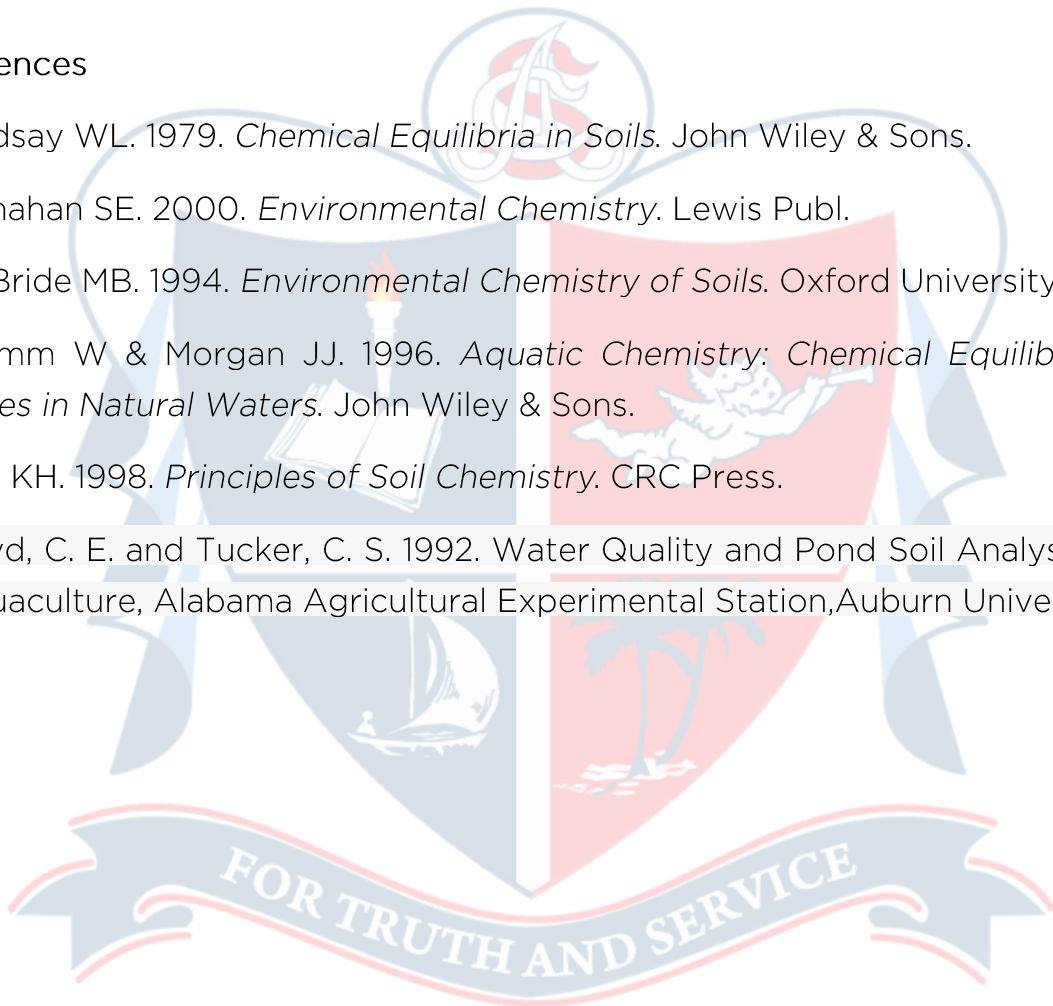
Module VI: Pollutant Dynamics

(15 Hours)

Introduction to pollutant dynamics. Basic concepts-bio-accumulation, bio-availability, Bioaccessibility or Environmental Availability, Relative Bioavailability (RBA), Bioconcentration factor (BCF, Bioaccumulation factor (BAF), Transport of Pollutants. Heavy metal pollution- Sources of heavy metal pollution, Major pollutants in the aquatic environment- Heavy metal and pesticide pollution and it's effects in the aquatic environment. Significance of heavy metals. Waste water treatment practices,

References

- Lindsay WL. 1979. *Chemical Equilibria in Soils*. John Wiley & Sons.
- Manahan SE. 2000. *Environmental Chemistry*. Lewis Publ.
- McBride MB. 1994. *Environmental Chemistry of Soils*. Oxford University Press.
- Stumm W & Morgan JJ. 1996. *Aquatic Chemistry: Chemical Equilibria and Rates in Natural Waters*. John Wiley & Sons.
- Tan KH. 1998. *Principles of Soil Chemistry*. CRC Press.
- Boyd, C. E. and Tucker, C. S. 1992. *Water Quality and Pond Soil Analyses for Aquaculture*, Alabama Agricultural Experimental Station, Auburn University.



Skill Component: Principles of Aquaculture and Hatchery Technology
(VCA1CRT0123)

60 Hours

4 Credits

Course Outcomes

On completion of the course the students will have attained the following:

- Explain the fundamental principles of aquaculture and ecological parameters
- Identifying the environmental issues pertaining to aquatic ecosystems.
- Develop an insight on the activities of different organizations as well as institutes involved in fisheries and aquaculture research & development.
- Expertise on the different types of rearing processes, different steps and procedures involved in the preparation and management of nursery and rearing systems of fish culture.
- Insight of natural breeding of finfishes and sexual maturity of breeding of food fishes.

Module I: Introduction

(12 Hours)

History, definition, scope and significance of aquaculture, comparison of aquaculture with agriculture and commercial fisheries. Different aquaculture systems. Aquaculture - Global and Indian Scenario. Laws of limiting factor. Fertilizations and manuring. Liming and application of fertilizers and manures, role of nutrients, the NPK contents of various fertilizers and manures, rate and precautions in the application of fertilizers and manures. Significance and important groups of phytoplankton, zooplankton and benthos in culture ponds. Physico-chemical conditions of soil and water optimum for culture. Management of water and soil quality parameters. Correction of pH, measures for increasing the concentration of oxygen and reducing the concentration of ammonia and hydrogen sulphide.

Module II: Fish Culture

(12 Hours)

Cultivable Freshwater, Brackish water and Marine Fishes: Cultivable freshwater fishes- carps, air-breathing fishes, tilapia, trout, freshwater prawn. Major freshwater resources of India. Brackish Water resources and fishes of commercial importance - Milkfish, mullet, pearl spot, seabass, shrimps, crabs; Major brackish water culture systems in India. Different organisms in mariculture

– fishes, shrimps, mussels and oysters. Economically important sea weeds of India- Chlorophyceae, Rhodophyceae and Phaeophyceae. Value added products from seaweeds.

Module III: Fisheries Institutions

(12 Hours)

Different organizations and institutes involved in fisheries and aquaculture research and development – FAO, NACA, SEAFDEC, INFOFISH, ICLARM, NABARD. ICAR Institutes -CMFRI,CICFRI,CIFA,CIBA,CIFE,CIFT,NBFGR,DCFR, Ministry of Food and Agriculture - CIFNET,IFP,CICEP,FSI Ministry of Commerce -MPEDA,EIA, RGCA. Aquaculture Authority of India, NRSA, INCOIS etc. State organizations like KUFOS, Matsyafed, ADAK, SAF, NIFAM, and State Fisheries Department.

Hatchery Technology in Aquatic Organisms

Module IV: Seed Production

(12 Hours)

Hatchery Management- Seed Production of Fishes, Crustaceans and Molluscs- Seed production and nursery rearing of *Onchorhynchus mykiss*, *Clarias batrachus*, *Mugil cephalus*, *Oreochromis mossambicus*, *Lates calcarifer*, *Rachycentron canadum*, *Penaeus monodon*, *Macrobrachium rosenbergii*, *Scylla serrata* and *Panulirus homarus*. Molluscs - pearl oysters and clams. Hypophysation of Indian major carps and exotic carps - Pituitary gland collection and preservation. Other ovulating agents. Brood stock management, sexing, dosage for injection, mechanism of ovulation. Development of carp eggs, Different carp hatcheries. Nursery rearing of carp seed. Production of common carp seeds - Methods followed in China and India. Fish seed and broodfishes .Bundh breeding techniques.

Module V: Design and Management of Hatcheries

(12 Hours)

Hatchery design and management: Criteria for site selection of hatchery and nursery, Design and function of incubators, Jar hatchery, Chinese hatchery and other hatchery systems- design and operation, hatchery protocols, larval rearing stages, rearing technology, packaging and transport of seed. Various components required - mechanical and biological filters, types of aerators. Selection criteria for broodstock and brood stock management. Broodstock transportation. Water quality monitoring and management. Quarantine and disease management in hatcheries. Quality assessment of seeds.

References

- VASANTHAKUMAR, B.&SAKHARE , V B . Advances In Aquatic Ecology.
- BISWAS , K P . Ecological and Fisheries Development In Wetlands: a study of
- VERMA , PS & AGARWAL . V K . Environmental Biology (Principles Of Ecology)
- NYBAKKEN , JAMES W. Marine Biology : Ecological approach
- PILLAY , T V R . Aquaculture and The Environment.
- CLOSS , GERRY et. al. Freshwater Ecology: A Scientific Introduction.
- ARVIND KUMAR .Atextbook Of Applied Aquatic Biology.
- FAO. 2007. Manual for Operating a Small Scale Recirculation Freshwater Prawn Hatchery.
- ICAR. 2006. Handbook of Fisheries and Aquaculture. ICAR.



Skill Component: Biology of Fishes (VCA1CRT0223)

60 Hours

4 Credits

Course Outcomes

On completion of the course the students will have attained the following:

- Awareness on the reproduction, respiration, circulation, excretion and osmoregulation mechanisms in aquatic organisms. Find out the different types of food and feeding strategies in fin fish and shellfish
- Find out the different types of food and feeding strategies in fin fish and shellfish
- Compare and discuss key physiological functions in fish and shellfish
- Explain the mechanisms involved in migration, biological clock and rhythms in fish and shellfish
- Summarize the various foundational concepts of biology including cellular, ecological and evolutionary biology

Module I: Food and Feeding**(10 Hours)**

Food and feeding habits – herbivores, carnivores and omnivores. Feeding adaptations. Digestion-General morphology of alimentary canal of herbivores, carnivores and omnivores; -digestive system and process of digestion in fish, Prawn and Mussels. Methods employed in the study of gut content analysis - occurrence method, numerical method, volumetric, gravimetric and point method -relative gut length-gastro-somatic index.

Module II Age and Growth studies**(5 hours)**

Age and growth – Techniques used in the study of growth- Use of scales and otoliths-Tagging and Marking- Length - weight relationship. Fish population dynamics and stock assessment- Growth models, mortality parameters, surplus production models, Analytical model

Module III: Respiration and Circulation**(15 Hours)**

Respiratory system – General description of respiratory organs in fish. Aquatic respiration, Respiratory gases, Gaseous exchange. Adaptations of air breathing fishes. Respiration in crustaceans and molluscs. Cardiovascular system – General features of heart, Circulatory system and oxygen transport in fishes (mullet), crustaceans (type –*Penaeus indicus*) and molluscs (type-freshwater mussel).

Module IV: Reproduction**(8 Hours)**

Reproduction: Structure of ovary and testes in fish, Development of primary and secondary sexual characteristics. Sexual dimorphism in fishes and crustaceans. Maturation and spawning in fishes, Factors affecting maturation and spawning. Fecundity, Condition factor, Size at first maturity. Oviparous, Viviparous and Ovo-viviparous fishes. Parental care and breeding.

Module V: Endocrinology and Migration**(7 Hours)**

Endocrine organs in fishes and crustaceans. Role of hormones in reproduction and moulting in crustaceans. Biological clocks- diurnal, lunar, circadian and tidal rhythms. Migration in fishes –anadromous and catadromous, homing, instinct and orientation.

Module VI: Excretion**(15 Hours)**

Excretion, Osmoregulation and Sense organs: Structure of teleost kidney, Kidney function in marine and freshwater teleost. Osmoregulation in freshwater Teleost, Marine Teleost and Elasmobranch. Sense organs in fishes – Organs of smell, Taste buds, Lateral line system, Ampulla of Lorenzini. Sound production in fishes. Specialized organs in fishes – Electric organs, Poison glands. Colouration and Bioluminescence. Sense organs in crustaceans and molluscs. Buoyancy in fishes - Swim bladder and mechanism of gas secretion

References

- KYLE, HARRY M. Biology of fishes
- JOHAL, M S & TANDON, K. K. Age and growth in Indian freshwater fishes
- RAHUL P, PARIHAR Text book of fish Biology and Indian fisheries
- MANJU TEMBHRE & SANTOSH KUMAR Anotamy and Physiology of fishes
- BHAMRAH, H S & KAVITA JUNEJA Introduction to fishes
- BISWAS, S P. Manual methods in fish Biology
- MATTY, A J. Fish Endocrinology

Skill Component: Practical: Principles of Aquaculture, Ecology and
Biology of Fishes (VCA1CRP0123)

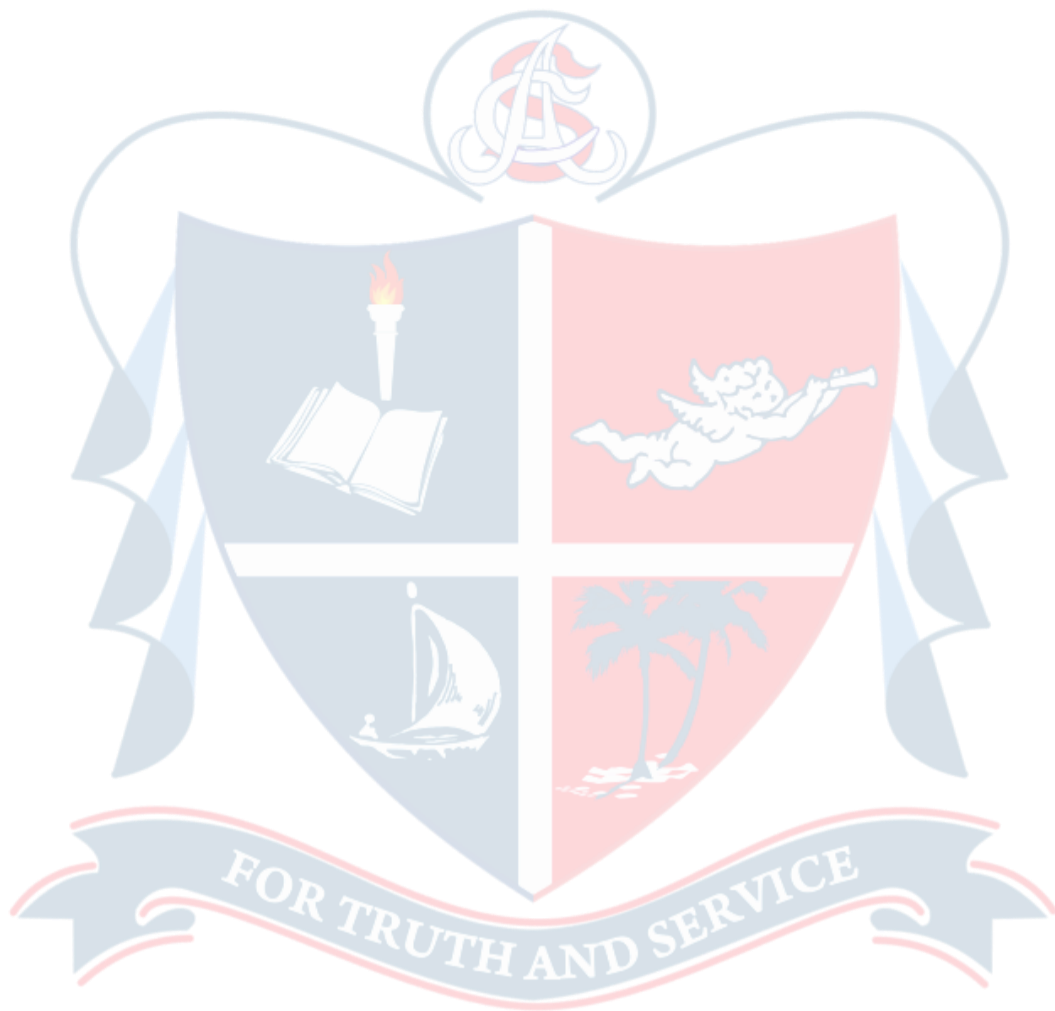
60 Hours

4 Credits

Course Outcomes

On completion of the course the students will have attained the following:

- Identify the commercially important fin fish and shell fish.
 - Explain the anatomical features of various fish taxonomic groups.
 - Explain the anatomical features of various fish taxonomic groups.
 - Communicate relevant biological problems to the scientific community, aquaculture industry and general public.
 - Knowledge to estimate / demonstrate important parameters like fecundity, relative gut length, gonado-somatic index, length-weight analysis etc
 - Estimate the productivity and lime requirements of a fish culture system.
1. Morphometric measurements of fishes
 2. Types of scales, mounting of placoid, cycloid & ctenoid scales
 3. Adaptation of mouth in relation to the feeding habit.
 4. Examination of structure of gill and assessment of feeding behaviour – sardine/ channa sp.
 5. Mounting of appendages of Prawn
 6. Length – weight analysis of fishes
 7. Dissect and display of alimentary canal of fishes (Sardine/Mullet)
 8. Dissect and display of alimentary canal/nervous system of prawns
 9. Fecundity estimation in fishes/ prawn and its relationship with length and weight
 10. Estimation of gonado-somatic index & determination
 11. Gut content analysis - demonstration
 12. Estimation of relative gut length
 13. Estimation of productivity of pond.
 14. Determination of lime requirement in pond.



Skill Component: On the Job Training 1 (OJT 1) (VCA1OJT0123)

3 Credits

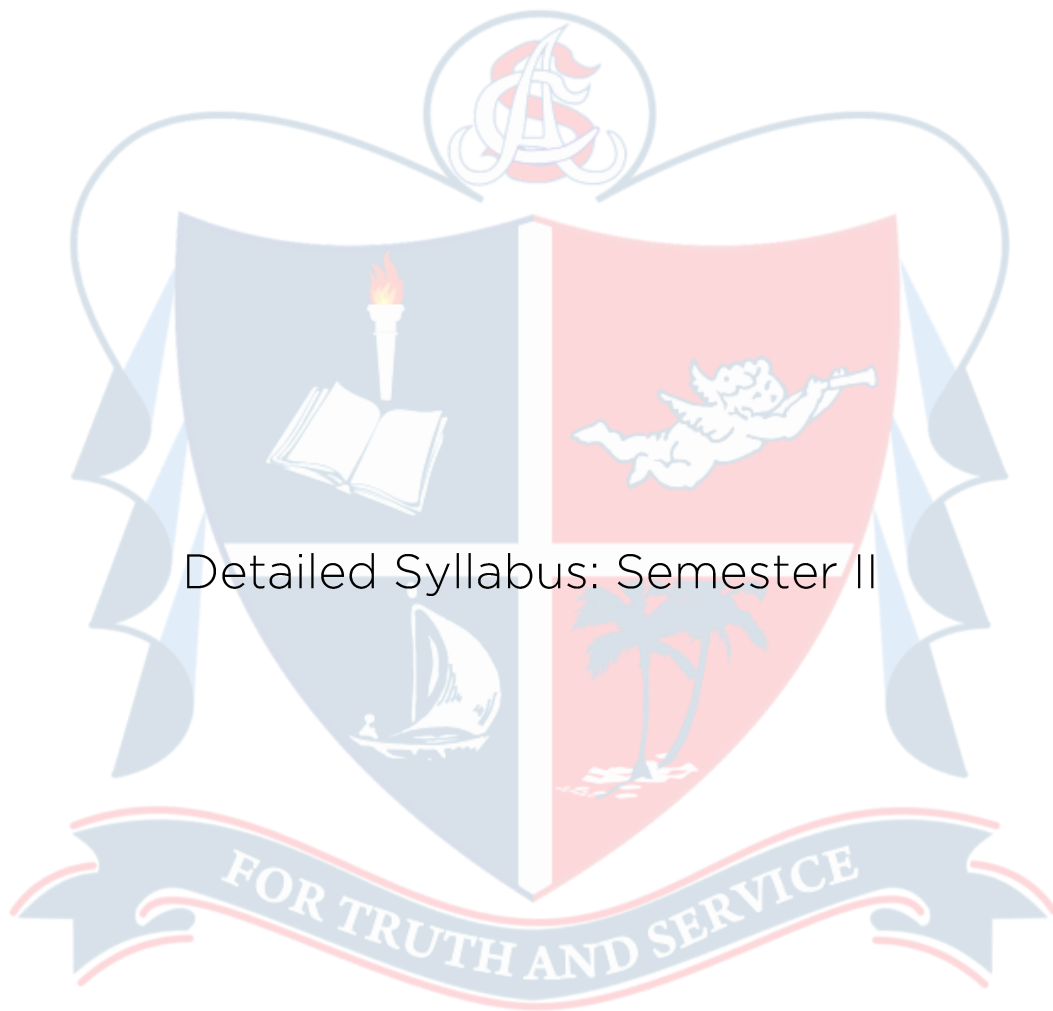
Course Outcomes

On completion of the course the students will have attained the following:

- Recognize the different pond preparation methods in aquaculture systems
- Gain knowledge on the farm equipment's and farm management practices

Students have to undergo training in fish farms for a period of two weeks in different aspects of pond preparation, monitoring and handling of farm equipment's. Each student has to submit a comprehensive report and present the report with the aid of PPT to the corresponding teachers. Student should also produce a certificate of training from the organization. All the above details should be submitted to the Department for evaluation.





Detailed Syllabus: Semester II

General Component: Advanced English Skill (ENG2CCT0323)

60 Hours

4 Credits

Course Outcomes

On completion of the course the students will have attained the following:

- Exhibit critical thinking and problem solving in both academic and non-academic settings.
- Proof-read a text to identify and correct the errors.
- Write letters, memos, agenda, minutes, essays and academic papers in the correct format and without grammatical errors.
- Make effective presentations blending both content and technology.

Module I**(12 Hours)**

Critical Thinking: Introduction to critical thinking - Benefits - Barriers - Reasoning - Arguments - Deductive and inductive arguments - Fallacies - Inferential comprehension. Critical thinking in academic writing - Clarity - Accuracy - Precision - Relevance.

Module II**(12 Hours)**

Research for Academic Writing and the Writing Process: Data collection - Use of print, electronic sources and digital sources - Selecting key points - Note making, paraphrasing, summary - Documentation - Plagiarism - Title - Body paragraphs - Introduction and conclusion - Revising - Proof-reading.

Module III**(12 Hours)**

Accuracy in Academic Writing: Articles - Nouns and prepositions - Subject-verb agreement - Phrasal verbs - Modals - Tenses - Conditionals - Prefixes and suffixes - Prepositions - Adverbs - Relative pronouns - Passives - Conjunctions - Embedded questions - Punctuation - Abbreviations.

Module IV**(12 Hours)**

Writing Models: Letters - Letters to the editor - Resume and covering letters - e-mail - Seminar papers - Project reports - Notices - Filling application forms - Minutes, agenda - Essays.

Module V**(12 Hours)**

Presentation Skills: Soft skills for academic presentations - Effective communication skills - Structuring the presentation - Choosing appropriate

medium – Flip charts – OHP – Power Point presentation – Clarity and brevity -
Inter-action and persuasion - Interview skills – Group Discussions.

References

- Marilyn Anderson, Pramod K Nayar and Madhucchandra Sen. Critical Thinking, Academic Writing and Presentation Skills. Pearson Education and Mahatma Gandhi University



General Component: Inland and Marine Fisheries (VCA2CMT0123)

75 Hours

5 Credits

Course Outcomes

On completion of the course the students will have attained the following:

- Recall the fish and fishery resources of India
- Recognize the different types of capture fishery resources in various inland resources (cold water and riverine systems, reservoirs, estuaries).
- Find out the problems encountered by the major water bodies including deep sea resources and disseminate different schemes practiced for the development.
- Give an outline about the various regulations as well as policies for assessment and conservation of fishery resources
- Identify the different types of commercially important marine fishery resources of India

Module I: Riverine and Coldwater Fisheries (15 Hours)

Inland fish production in India- Riverine fisheries – major river systems in India, capture fisheries, fishing methods, recent statistics of catches, problems encountered in fisheries development of major rivers. Coldwater fisheries- major rivers and species – problems encountered in fisheries development of rivers supporting cold water fisheries.

Module II: Reservoir and Estuarine Fisheries (15 Hours)

Reservoir fisheries- Major reservoirs in India- capture fisheries, fishing methods, recent statistics of catches, problems encountered in fisheries development
Estuarine fisheries- definition and classification of estuaries- capture fisheries- resident and migrant species, fishing methods, recent statistics of catches, problems encountered in fisheries development of major estuaries.

Module III: Pelagic Fishery Resources (11 Hours)

Marine Fisheries- Pelagic Resources, Demersal and Deep Sea Resources

Marine fishery resources in India- important fishing zones including Wadge bank, maritime states. Major pelagic resource groups– sardine, mackerel, anchovies, ribbon fish, tuna, seer fish. Methods of fishing- Recent catch statistics of pelagic fisheries.

Module IV: Demersal Fishery Resources**(11 Hours)**

Major demersal resource groups- elasmobranchs, cephalopods, silverbellies, flat fishes, crabs, sciaenids, pomfrets, bombay duck, prawns, lobsters, molluscan resources. Methods of fishing, recent catch statistics. Fishery of mud banks.

Module V: Deep sea resources**(11 Hours)**

Major deep sea resources - fishes, shrimps, lobsters - status of deep sea fishing in India. Chartered fishing in India- policies and problems. Marine fish production in India. - Estimated fishery resources - inshore- offshore - deep sea resource. Fishing regulations.

Module VI: Fishery Assessment and Regulations**(12 Hours)**

Fishery Assessment and Regulations: Stratified random sampling for estimation of fish landing. Over fishing -Economic and biological, Conservation and regulation of fishing pressure - closed season, mesh size regulations, sanctuaries. Important fishing regulations KMFRA, Deep Sea Fishing Policy.

References

- SHANBHOGUE, S L . Marine fisheries of India.
- SEBASTIAN, V D & KURIAN.,C V . Prawns and prawn fisheries of India.
- RAHUL P, PARIHAR .Text book of Fish biology and Indian fisheries.
- PURNESH KUMAR , TALWARA & ARUN G & JHINGRAN . Inland fishes of India and adjacent countries.
- ARUN G , JHINGRAN & PURNESH ., TALWARA . Inland fishes of India and adjacent countries.
- SPENCE , ALAN. Crab and Lobster fishing.

Skill Component: Fishing Methods (VCA2CRT0123)

75 Hours

5 Credits

Course Outcomes

On completion of the course the students will have attained the following:

- In depth knowledge of the types of fish crafts in India (traditional, motorized and mechanized fishing vessels)
- Ability to explain the traditional and modern fishing gears operated in India
- Thorough knowledge on the importance of fish aggregating devices, artificial reefs, by-catch reduction devices and their contribution to stock replenishment
- Awareness on the significance of implementing responsible fishing and supporting legislations
- Able to discuss the different types of synthetic materials used in the construction of fishing gears.

Module I: Fishing Crafts**(19 Hours)**

Different types of fishing crafts in India- inland and marine – traditional, motorized and mechanized, trawlers, gill netters, purse seiners, long liners, trollers, deep sea vessels. Boat building materials – types (preparation, seasoning, preservation), advantages & disadvantages.

Module II: Fishing Gears**(10 Hours)**

Traditional fishing gears of Kerala; Fishing gear materials - natural and synthetic, yarn numbering systems, types of knots, knotless netting, meshes, braiding, shaping, creasing, baiting, fly-meshing, tailoring; Mounting of webbing – different methods, hanging coefficient, take up ratio

Module III: Modern Fishing Gears**(9 Hours)**

Modern commercial fishing methods- Operation and classification of trawling, purse seining, lampara net fishing, gill netting, line fishing. Squid jigging. Fishing accessories- hooks, floats, sinkers and ropes.

Module IV: Fish aggregating devices**(9 Hours)**

FAD's and Fish Finding Devices: Fish aggregating devices and artificial reefs; Impact of artificial reefs on fish stock improvement; Turtle Exclusion Devices (TED) - By-catch Reduction Devices (BRD).

Module V: Fish finding devices**(9 Hours)**

Fish finder, GPS navigator, sonar, net sonde, Echo sounder, gear monitoring equipments; remote sensing.

Module VI: Responsible Fisheries and Regulations**(19 Hours)**

Responsible Fisheries, Regulations and Legislations: Concept of Responsible Fisheries; Monsoon trawl ban, closed season, mesh size regulations, juvenile fishing, Exclusive Economic Zone (EEZ), Coastal Regulation Zone (CRZ), Integrated Coastal Zone Management (ICZM). MSY, MEY, Over fishing: Recruitment over fishing, Aquaranching, Indian fisheries Act.1976. Coast Guard Act.1978, Maritime zones of India Act.1981

References

- BISWAS,KP - Harvesting aquatic resources.
- VONBRANDI,ANDRES - Fish catching methods of the world .
- BOOPENDRANATH,M R& SHAHUL HAMEED.,M - Modern fishing gear technology.
- ANIL JAMWAL et.al - Principles of remote sensing.
- SREEKRISHNA,Y& LATHA SHENOY - Fishing gear and craft technology.
- GEORGE, V C ED.-Proceedings of the national workshop on low energy fishing .
- BALACHANDRAN ,KK - Advances and priorities in fisheries technology
- BISWAS ,K P - Advances in fishing technology.

Skill Component: Freshwater and Brackish Water Aquaculture
(VCA2CRT0223)

75 Hours

5 Credits

Course Outcomes

On completion of the course the students will have attained the following:

- Proficiency in pre-stocking pond preparation steps such as drying, ploughing, liming, manuring, fertilization and proper procedures for grow out.
- Demonstrate the biology and feeding habits of cultivable carps, Ecology of different types of carp farming systems, culture of freshwater prawns, molluscs.
- Knowledge on the different systems of aquaculture including recent techniques like aquaponics and recirculatory aquaculture systems.
- Interpret the economically viable and environmentally sustainable culture technologies for finfish and shellfish in Freshwater and brackish water systems Interpret the economically viable and environmentally sustainable culture technologies for finfish and shellfish in brackish water systems in different agro-ecological regions
- Interpret different policies and planning for the socio-economic development, through environmentally sustainable, brackish water aquaculture systems

Freshwater Aquaculture**Module I: Freshwater Culture of Fishes (10 Hours)**

Fishes: Culture of carps-Nursery rearing and stocking ponds - composite fish culture, preparation of ponds- different methods for the eradication of weed fishes, predators, aquatic insects and aquatic weeds, stocking and post stocking management, harvesting. Culture of air breathing fishes- Channa, catfishes, Anabas. Culture of cold water fishes in India.

Module II: Freshwater Culture of Crustaceans and Molluscs (9 Hours)

Prawns: Cultivable species of freshwater prawns and their biology - culture of *Macrobrachium rosenbergii*.

Molluscs :Important freshwater molluscs of Kerala. Freshwater pearl culture -

Present status of freshwater pearl culture and production in India.

Frogs: Species and culture of frogs.

Module III: Systems in Aquaculture (19 Hours)

Fish culture in ponds, cages and pens, raceways, indoor tanks, canals, silo culture, sewage-fed fish culture. Monoculture, polyculture, composite fish culture. Integrated fish farming with duck, pig, poultry, livestock, rice. Recirculatory Aquaculture Systems.

Module IV: Brackish water Finfish Culture (13 Hours)

History, development and present status of brackish water farming in India, Cultivable species in brackish water systems. ecological factors – abiotic and biotic factors. Selection of site, general planning and design of brackish water farms. Culture practices – monoculture and polyculture of *Chanos chanos*, *Mugil cephalus*, *Lates calcarifer*, *Etroplus suratensis*, *Oreochromis mossambicus*. Nursery, rearing and grow out in ponds, cages and pens.

Module V: Crustacean Culture (12 Hours)

Species of shrimps cultured in brackish water – *Penaeus mondon*, *Penaeus indicus*, *Litopenaeus vannamei*. Extensive, semi-intensive and intensive shrimp farming practices. Species of crabs cultured and culture techniques, prospects in India. Species of lobsters, culture, problems and prospects in India; lobster fattening. Site selection and design of brackish water shrimp farms

Module VI Molluscan Culture (12 Hours)

Important culturable species of oysters, mussels and clams cultured. Site selection criteria. Methods of culture. Site selection and ecological parameters for molluscan culture.

References

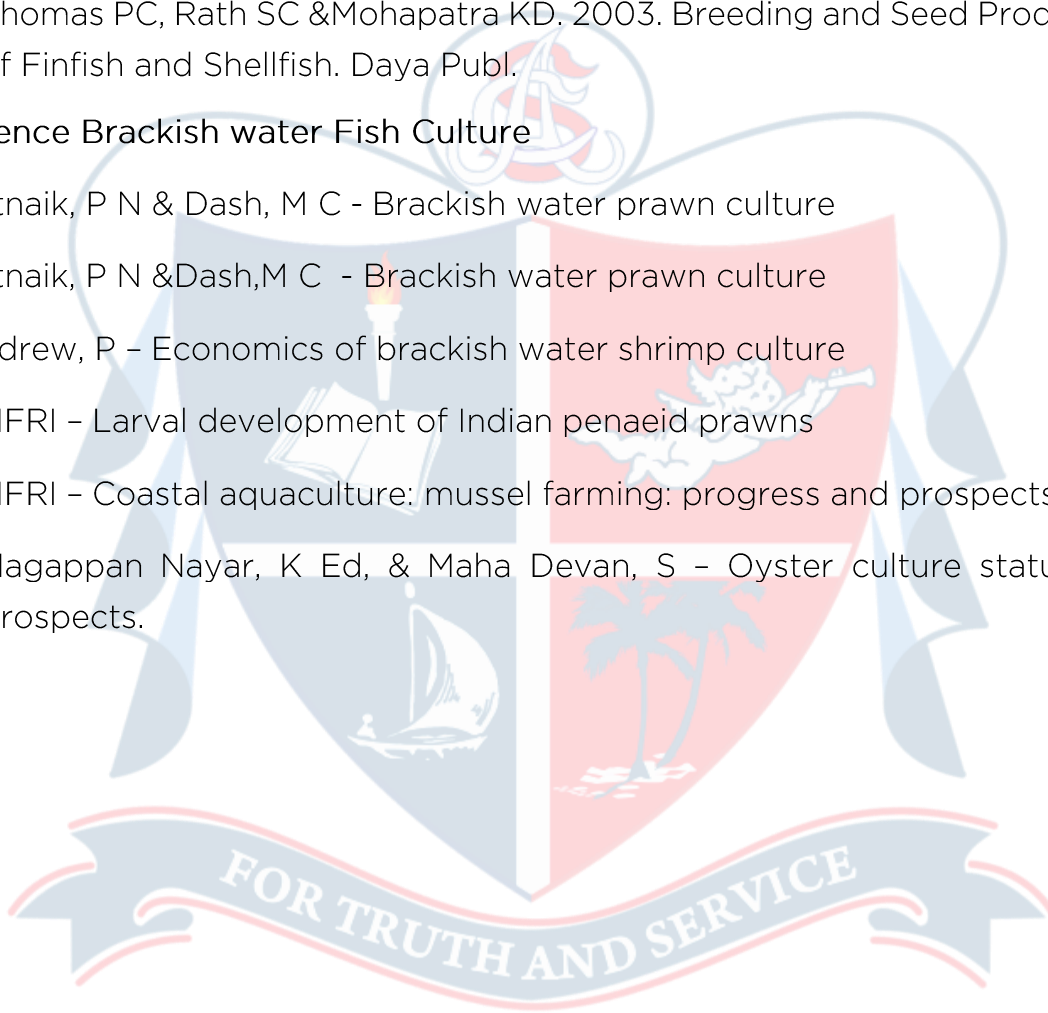
Freshwater Aquaculture

- Rajendra Kumar Rath – Freshwater aquaculture
- Arup Kumar Sadhu & Chiranjib Chakraborty – Biology, hatchery and culture technology of tiger prawn and giant freshwater prawn
- Chakrabarti, N M – Biology, culture and production of Indian major carps _a review
- Closs, Gerry et.al. – Freshwater ecology: a scientific introduction

- Sinha ,V R P & Ramachandran, V – Freshwater fish culture.
- FAO. 1992. Manual of Seed Production of Carps. FAO Publ.
- ICAR. 2006. Hand Book of Fisheries and Aquaculture. ICAR.
- Jhingran VG & Pullin RSV. 1985. Hatchery Manual for the Common, Chinese and Indian Major Carps. ICLARM, Philippines.
- Mcvey JP. 1983. Handbook of Mariculture. CRC Press.
- Thomas PC, Rath SC & Mohapatra KD. 2003. Breeding and Seed Production of Finfish and Shellfish. Daya Publ.

Reference Brackish water Fish Culture

- Patnaik, P N & Dash, M C - Brackish water prawn culture
- Patnaik, P N & Dash, M C - Brackish water prawn culture
- Andrew, P – Economics of brackish water shrimp culture
- CMFRI – Larval development of Indian penaeid prawns
- CMFRI – Coastal aquaculture: mussel farming: progress and prospects
- Nagappan Nayar, K Ed, & Maha Devan, S – Oyster culture status and prospects.



Practical: Skill Component: Fishing Methods and Hatchery Technology
(VCA2CRP0123)

75 Hours

5 Credits

Course Outcomes

On completion of the course the students will have attained the following:

- List out the traditional and modern fishing gears and Identification of synthetic and natural fibres, fishing accessories (Floats/sinkers/Shackles/swivels/otterboards/hooks/Artificial and live baits
 - Create an awareness about fish finding devices
 - Identify the larvae of cultivable fishes, larval stages of shrimps and prawns
 - Induced breeding in Fish and shrimps (demonstration)
 - Demonstrate the major live feed preparation –Daphnia, Moina , Artemia (Artemia cyst hatching Decapsulation of Artemia.), Copepods
1. Identification of traditional and modern fishing gears.
 2. Identification of fishing accessories (Floats/sinkers/Shackles/swivels/otterboards)
 3. Identification of synthetic and natural fibres
 4. Different types of hooks
 5. Artificial and live baits
 6. Fish detection devices and remote sensing
 7. Deck arrangement of different fishing vessels
 8. Knots and splicing
 9. Identification of larvae of cultivable fishes, larval stages of shrimps and prawns
 10. Hatchery layout and identification of equipments
 11. Identification of major live feeds –Daphnia, Moina , Artemia, Copepods
 12. Artemia cyst hatching.
 13. Decapsulation of Artemia.
 14. Induced breeding in Fish and shrimps (demonstration)

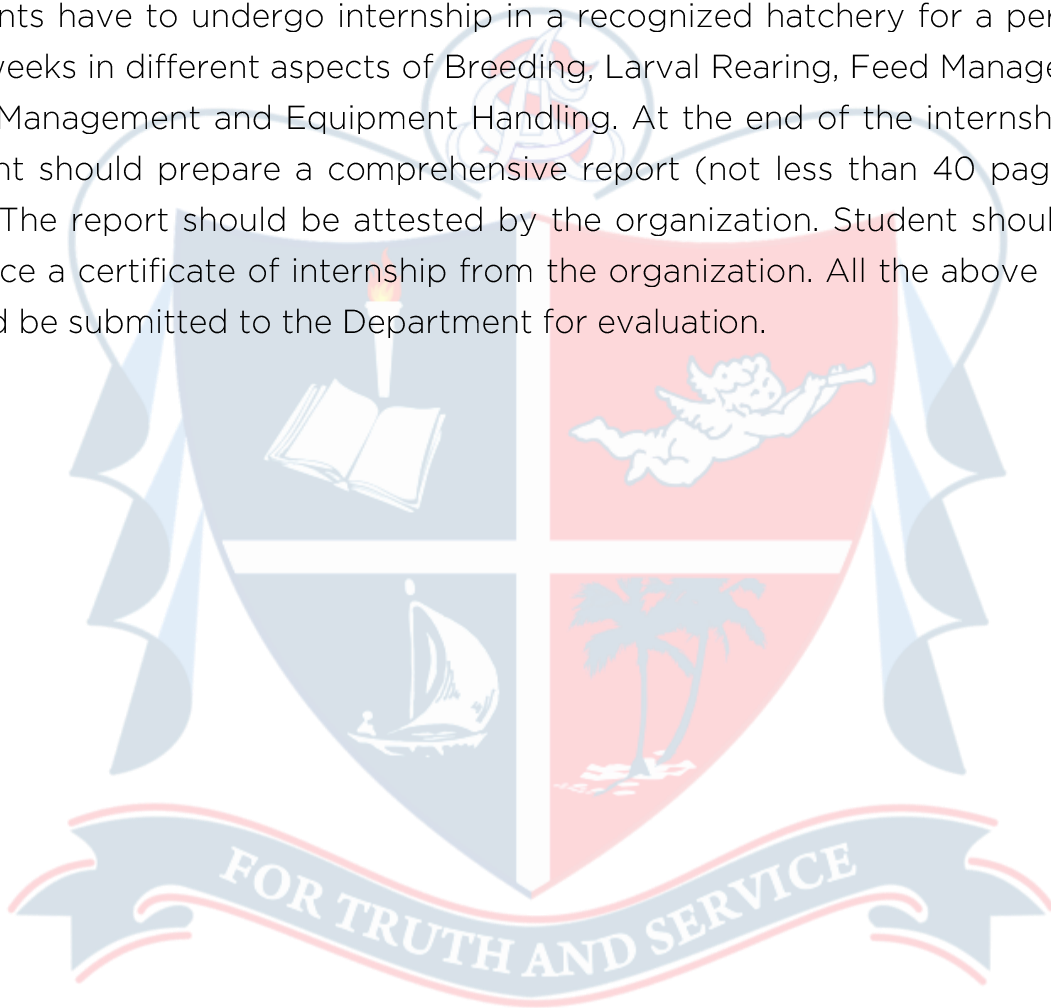
Skill Component: Internship I (VCA2CPR0123)

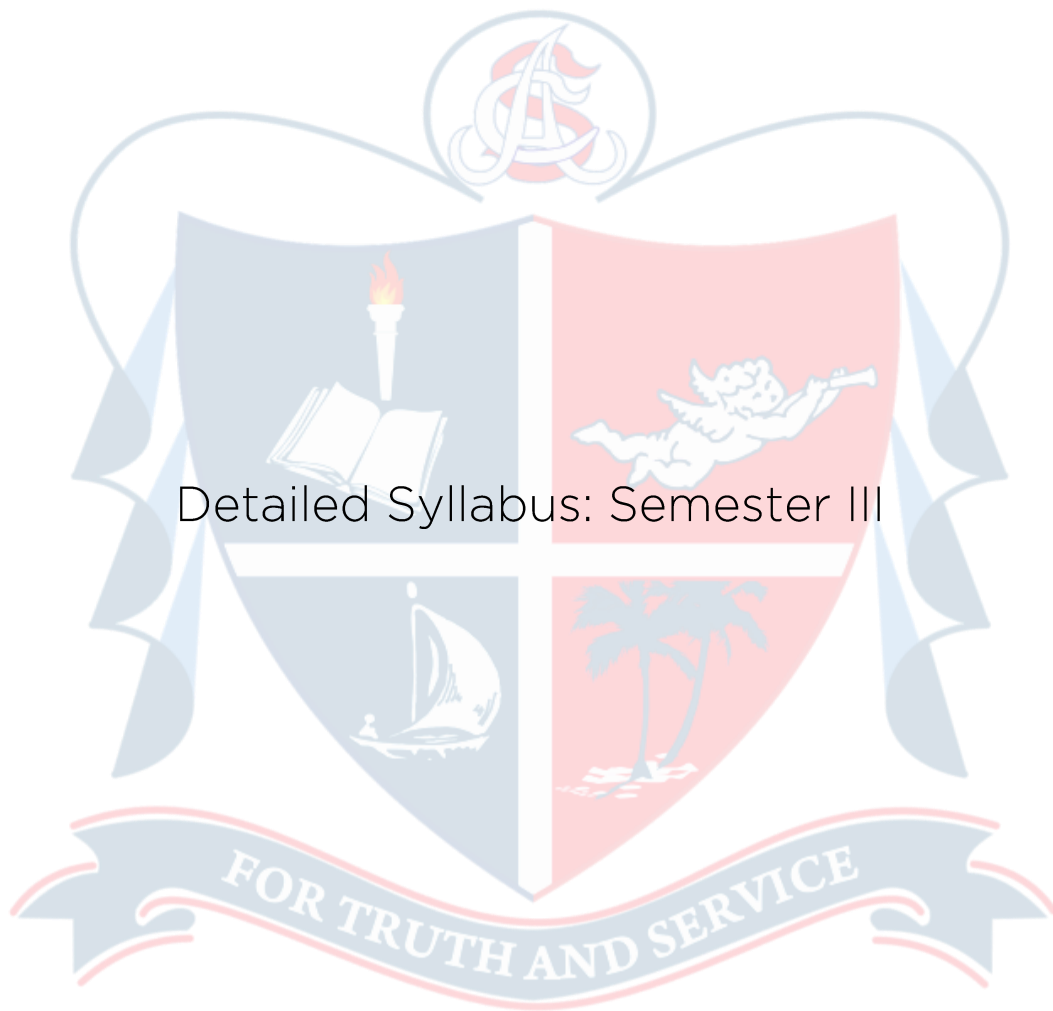
6 Credits

Course Outcomes

- Know the fundamentals of hatchery techniques of fishes
- Awareness on fish seed management and hatchery equipment handling
- Basic knowledge on the larval rearing techniques of fishes

Students have to undergo internship in a recognized hatchery for a period of four weeks in different aspects of Breeding, Larval Rearing, Feed Management, Seed Management and Equipment Handling. At the end of the internship, the student should prepare a comprehensive report (not less than 40 pages, A4 size). The report should be attested by the organization. Student should also produce a certificate of internship from the organization. All the above details should be submitted to the Department for evaluation.





Detailed Syllabus: Semester III

General Component: Business Entrepreneurship (VCA3CMT0123)

60 Hours4

Credits

Course Outcomes

On completion of the course the students will have attained the following:

- Find out the relevance, characteristics and competencies of entrepreneurs
- Illustrate opportunities and challenges of an entrepreneurial role of individuals
- Ability to define institutional support and governmental policies relating to entrepreneurship.
- Ability to develop and launching business plan
- Evaluate the resource, financial, technical, marketing and social aspects and lead the plan towards implementation and follow up

Module I: Introduction to Entrepreneurship (15 Hours)

Introduction to Entrepreneurship: Introduction to Entrepreneur, Entrepreneurship and Enterprise, Importance and Relevance of the Entrepreneur, Factors Influencing Entrepreneurship, Pros and Cons of being an Entrepreneur, Women Entrepreneurs, Problems and Promotion, Types of Entrepreneurs, Characteristics of a Successful Entrepreneur, Competency Requirement for Entrepreneurs.

Module II: Entrepreneurial traits and Startup's (15 Hours)

Entrepreneurial traits, motivation and development Types of startups; Entrepreneurial class Theories; Entrepreneurial leadership; International Entrepreneurship- Opportunities and challenges; Source of innovative ideas; Entrepreneurship and creativity; Techniques for generating ideas, Impediments to creativity.

Module III: Entrepreneurship and Institutions (10 Hours)

Entrepreneurial Development Institutions and Policy initiatives Implementation of the Project: Financial Assistance through SFC's, SIDBI, Commercial Banks, KVIC, NABARD. Financial incentives and Tax Concessions for MS&MEs, Role of government in entrepreneurship development; recent trends,

Module IV: Business Plan Development (10 Hours)

Business Plan Development and Launching: Preparing the Business Plan (BP) Typical BP format, Financial Aspects of the BP, Marketing Aspects of the BP, Human Resource Aspects of the BP, Technical Aspects of the BP, Social Aspects of the BP, Preparation of BP, and Common Pitfalls to be avoided in Preparation of a BP.

Module V: Business Launching

(10 Hours)

Business Launching, Feedback & Follow-up: Launching of Enterprise Steps involved in floating a Business Venture, Location, Formalities, Trade license, Approvals, Environmental Clearance, Registration. Feedback & Follow-up: Activity Course will involve development of feasible Business Plan by students in Groups.

References

- Ramachandran, K.(2016), Entrepreneurship Development, Tata McGraw Hill, India
- Kumar, Arya, (2010) Entrepreneurship: Creating and Leading an Entrepreneurial Organization, Pearson, India.
- Hishrich, Peters (2008) Entrepreneurship: Starting, Developing and Managing a New Enterprise, Irwin.
- Roy, Rajeev (2015). Entrepreneurship, Oxford University Press.
- Kuratko, D.F., and T. V. Rao (2010) Entrepreneurship: A South-Asian Perspective, Cengage Learning

General Component: Environmental Science & Human Rights
(VCA3CMT0223)

75 Hours

5 Credits

Course Outcomes

On completion of the course the students will have attained the following:

- Ability to explain how perceptions of environmental problems and the proposed solutions are shaped by their historical, geographical, social, political, economic, and cultural contexts.
- Explain various paradigms or world views and their implicit and explicit assumptions and values shape the viewer's perception of environmental problems and solutions
- Identify and interpret basic rights of environment system variables to assess socio-environmental conditions.
- Illustrate Human Rights in the context of the UN, India and environmental protection and conservation.
- Assess necessary scientific concepts and data, consider likely social dynamics and establish integral cultural contexts to address environmental problems.

Module I: Introduction

(15 Hours)

Multidisciplinary nature of environmental studies: Definition, Basic concepts of environmental studies, scope and importance- productive value of nature, aesthetic value of nature, optional values of nature. Physical elements, biological elements and cultural elements. Components of environment- Lithosphere, hydrosphere, biosphere, atmosphere. Biomes and Habitats: Classification of biomes - Terrestrial biomes - tundra, taiga, grassland, desert, evergreen and deciduous forests, tropical rain forests and their characteristics - flora and fauna. Need for public awareness- Institutions in the environment, people in the environment. Concept of sustainability and sustainable development. Renewable and non- renewable resources.

Module II: Ecology and Environment

(15 Hours):

Definition, principles and scope of ecology, human ecology and human settlement. Ecosystem stability, ecosystem regulation, evolution of biosphere.

Social Issues and the Environment :Urban problems related to energy; Water conservation, rain water harvesting, watershed management; Resettlement and rehabilitation of people: its problems and concerns; Environmental ethics: Issues and possible solutions, Consumerism and waste products; Environment Protection Act; Air (Prevention and Control of Pollution) Act; Water (Prevention and control of Pollution) Act; Wildlife Protection Act; Forest Conservation Act; Issues involved in enforcement of environmental legislation; Public awareness

Module III: Climate change (15 Hours)

Climate change and Environment - preliminary concepts - global warming - anthropogenic causes. Consequences of global warming - sea level rise, climate change, human diseases. Acid rain- Formation of acid rain, effects of acid rain, Ozone layer depletion - causes of depletion of ozone layer, Protection and maintenance of ozone layer, nuclear accidents and holocaust; changes in rainfall pattern and amount- impact on agriculture, fisheries, industries, human comfort etc

Module IV: Aquatic environment management (10 Hours)

Aquatic environment management: Coastal resources, Present trend of dwindling fisheries resources, habitat modification and improvement (rehabilitation of channels and floodplains), protection and restoration of fish movements (different types of fish passes and enhancement of fish migration), Marine protected areas.Coastal zone management- National and international policies and planning for coastal resource management.

Module V: Introduction Human Rights (10 Hours)

An Introduction to Human Rights, Meaning, concept and development, Three Generations of Human Rights (Civil and Political Rights; Economic, Social and Cultural Rights). Human Rights in India- Fundamental rights and Indian Constitution, Rights for children and women, Scheduled Castes, Scheduled Tribes, Other Backward Castes and Minorities . Human Rights and United Nations- contributions, main human rights related organs - UNESCO,UNICEF, WHO, ILO, Declarations for women and children, Universal Declaration of Human Rights.

Module VI: Human Rights (10 Hours)

Environment and Human Rights- Right to Clean Environment and Public Safety: Issues of Industrial Pollution, Prevention, Rehabilitation and Safety Aspect of New Technologies such as Chemical and Nuclear Technologies, Issues of Waste

Disposal, Protection of Environment

Conservation of natural resources and human rights: Reports, Case studies and policy formulation. Conservation issues of western ghats- mention Gadgil committee report, Kasthuriengan report. Over exploitation of ground water resources, marine fisheries, sand mining etc.

References

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- AmartyaSen, The Idea Justice, New Delhi: Penguin Books, 2009.
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- Shireesh Pal Singh, Human Rights Education in 21st Century, Discovery Publishing House Pvt.Ltd, New Delhi,
- S.K.Khanna, Children And The Human Rights, Common Wealth Publishers,1998. 2011.
- SudhirKapoor, Human Rights in 21st Century,Mangal Deep Publications, Jaipur,2001.
- United Nations Development Programme, Human Development Report 2004: Cultural Liberty in Today's Diverse World, New Delhi: Oxford University Press, 2004



General Component: Sustainable Aquaculture (VCA3CMT0323)

75 Hours

5 Credits

Course Outcomes

On completion of the course the students will have attained the following:

- Summarise global understanding of the advances in farming systems and environmental concerns measures.
- Knowledge of the aquatic resources and their relevance in nutrition.
- Explain conflict management of Aquatic resources.
- Interpret methods for region specific sustainable aquaculture practices applying the principles of responsible aquaculture.
- Adept in environmental issues relating to aquaculture and the measures of mitigation.

Module I: Present scenario and problems**(10 Hours)**

Introduction to aquaculture. Trends in global and Indian aquaculture. Undesirable environmental changes - Social conflicts between users of land and aquatic resources, destruction of aquatic ecosystems, habitat destruction. Use of harmful chemicals and veterinary drugs. Social and cultural effects on aquaculture workers and communities. Advanced farming systems- Biofloc and its importance in aquaculture, Aquaponics- relevance and advantages, Integrated Multi-trophic Aquaculture (IMTA). Constraints - environmental degradation and disease outbreaks - infectious and non-infectious

Module II: Technical dimension of sustainable aquaculture**(10 hours)**

Carrying capacity; Factors influencing carrying capacity in water- water quality, fish species and size, feed, nutrients, Factors influencing growth rate- water quality, age and genetics, fish health, size, stocking density, production rate. Factors influencing yield rate and economics- survival, harvest frequency and restocking, economics

Module III: Technical aspects of aquaculture farming**(10 hours)**

Site selection, construction of ponds and water reservoir-surveying tools and types of measurement, pond construction plan, building the pond, dams for fish pond construction. Seed production, nutrition and feed- Management of seed production. Aquaculture hygiene and monitoring of fish health-major hazards,

sanitary and disease control in aquaculture, harvesting, storage and transportation of live fish, packing, documentation and registration

Module IV: Environmental and socio-economic issues (15 Hours)

Exotic species introduction, Major exotic species in India, Impacts of exotic fish introduction. Guidelines for invasive species planning and management; Escapement- contamination of indigenous gene pool, disease transfer; Environmental impact-habitat destruction, water abstraction; over exploitation of wild stocks; Mangrove deforestation and its effects in aquaculture - global warming and climatic changes, desertification, loss of fish stock, flooding, coastal damage. Urbanisation and mining activities. Salinization of soil and water. Conflicts over water and land use; conflicts of interest between aqua farmers and fishermen; resistance from local public; anti-dumping duties. Export vs. domestic marketing, value addition.

Module V: Strategies for sustainability and economics (15 Hours)

Sustainability concept- food security; biosecurity; organic farming; integrated farming; responsible aquaculture; rotational aquaculture; bioremediation. Selection of species, farm site, farm design and layout, feed management, restrictions to chemicals and veterinary drugs, propagation of native plant vegetation. Restrictions to overfishing, bycatch reduction, antibiotics, antifoulants and pesticides. Application of renewable energy in aquaculture - solar energy, wind, and tidal energy. Seed certification. Economic dimension of sustainable aquaculture-Factors affecting economics and production, record keeping, capital. Budgeting, accounting and business plan in aquaculture

Module VI: Governance and social dimension (15 Hours)

Governance- aquaculture governance, trends, issues. Pillars and Principles of governance- Coastal Aquaculture Guidelines, Source Book- Coastal aquaculture authority Act ,2005, Model bill on inland fisheries and aquaculture. Control, regulation and ban on destructive gears- untenable fishing practices in inland water, conservation of stock and resources, leasing- licensing of open water body, certification of fish feed, feed quality control and certification, environmental and human health issues, health monitoring and disease reporting. Use of chemicals and antibiotics in shrimp aquaculture. Inland fisheries legislation of India. FAO Code of Conduct for Responsible Fisheries- nature and scope of the code; Introduction to social acceptability-meaning, concept

References

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Skill Component: Biostatistics and Computer Applications (VCA3CRT0123)

60 Hours

4 Credits

Course Outcomes

On completion of the course the students will have attained the following:

- Build to present the statistical data in order to comprehend the complicated practical field scenarios.
- Decision making ability with application of computer-based data presentation and analytical tools
- Summarise the established linear relationship among variables of given data set and deriving model regression for better predictability.
- Recognize the importance of measures that can be used to summarize a data set: mean, median, mode, percentiles, variance, standard deviation, and range.
- Ability to perform various numerical data process on Microsoft office.

Module I: Basic Statistic (9 Hours)

Origin, growth, meaning, definition and scope of fisheries statistics. Methods of data collection-biological data collection. Sampling methods - biological sampling, simple random sampling, stratified random sampling, systematic sampling, cluster sampling, subsampling or two stage sampling. Sampling design to estimate total marine fish landing, estimation of inland fish catch. Frequency distribution, tabulation and diagrammatic representation of data - simple bar diagram, multiple bar diagram, pie diagram, histogram, frequency polygon, frequency curve, ogive curve.

Module II: Measures of central tendency (15 Hours)

Arithmetic mean, median and mode - ungrouped data, grouped data, quartiles, geometric mean and harmonic mean. Measures of dispersion - range, mean deviation, standard deviation and its application, comparison of different measures of dispersion. Coefficient of variation. Skewness and kurtosis. Parameters and statistics. Definition, derivation and application of regression and correlation- scatter diagram, simple correlation, simple linear regression. Length and weight relationship- Applications of length and weight relationship,

application of linear regression analysis.

Module III: Statistical Tests

(15 Hours)

Application and use of least square method. Probability- application of probability, definition of probability, random experiment, simple event or event, sample space, compound event, outcome. Addition theorem, multiplication theorem. Permutation and combination. Distribution-, binomial, poisson and normal – properties of normal curve, importance of normal distribution . Testing of hypothesis- statistical hypothesis, null hypothesis, alternative hypothesis, test statistics, rejection region, type I and type II error, level of significance. Degrees of freedom. Chi-square test - test of goodness of fit, test of independence , t-test, f-test, Z- test. Analysis of Variance.

Module IV: Computer - History & Introduction

(12 Hours)

History of computing; Computer organization; Binary system; Hardware and software; Generation of computers; Computer programming; System flowcharts. Microprocessors, Storage devices, Memory systems and ASCII Code; Input-Output devices; Disk Operating System; Booting; Formatting; Operating Systems. Introduction to Office applications Web Development-Office application software, Word Processing, Worksheet, presentation softwares and data analysis. SQL. Basics of web development using HTML. Introduction to the World Wide Web, Creation of email accounts and search for organized information.

Module V: Computer Application in Fisheries

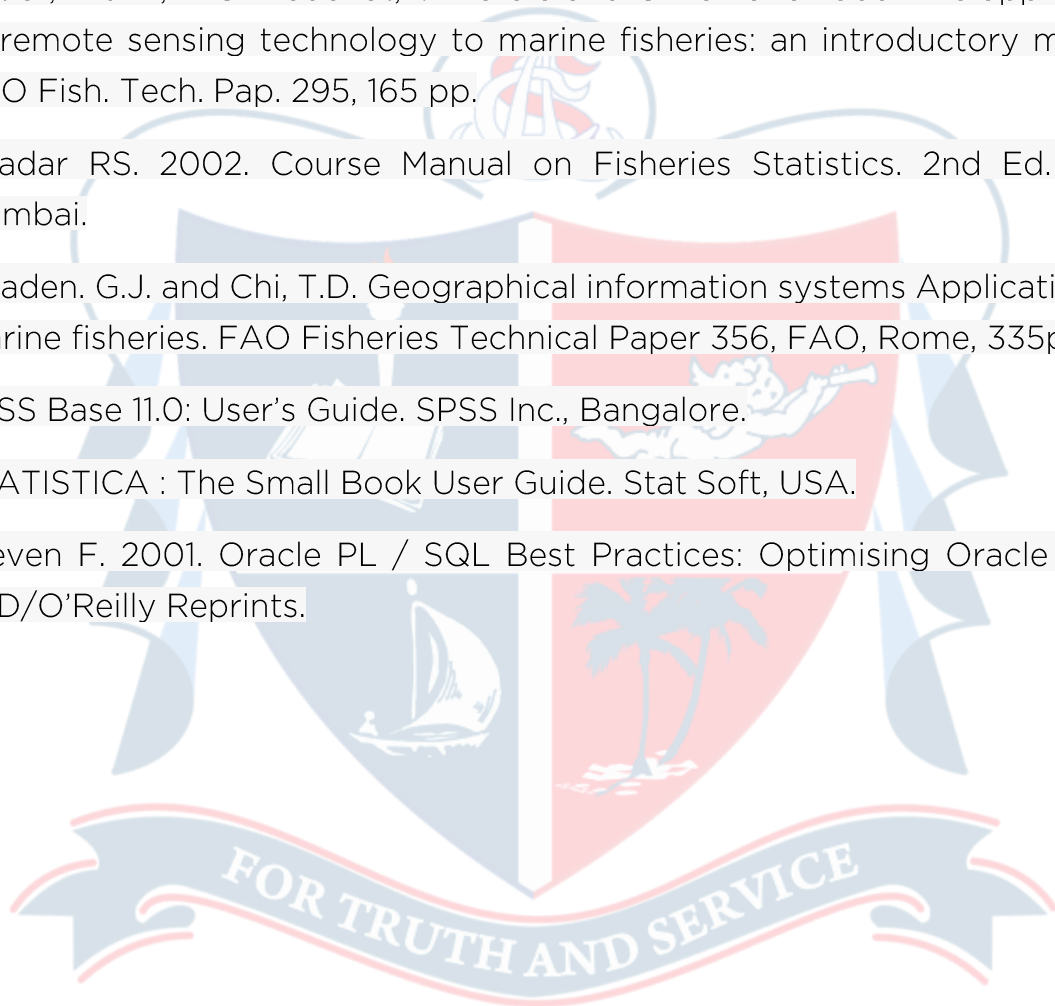
(9 Hours)

Common software for data analysis in fisheries. Introduction to computer software: SPSS, SAS, SYSTAT, R and STATISTICA for analysis and presentation of fisheries data; Basic concepts of database management systems; Introduction to MS-ACCESS, ORACLE (RDBMS). Geographical Information Systems: Applications to Marine Fisheries. Remote sensing for fisheries and coastal zone management.

Reference BS and CA

- Sunder, Rao & Richard, J - Introduction to biostatistics: Manual for students in health Science
- Mariappan, P (Dr.) - Biostatistics: An introduction
- Arumumugam, N et.al. – Biostatistics, computer application, bioinformatics and instrumentation

- Rajaraman, V – Fundamentals of computers
- Ramakrishnan, P – Biostatistics (For UG and PG Students)
- Richard, J & Sundar Rao, P S S (Dr.) – Introduction to biostatistics and research methods
- Forthofer, Ronald N et.al. - Biostatistics: A guide to design, analysis and discovery.
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- SPSS Base 11.0: User's Guide. SPSS Inc., Bangalore.
- STATISTICA : The Small Book User Guide. Stat Soft, USA.
- Steven F. 2001. Oracle PL / SQL Best Practices: Optimising Oracle Code. SPD/O'Reilly Reprints.



Skill Component: Aquaculture Nutrition (VCA3CRT0123)

60 Hours

4 Credits

Course Outcomes

On completion of the course the students will have attained the following:

- Thorough knowledge on the principles of feed formulation and equipments used in feed manufacture.
- Recognize the nutritional needs of aquatic organisms in culture and their deficiency symptoms
- Information on the different types of fish feed ingredients and feeding mechanisms
- Knowledge on the different types of fish feeds and their quality standards

Module I: Nutritional Requirements of Fish and Feed Ingredients (15 Hours)

Nutritional requirements of Proteins, amino acids, carbohydrates, lipids, vitamins and minerals in finfishes and shell fishes. The structure and functions of major nutrients. Structure of protein, carbohydrate and lipid. Non nutrient constituents of fish feed. Biochemical composition of fish feed: Proximate Analysis of fish feed- Moisture, Crude protein, Crude Lipid, Crude Fibre, Ash and Nitrogen free extract- Methods of analysis of each component . Nutritional deficiencies in fishes- carbohydrate deficiencies, protein deficiencies, lipid deficiencies, vitamin and mineral deficiencies. Storage, quality standards, proximate composition & chemical evaluation.

Module II: Types of fish feeds (15 Hours)

Types of feeds (Wet, Moist and Dry feeds-advantages and disadvantages). Different size and grades of fish / shrimp feeds - starter, grower and finisher feeds. Larval feeds- Minced diets, Microparticulate diets, Spray dried diets, Microbound diets, Microcoated diets and Microencapsulated diets. Different forms of feed-fodders, mash, pellets, floating and sinking feeds. Characteristics of pellets. Farm made feeds, factory made fish & shrimp feeds in India. Storage and transportation of feeds. Practical feeding in grow-outs of fishes & shrimps. Feed ration, feed quantity estimation and feeding frequency. Types of fish feeding devices- Check trays, demand feeders, automatic feeders and feed dispensers.

Module III: Nutritional Bioenergetics (10 Hours)

Basic concepts in energetics- Gross Energy (E), Intake Energy (IE), Gross energy, Digestible energy, Digested Energy, Urinary Energy (UE), Gill Excretion Energy (ZE), Metabolizable Energy (ME), Total Heat Production (HE), Basal Metabolic Rate or Basal Metabolism (HeE, Heat increment or Specific Dynamic Action (SDA), Digestibility co-efficient and measurement of digestible energy, Net energy, Retained energy, Protein utilization. (Protein Efficiency Ratio, Protein Conversion ratio, Productive protein value). Factors affecting digestibility in fishes. Feed Conversion Efficiency, Feed Conversion Ratio (FCR), Nitrogen Balance Index.

Module IV: Fish Feed Ingredients (10 Hours)

Different feed ingredients- Conventional and nonconventional feed ingredients- animal origin and plant origin (groundnut oil cake, soybean meal, palm kernel meal, Brewers dried yeast, fish meal, poultry byproduct meal and wheat offal). Nonconventional feed ingredients- Animal source (tadpole, fly larvae, earthworm meal, toad meal, shrimp waste, crab meal, and animal wastes such as pig and poultry droppings and blood meal), plant source (leaf protein, leaf meal, aquatic macrophytes). SCP, silages. Feed additives- Definition of feed additive and types of feed additives- Nutrient and non-nutrient feed additives. Nutrient feed additives- Synthetic Amino acids and Vitamins. Non-nutrient feed additives- binders, antioxidants, preservatives, chemoattractants, carotenoid pigments, immunostimulants, growth promoters, flavorings and palatability enhancers, probiotics and chemoattractants. Anti-nutritional factors.

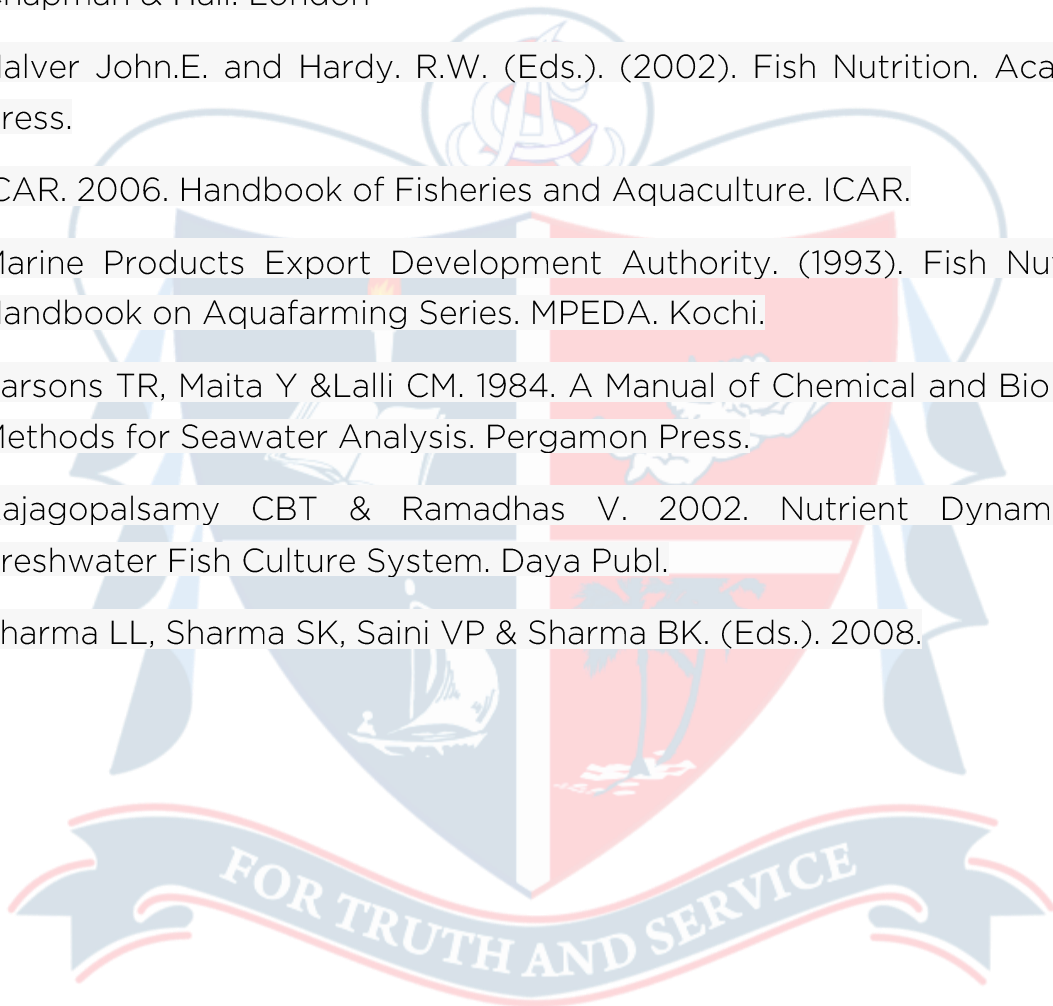
Module V: Feed Manufacturing, Feed Management and Feed Quality**(10 Hours)**

Principles of feed formulation (Pearson's Square and Linear programming). Feed manufacturing processes- Grinding, Mixing, Conditioning and Expansion, Pelleting, Cooling and drying, Crumbling and Screening Coating (Top-Dressing), Shipping and Storage. Equipment's used in Feed mills, Weighing Scales, Grinders, Mincers, Mixers, Elevators, Extruders, Coolers/Dryers, Fat sprayer, Crumbler, Sifter and Bag seamer. Quality problems- Mycotoxins and their effects on feeds- aflatoxins, ochratoxin A, zearalenone, fumonisia. Pests and rancidity. Record keeping. Quality standards of fish feeds. Economics of fish

feed preparation.

References

- CMFRI. (1987). Proceedings of the Summer Institute in Recent Advances in Finfish and Shellfish nutrition.11-30, May, 1987. CMFRI, Kochi.
- Das.D. (2005). Biochemistry. (Edn.12). Academic Publishers. Calcutta.
- DeSilva. Sena. S. and Anderson. T.A. (1995). Fish nutrition in Aquaculture. Chapman & Hall. London
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- ICAR. 2006. Handbook of Fisheries and Aquaculture. ICAR.
- Marine Products Export Development Authority. (1993). Fish Nutrition. Handbook on Aquafarming Series. MPEDA. Kochi.
- Parsons TR, Maita Y &Lalli CM. 1984. A Manual of Chemical and Biological Methods for Seawater Analysis. Pergamon Press.
- Rajagopalsamy CBT & Ramadhas V. 2002. Nutrient Dynamics in Freshwater Fish Culture System. Daya Publ.
- Sharma LL, Sharma SK, Saini VP & Sharma BK. (Eds.). 2008.



Skill Component: Practical: Biostatistics, Aquaculture Nutrition and Soil and
Water Quality (VCA3CRP0123)

60 Hours

4 Credits

Course Outcomes

On completion of the course the students will have attained the following:

- Know the descriptive statistical analysis, calculation of mean, median, mode, standard deviation, standard error using computer programmes/packages, t- test, Chi -square, F- test, one way ANOVA, Data analysis using computer and Correlation and regression analysis using computer programmes/packages.
 - Preparation of formulated feeds using locally available feed ingredients and determination of its sinking rate and stability.
 - Determination of proximate composition of feed of formulated feeds (crude protein)
 - Determination of water quality parameters (Dissolved oxygen, carbon dioxide in water, pH by electrometric method, salinity in water)
 - Know the soil sampling, determination of soil moisture; bulk density; mud acidity and soil texture.
1. Descriptive statistical analysis, calculation of mean, median, mode, standard deviation, standard error using computer programmes/packages.
 2. t- test, Chi -square, F- test, one way ANOVA, Data analysis using computer.
 3. Correlation and regression analysis using computer programmes/packages.
 4. Graphical representation and tabulation, of data using computer programmes/packages.
 5. Preparation of formulated feeds using locally available feed ingredients.
 6. Determination of sinking rate and stability of formulated feeds
 7. Determination of moisture content of formulated feeds
 8. Determination of crude protein of formulated feeds
 9. Determination of Dissolved oxygen in water
 10. Estimation of free carbon dioxide in water

11. Determination of pH by electrometric method
12. Estimation of salinity in water
13. Soil Sampling and Determination of Soil moisture; bulk density; mud acidity and soil texture.



Skill Component: On the Job Training 2 (OJT 2) (VCA3OJT0123)

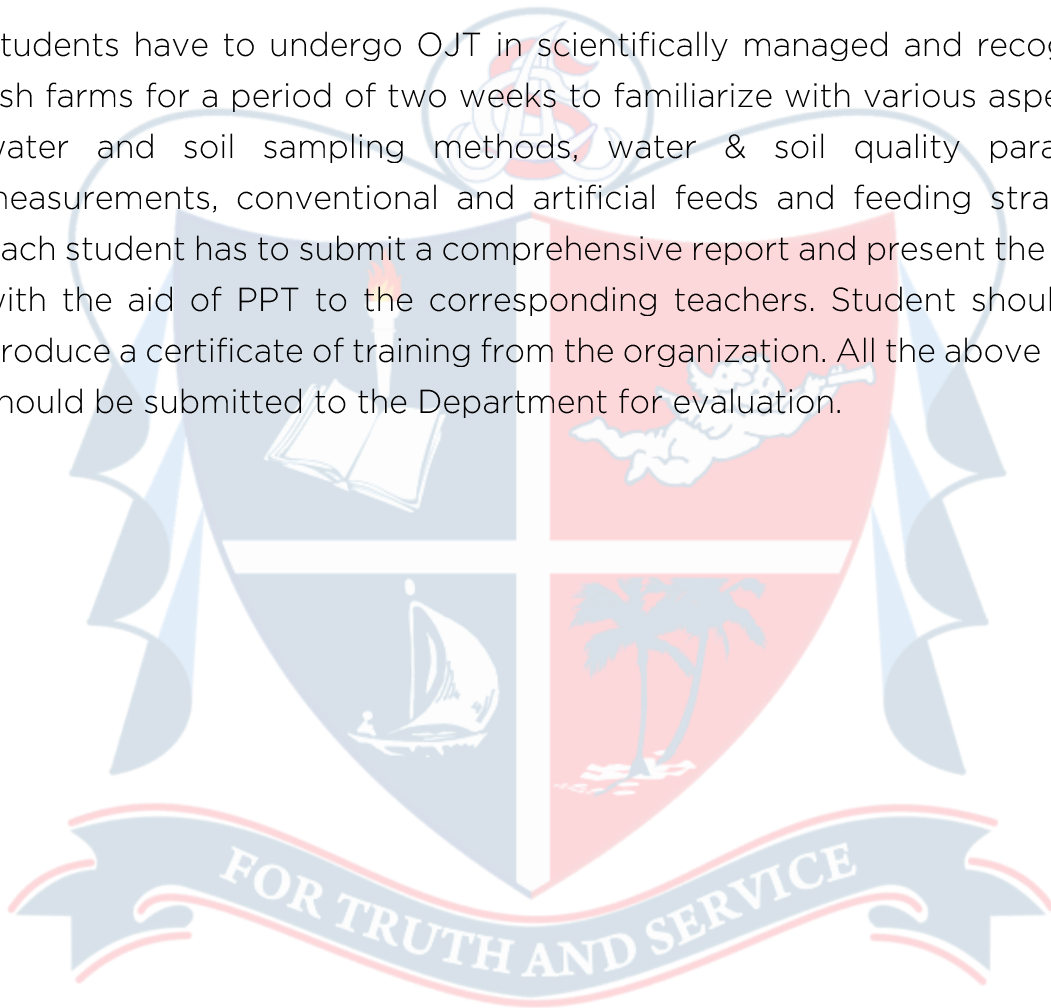
3 Credits

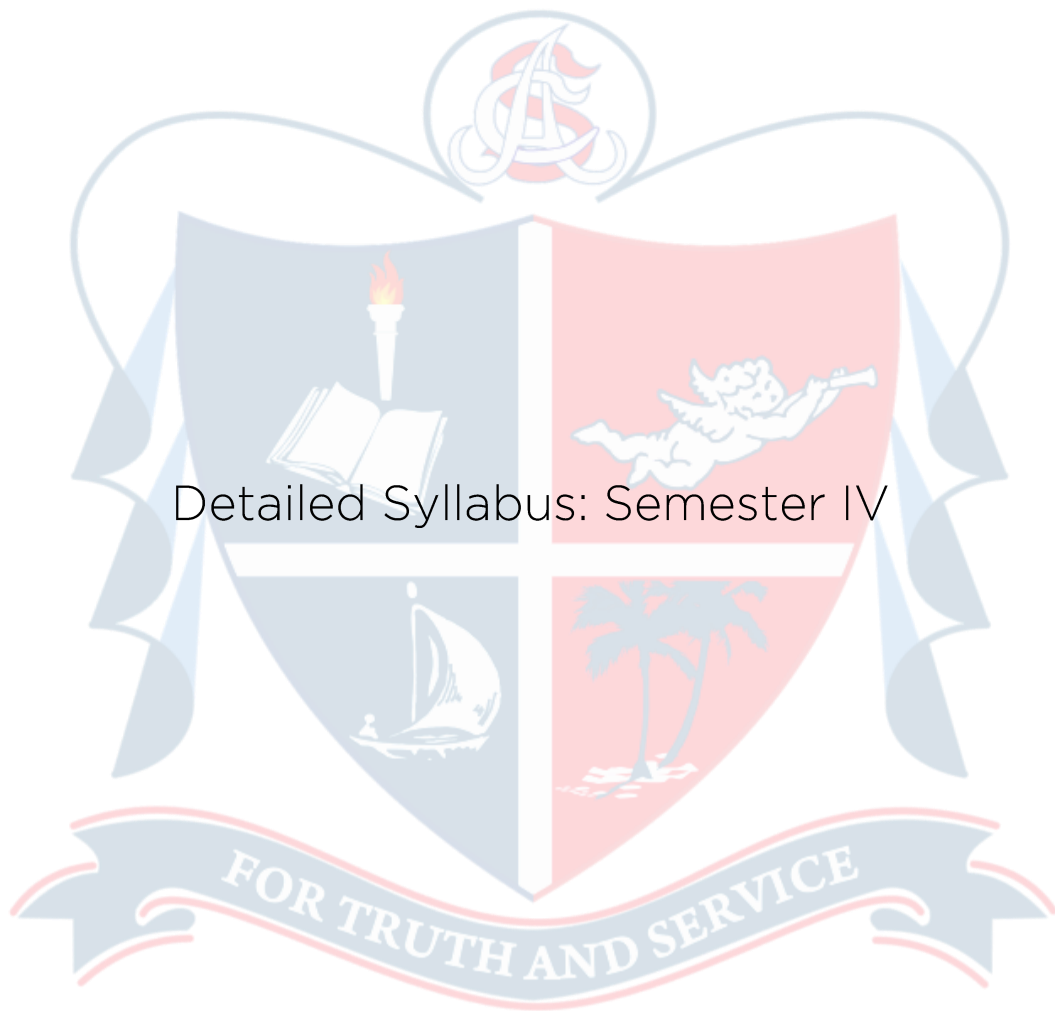
Course Outcomes

- Skill to estimate water quality parameters.
- Acquire knowledge on fish feed ingredients, preparation techniques and feeding strategies

Course Outline

- Students have to undergo OJT in scientifically managed and recognized fish farms for a period of two weeks to familiarize with various aspects of water and soil sampling methods, water & soil quality parameter measurements, conventional and artificial feeds and feeding strategies. Each student has to submit a comprehensive report and present the report with the aid of PPT to the corresponding teachers. Student should also produce a certificate of training from the organization. All the above details should be submitted to the Department for evaluation.





Detailed Syllabus: Semester IV

General Component: Oceanography (VCA4CMT0123)

75 Hours

5 Credits

Course Outcomes

On completion of the course the students will have attained the following:

- Clear knowledge of the topographical significance to the marine environment and the availability and distribution of non-living resources of significance.
- Adept in the thermodynamics relating to ocean currents and the significance of phenomena like El Nino
- Application level knowledge of biological oceanography and chemical oceanography
- Recognize the relevance of oceanography and the implications of thermocline and light penetration in the marine realm
- In depth knowledge of the community interactions at the micro and macro level in specific aquatic ecosystems.

Module I: Introduction to oceanography (10 Hours)

History of Oceanography, Major expeditions, Earth and ocean floor: Origin. Structure of earth. Continental Drift. Palaeomagnetism. Plate tectonics. Fundamentals of Physical Oceanography and Meteorology. Basic marine meteorology - weather, air-sea interactions. Monsoons, seasonal changes. Major oceans in the world. Oceans and climate.

Module II: Composition and properties of seawater (10 Hours)

Elemental composition of seawater. Chemical and physical properties of seawater- temperature, salinity, density, light, pressure, colour. Surface tension and viscosity. Light penetration- colour of the sea, concept of extinction coefficient, sound propagation, Sound Fixing and Ranging channel (SOFAR) and shadow zone. Latitudinal and vertical distribution of temperature, salinity and density, heat budget, seasonal thermocline. Distribution of dissolved gases, major and minor elements, nutrients.

Module III: Ocean Currents**(15 Hours)**

Global and regional circulation; major wind systems. Coriolis force. Ekman current- Ekman spiral. Concept of water mass. Ocean circulations, upwelling and downwelling. Types of ocean currents-Geostrophic currents, Western boundary currents, Eastern boundary currents, swell, rip currents. Biological significance of currents. Coastal upwelling and equatorial upwelling. Importance of upwelling in fisheries. Peru Current and El-Nino. Longmuir circulation. Eddies. Waves and its types. Wind waves- characteristics, generation, wind speed, fetch and duration. Tsunami-characteristics and causes. Tides- influence of sun and moon, spring and neap tides. Tidal range.

Module IV: Marine Environment**(12 Hours)**

General characteristics of the marine environment. Deep-sea system characteristics and adaptations of deep-sea organisms. Major ecological zones of oceans. Characteristics and importance of beaches. Deep- ocean topographic features - continental shelf, continental slope, continental rise, oceanic ridges, trenches, sea mounts, guyots, plateaus, submarine canyons. Populations in the ocean- Plankton, Non-living resources from the marine environment - ocean as a source of nonconventional energy. Mineral wealth, petroleum and gas from the shelf, polymetallic nodules and their distribution. Marine oozes.

Module V: Chemical Oceanography and Instruments**(13 Hours)**

History and importance of chemical oceanography. Oceanographic equipment's- metre wheel, messenger, winches etc. Water samplers- Nansen, Van-dhon and Niskin bottles. Temperature measurements- reversing thermometers, MBT, XBT, CTD. Composition of sea water- major and minor elements, salinity, pH, electrical conductivity, fluorometer, estimation of dissolved oxygen and carbon dioxide, chlorinity. Concept of constancy of composition. Dissolved gases- oxygen, carbon dioxide and hydrogen sulphide. Oceanographic data collection- in-situ methods and remote sensing.

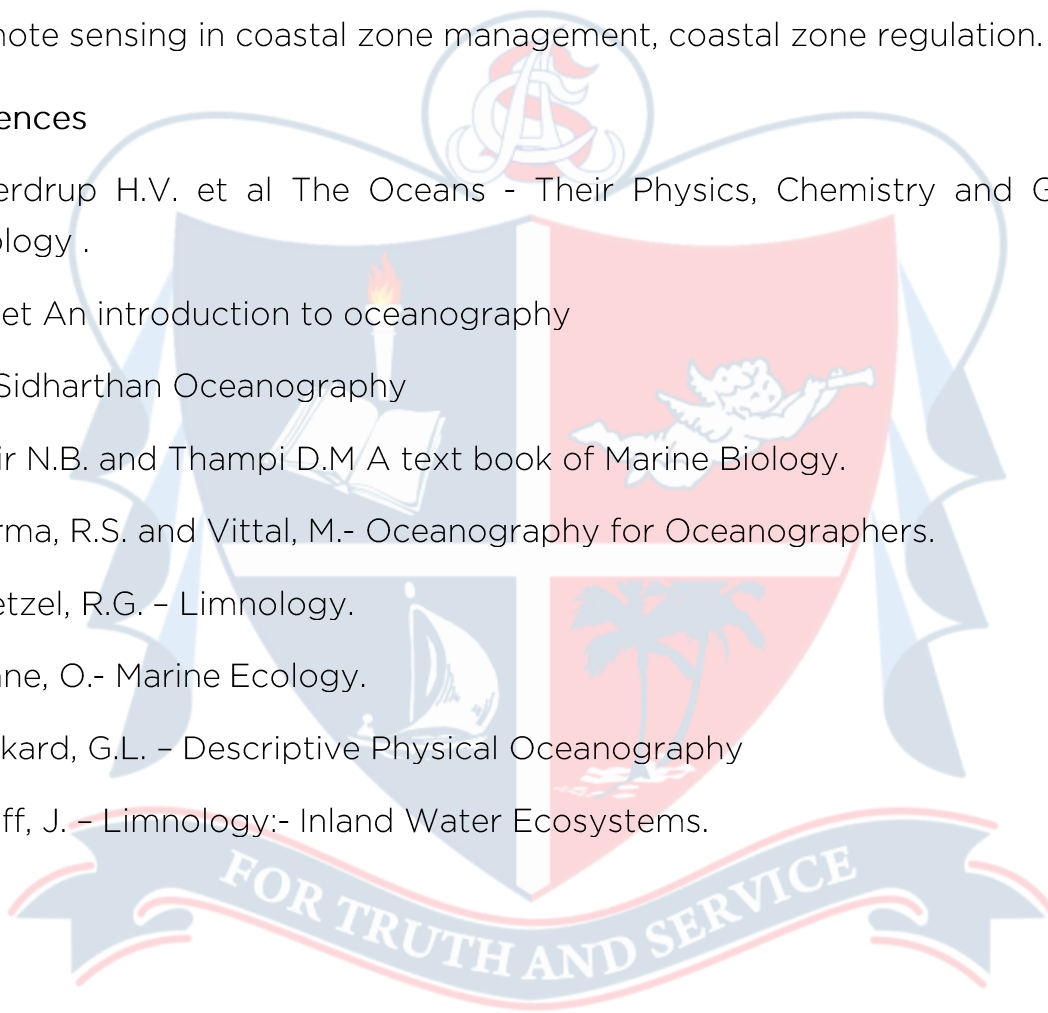
Module VI: Biological Oceanography

(15 Hours)

Biological divisions of the sea. Intertidal zone. Intertidal environment- zonation and adaptations of intertidal organisms. Intertidal rocky, sandy and muddy shore- associated fauna and their adaptations. Mangroves- zonation, characteristic and importance. Salt marshes. Population of the oceans - phytoplankton, zooplankton, benthos and nekton. Marine food chains and food webs. Oceanography In relation to fisheries. Application of Geographic Information System (GIS) in fisheries. Coastal zone management - Application of remote sensing in coastal zone management, coastal zone regulation.

References

- Sverdrup H.V. et al The Oceans - Their Physics, Chemistry and General Biology .
- Piuert An introduction to oceanography
- K. Sidharthan Oceanography
- Nair N.B. and Thampi D.M A text book of Marine Biology.
- Sarma, R.S. and Vittal, M.- Oceanography for Oceanographers.
- Wetzel, R.G. – Limnology.
- Kinne, O.- Marine Ecology.
- Pickard, G.L. – Descriptive Physical Oceanography
- Klaff, J. – Limnology:- Inland Water Ecosystems.



General Component: Aquaculture Biotechnology (VCA4CMT0223)

75 Hours

5 Credits

Course Outcome

On completion of the course the students will have attained the following:

- Summarise the knowledge related with recent biotechnological advances in the aquaculture sector and familiarization with biological databases.
- Skill to demonstrate the biotechnological tools in aquaculture.
- Compare the fundamental principles of DNA and RNA vaccines, molecular diagnosis of diseases, Ribotyping etc.
- Identify the relevance of bioethical issues and social issues associated with biotechnological experiments.
- Develop the skill to apply the knowledge from this course for their own research and extension projects,

Module I: Fish Breeding techniques and gene bank conservation (9 Hours)

Synthetic hormones for induced breeding- GnRH analogue structure and function. Hormonal manipulation of sex in fishes- Sex reversal, androgenesis, gynogenesis and its applications, Cryopreservation of gametes and embryos- principles of cryopreservation, cryopreservation of male gametes, cryoprotectant, preservation procedure, Cryopreservation of egg and embryo. Hybridisation in fishes - structural changes, quantitative changes, qualitative changes. Characteristics of hybrids - phenotype characters. Food habits of hybrid and filtering apparatus, growth pattern.

Module II: Transgenics (12 Hours)

Methods of gene transfer in fishes- electroporation, microinjection, sperm mediated gene transfer, Steps involved in the production of transgenic fish. Transgene and their construction - Isolation, fragmentation, amplification and annealing of DNA to the vector, introduction into the host. Screening for transgenics, site of integration, applications. Regulation of Genetically Modified Organisms (GMOs), IPR, Evaluation of GFP transgenics. Single gene traits- Physical traits with single gene inheritance. Inbreeding and cross breeding. Biosafety regulations and ethics. Hybridoma - principles, preparation and selection of hybridoma in selective growth medium, screening and cloning of hybridoma.

Module III: Feed Technology**(8 Hours)**

Biotechnological aspects for improving nutrient content, value, digestibility of low -quality feeds. Incorporation of chemicals- additives in fish nutrition. Protection of proteins, amino acids and lipids. Use of enzymes to enhance nutrient availability and to reduce feed wastage. Immune supplements to inhibit pathogenic organisms. Addition of antibodies in feed, genetic manipulation of intestinal microorganisms to improve animal health and growth. Nutrigenomics tools – transcriptomics, proteomics, metabolomics.

Module IV: Health Management**(15 Hours)**

Relevance of health management in fisheries. Good water quality management, stocking and feeding management, hygiene management. DNA and RNA vaccines, molecular diagnosis of viral diseases, PCR, Dot-blot, ribotyping of pathogenic microbes, RNAi, Biofilms and its impact on health management, genetically modified microorganisms as probiotics, immunostimulants. Bioremediation- definition, advantages and disadvantages. Bioremediation of soil and water, different types of bioremediation – bio stimulation, bioaugmentation, intrinsic bioremediation, incineration and phytoremediation. Fish cell line with special reference to important biological tools for carrying out investigations in physiology, virology, toxicology, carcinogenesis.

Module V: Algal Biotechnology**(15 Hours)**

Importance of algal biotechnology in aquaculture- Biofuel production, nutrient rich food production, biofertilizer production. Microalgae - indoor and mass culture methods. Photobioreactors - hanging plastic bags, two-plane horizontal tubular photobioreactor, vertically stacked tubular photobioreactor, vertical flat-panel photobioreactor, innovative flat-plate photobioreactor. Biotechnological approaches for production of important microalgae, applications of algal biotechnology for disease control in aquaculture. Ecological application of microalgal mass culture; single cell protein from Spirulina, raceway system of micro algae culture, vitamins, minerals and omega3 fatty acids from micro algae, enrichment of micro algae with micronutrients.

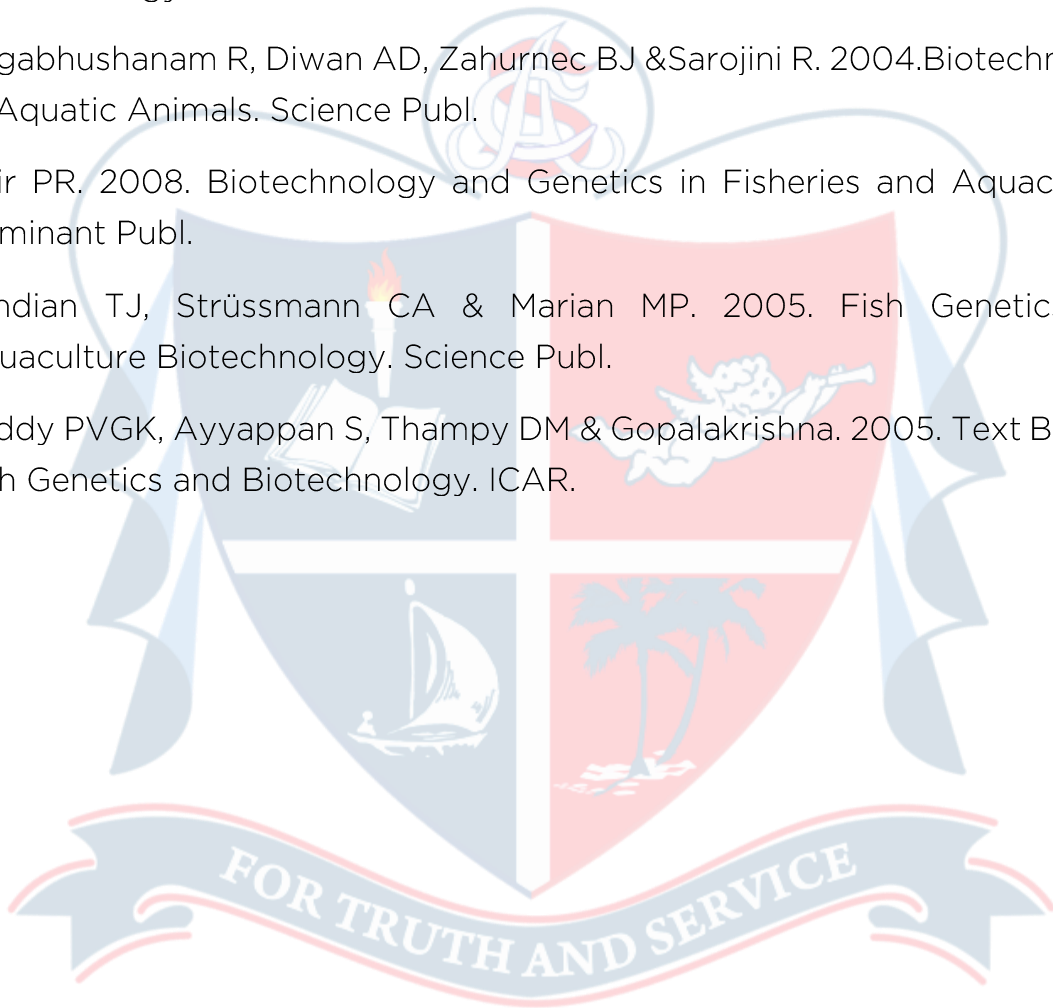
Module VI: Post-harvest Biotechnology**(16 Hours)**

Definition, principles and scope of post- harvest biotechnology in aquaculture. Role in contributing to national food and nutrition security, livelihood of the people and the national economy, minimizing spoilage and value addition of commodities. Institute contributing to post harvest biotechnology- Central

Institute of Fishery Technology (CIFT). Delaying of spoilage- general principles of fish preservation and processing, maintenance of food quality – appearance, texture, flavour and nutritive value. Food safety and reduction between harvest and consumption. Detection of toxic substances and pathogenic microbes, biosensors for toxins.

References

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- Nagabhushanam R, Diwan AD, Zahurnec BJ & Sarojini R. 2004. Biotechnology of Aquatic Animals. Science Publ.
- Nair PR. 2008. Biotechnology and Genetics in Fisheries and Aquaculture. Dominant Publ.
- Pandian TJ, Strüssmann CA & Marian MP. 2005. Fish Genetics and Aquaculture Biotechnology. Science Publ.
- Reddy PVGK, Ayyappan S, Thampy DM & Gopalakrishna. 2005. Text Book of Fish Genetics and Biotechnology. ICAR.



Skill Component: Fish Preservation and Processing (VCA4CRT0123)

75 Hours

5 Credits

Course Outcomes

On completion of the course the students will have attained the following:

- Awareness on basic hygienic practices for handling seafood and understand spoilages
- Define National and International quality standards quality of water and ice in the fish processing sector.
- Identify the potential hazards in fish and fishery products maintains hygienic standards in the seafood processing industry.
- Compare various thermal and non-thermal techniques for fish preservation and Packaging materials.
- Find the quality of processed products. cold chain system of processed fish and fishery products

Module I: Introduction**(12 Hours)**

Proximate composition of seafood. Spoilage pattern of seafood. Spoilage indices. Onboard handling of seafood. Importance of hygiene and sanitation in fish handling. Quality of water and ice in fish handling and processing. Different types of ice used in the seafood industry and their merits.

Module II: Common Seafood Preservation Techniques**(12 Hours)**

Principles of smoking, drying and salting of fish, Traditional drying / curing methods. Different types of drying. Spoilage of dried products. Different types of Smoking: Cold, hot smoking, electrostatic smoking. Spoilage of smoked products.

Module III: Principles of fermentation and canning**(13 Hours)**

Principle of fermentations: fermented products. Fundamental principles involved in chilling and freezing of fish and fishery products. Thermal processing (Cooking, Sous-vide, Canning), Principles involved in canning of fish. Retortable pouch processing. Spoilage of canned products. Principles of freeze drying. AFD and its merits. Introduction to extrusion technology.

Module IV: Non-thermal Food Processing Techniques, Storage and Packaging

(13 Hours)

Principles and advantages of high pressure processing, Ultrasound food processing, Pulsed electric field processing, Pulsed light technology, microwave processing, Irradiation. Different types of cold storages. Functions of packing. Different types of packing materials.

Module V: Quality Assurance and Export of Fishery Products (10 Hours)

Quality control - basic concepts, quality and quality control. Sanitation procedures in seafood processing plants. Waste management in fish processing industries. Risk factors in seafood biotoxins, seafood pathogens, endogenous parasites.

Module VI: Method of evaluating fish freshness (15 Hours)

Methods of evaluating fish freshness and quality - organoleptic, physical, chemical, microbiological and instrumental methods. Quality control programmes - pre-shipment inspection, IPQC, MIPQC, HACCP and ISO Series in seafood industry. Quality standards in India and major importing countries like USA, Japan and EU. Export of fishery products from India - major countries, important products, export documents and procedures. Traceability, Quality certifications, Ecolabelling.

References

- Brody, J Fishery products technology, West port
- Burgess, G.H.S et al. Fish handling and processing HMSO London
- Kreuzer, R. Freezing and irradiation of fish. Fishing News., London
- Kreuzer, R. Ed Fish inspection and quality control. Fishing News New England
- Kreuzer, R. (Ed) Fishery products. Fishing News England.
- Greensmith, M Practical Dehydration. Food Trade Press.
- Govindan T.K. Fish processing technology. IBH, New Delhi.
- Windsor, M. and Barlow, Introduction to fishery by-products . Fishing News
- Charles Cutting, L., Fish processing and preservation. AGRO Botanical Publishers (India).

- Gopakumar K. Fish Packaging Technology – Materials and Methods.
- Connell, J.J. (Ed.). 1980. Advances in Fishery Science and Technology. Fishing News Books Limited. England.
- Wheaton, F.W. and Lawson, T.B. 1985. Processing Aquatic Food Products. Wiley and Interscience Publishers.
- Borgstrom, G. 1962. Fish as Food. Vol 1 - 4. Academic Press. New York.
- Saccharow, S. and Griffin, R.C. 1980. Principles of Food Packaging – 2nd Edition. AVI Publishing Company, Connecticut.



Skill Component: Ornamental Fish culture (VCA4CRT0223)

75 Hours

5 Credits

Course Outcomes

On completion of the course the students will have attained the following:

- Give an outline about the commercial ornamental fish production, their hatchery techniques and management
- Demonstrate the design, construction, setting up and management of home and public aquarium
- Proficiency in water quality and disease management of ornamental fish culture systems.

Develop different policies and planning for the socio-economic development, through entrepreneurially oriented ornamental fish culture system

Ornamental Fish Culture**Module I: Introduction****(10 Hours)**

Introduction to aquarium, ornamental fishes and aquarium accessories. World aquarium trade and present status. Design and construction of public fresh water and marine aquaria and oceanarium. Aerators, filters and lighting. Water quality requirements. Temperature control. Biofilters in aquarium.

Module II: Aquarium Management**(10 Hours)**

Setting up of aquarium - under gravel filter, pebbles, plants, drift wood, ornamental objects and selection of fishes, Quarantine measures. Aquarium maintenance and water quality. Control of snail and algal growth. Handling, care and transportation of fish. Temperature acclimation, oxygen packing.

Module III: Fresh water Ornamental Fishes**(15 Hours)**

Species of ornamental fishes; their taxonomy and biology- guppy, platy, swordtail, mollies, gold fishes and koi carps, gouramies, barbs and tetras. Cichlids - angel fish, oscars, orange chromide. Maturation, secondary sexual characters of male and female fish. Breeding habits - Live bearers, egg layers- egg scatters, egg depositors, egg buriers, nest builders. Spawning, parental care, fertilization and development of eggs. Hatching, larval rearing and their health. Indigenous ornamental fishes of Kerala.

Module IV: Commercial Production**(12 Hours)**

Requirements and design for the commercial production units of ornamental fishes. Commercial production of goldfish, live bearers, gouramies, barbs, tetras and angel fish. Natural ponds for the mass production of ornamental fishes. Freshwater aquarium plants- their taxonomy and morphology, multiplication of aquarium plants - different methods - Mass production, micro propagation

Module V: Marine Ornamental Fishes (13 Hours)

Marine ornamental fishes - varieties and their habitat. Major marine ornamental fish resources of India. Method of collection of live fish. Use of anesthetics. Breeding of marine ornamental fishes (clown fishes and Damsel fishes). Reef aquarium and live rocks. Other ornamental organisms - anemones, worms, lobsters, shrimps, octopus, starfish.

Module VI: Nutrition and Diseases (15 Hours)

Nutritional requirements of aquarium fishes. Different kinds of feeds. Culture of fish food organisms; Preparation of dry feeds - feeding methods. Use of pigments for colour enhancement. Larval feeds and feeding. Provision of nutrients and optimum environmental conditions for their growth. Common disease in ornamental fishes - infectious and non infectious and their control and prophylaxis.

Reference Ornamental Fish Culture

- Hems, J & Hervy, G F - Gold fish
- Srivastava, CBL - Aquarium fish keeping
- Srivastava, CBL - Aquarium fish keeping
- Amit Saxena - Aquarium management
- Shinekumar, D (Dr.) - Varna matsyangalum valarthumatsyangalum :vinodhathinumvarumanathinum
- Meenakshi Jindal (Dr.) et.al. - Freshwater ornamental fishes
- Inasu N D (Dr.) - Sexual dimorphism of some indigenous ornamental fishes v.1.

Skill Component: Practical: Fish Processing and Ornamental Fish culture
(VCA4CRP0123)

75 Hours

5 Credits

Course Outcomes

On completion of the course the students will have attained the following:

- Identify freshwater and marine ornamental species
- Expertise in the breeding and seed production of ornamental fishes.
- Proficiency in aquarium setting and maintenance.
- Knowledge in aquarium plant rearing and propagation and the role of aquarium plants in maintaining water quality in aquarium.
- Recognise and monitor the health of species and recognition of disease by observing symptoms

Fish Processing Technology

1. Evaluation of fish / fishery products for organoleptic, chemical and microbial quality.
2. Methods for analysis of bacterial quality parameters, chemical parameters and filth.
3. Sanitary standards in fish processing units.
4. Filleting of fish, treatments, glazing, packaging, freezing.
5. Process flow of Prawns, Lobster, Squid, Cuttle Fish, Crab etc. in different styles
6. Freezing: Studies on physical, chemical and sensory changes during freezing. Production of frozen fishery products- dressed fish, fillets, minced fish, surimi, Production of prawn products- whole prawns, HL, PUD, PD, Butterfly prawns.
7. Chill storage studies: Chemical, physical and sensory analysis, determination of shelf life. Handling of fish, bivalves, prawns, mollusks, Depuration, treatment with chemicals, evaluation of freshness of fish.
8. Canning: Canning process of table fishes, Bivalves, Crustaceans in different containers, Canned culinary preparations, Examination of canned fishery products. Defects in canned fishery products
9. Preparation of dried, cured and fermented fish products, examination of salt,

protein, moisture in dried / cured products, examination of spoilage of dried / cured fish products, marinades, pickles, sauce.

10. Preparation methods of fish meal, FPC, fish oils, chitin, chitin, chitosan, glucosamine hydrochloride, fish maws, isinglass, shark fin rays, agar, alginic acid, , glue, pearl essence, fish sauce, smoked fish products.

11. Value added product development: Fish cutlet, fish balls, fish burger, fish wafer, fish finger, fish nuggets,

Ornamental Fish Culture

- Identification of economically important aquarium fishes (Exotic, Indigenous and marine ornamental fishes), important molluscs and crustaceans used in aquariums and aquarium plants and invertebrates.
- Construction and maintenance of aquarium, setting up of aquarium tanks.
- Breeding and rearing of commercially important ornamental fishes in hatchery.
- Live feed culture.
- Preparation of feeds and practicing feeding schedules
- Therapeutic methods applicable to aquarium fishes.
- Identification of common diseases and parasites of aquarium fishes.



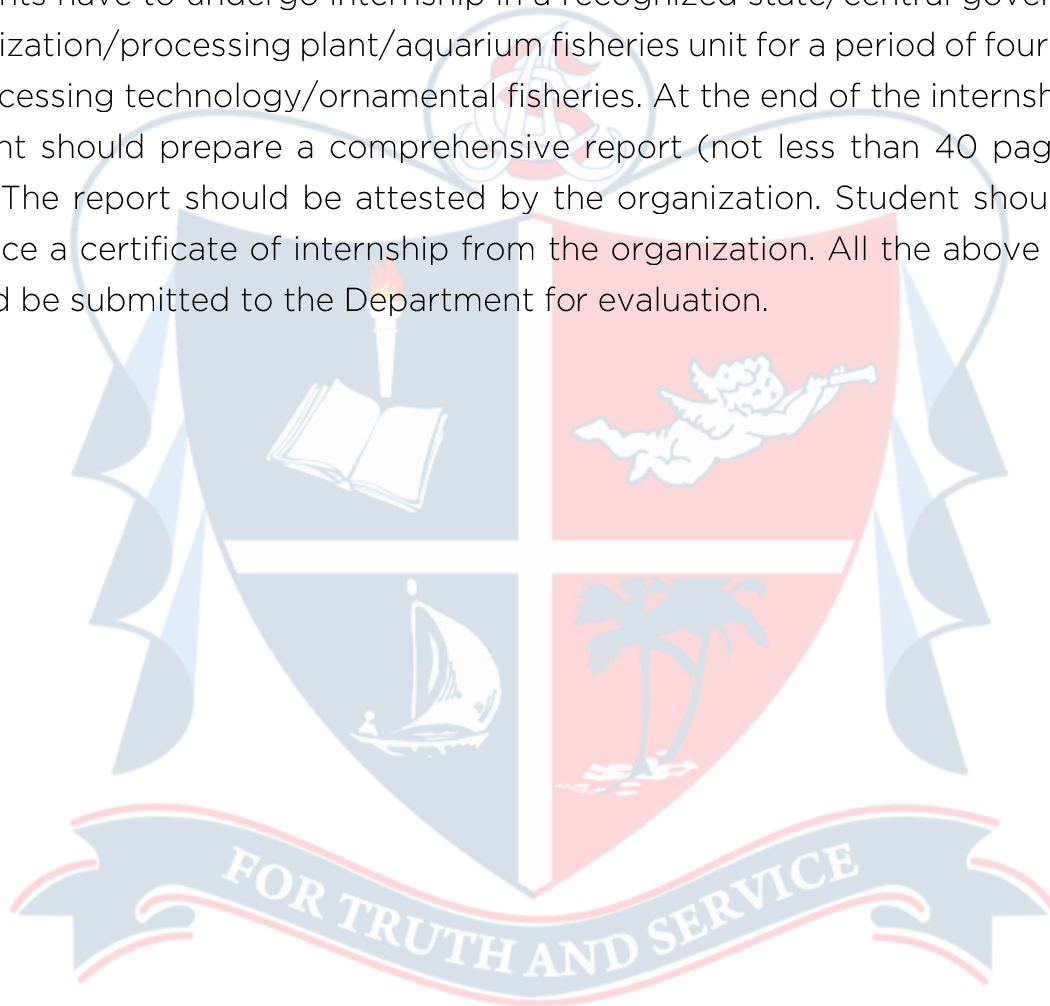
Skill Component: Internship 2 (VCA4CIN0123)

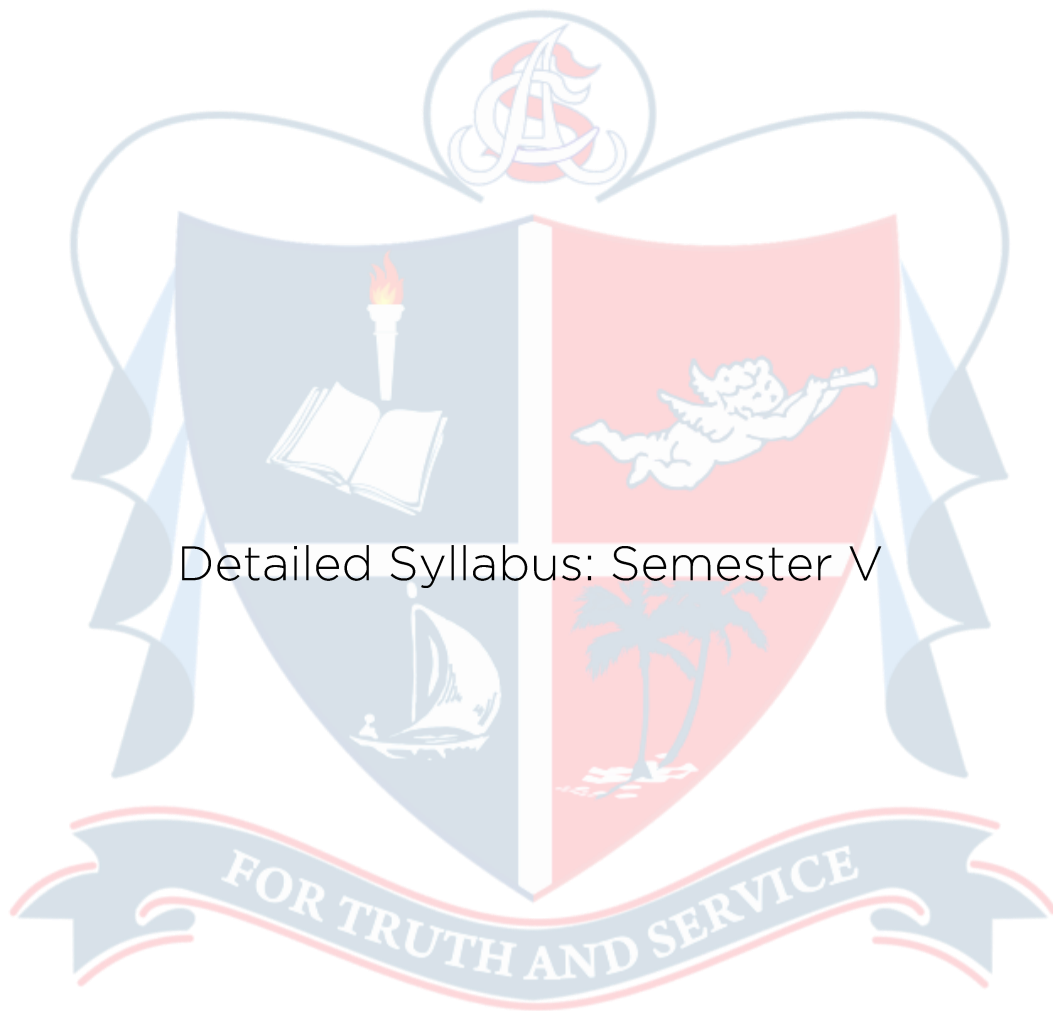
6 Credits

Course Outcomes

- Gain knowledge on different fish processing technologies
- Know the basic concepts of ornamental fish culture
- To develop the practical knowledge on ornamental fish breeding

Students have to undergo internship in a recognized state/central government organization/processing plant/aquarium fisheries unit for a period of four weeks in processing technology/ornamental fisheries. At the end of the internship, the student should prepare a comprehensive report (not less than 40 pages, A4 size). The report should be attested by the organization. Student should also produce a certificate of internship from the organization. All the above details should be submitted to the Department for evaluation.





Detailed Syllabus: Semester V

General Component: Research Methodology (VCA5CMT0123)

60 Hours

4 Credits

Course Outcomes

On completion of the course the students will have attained the following:

- Discuss the role and importance of research.
- Recognize the issues and concepts salient to research process.
- Acquire knowledge on methods of sample collection, data collection and report writing
- Able to identify the complex issues inherent in selecting a research problem, selecting an appropriate research design
- Design and implementing a research project

Module I: Research Methodology**(10 Hours)**

Research methodology- meaning. Research, meaning, objectives, significance. Research process- different steps, criteria for good research. Types of research descriptive, analytical, applied, fundamental, quantitative, qualitative, empirical and conceptual.

Module II: Research Problem**(5 Hours)**

Selection of research problem-sources-technique involved in defining a problem.

Module III: Research Design**(10 Hours)**

Research design-meaning-need, concepts-elements Sampling design-steps criteria of selecting a sampling procedure-sampling process

Module IV: Types of Data**(10 Hours)**

Types of data-primary data -meaning-advantages-disadvantages-methods of collecting primary data-sources. Secondary data- meaning, advantages disadvantages-sources.

Module V: Interpretation

(25 Hours)

Interpretation-meaning-techniques-of interpretation. Report writing-significance types of reports; (technical and popular) steps-layout-oral presentation. Note on course work. This course should not be taught in the conventional lecture method alone. Every lecture should be complemented by an appropriate activity (For example, reference, assignments, project reports etc.).

References

- Research methodology, OR Krishnamoorthi, Himalaya publishing house, Mumbai
- Research Methodology Ranjith Kumar Pearson, 2nd edition 2
- Research Methods for management Dr. S.ShajahanJaico Publishing House
- Research Methodology. methods and techniques C.R.Kothari New Age International publishers
- Research Methods Ram Ahuja Rawat publications
- Research Methodology K.R.Sharma National Publishing House



General Component: Aquaculture Development Planning and Management
(VCA5CMT0223)

75 Hours

5 Credits

Course Outcomes

On completion of the course the students will have attained the following:

- Demonstrate sustainable development of various levels of aquaculture planning.
- Define the role and performance of FFDA and BFFDA
- Ability to illustrate project and project appraisal applying relevant project management techniques
- Define critically analyzing aquaculture and rural development programmes in the fisheries sector.
- Know the role and relevance of Panchayati Raj institutions in aquaculture development

Module I: introduction

(15 Hours)

Introduction to aquaculture development, planning and management. Importance, principles and processes in developing aquaculture programmes; Planning for sustainable development; Types of planning; Planning strategies at various levels - Top down and bottom up approaches.

Module II : Role of Institutions

(15 Hours)

Role and relevance of Panchayati Raj institutions in aquaculture development; Plan allocation and performance of FFDA, BFDA and other aquaculture related programmes over the different plan-periods in India.

Module III: Project Preparation

(10 Hours)

Project preparation and project appraisal in terms of social benefit analysis, shadow prices;

Module IV : Project management techniques

(10 Hours)

Project management techniques - PERT and CPM; Logical framework approach (LFA), Stakeholder analysis; Participatory Monitoring and evaluation (PROME); People's participation in aquaculture programmes, significance, importance and approaches.

Module V: Aquaculture and Rural Development

(15 Hours)

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Critical analysis of aquaculture and rural development programmes; design, operation, institutional mechanism and socio-cultural and economic impact of programmes such as NREGA; labour market relations;

Module VI: Fisheries management planning (10 Hours)

Fisheries development vis-à-vis fisheries for development; Livelihood Frameworks.

References

- Agarwal SC. 2004. Fishery Management. APH Publ. Corp.
- Agarwal SC & Johal S. 2003. Fishery Development. Narendra Publ.
- Felix S. 2007. Aquaculture Management Techniques. Daya Publ. House.
- Singh B. 2007. Fishery Management: Planning and Objectives. Vista International Publ. House.
- Sinha VRP. 2005. Fisheries Research Planning and Management in Developing Countries. Narendra Publ. House.



General Component: Mariculture (VCA5CMT0323)

75 Hours

5 Credits

Course Outcomes

On completion of the course the students will have attained the following:

- Recognize and know the major candidate species for mariculture and their techniques.
- Demonstrate about steps and procedures involved in the culture of various marine fishes, crustaceans, molluscs, aquatic plants and invertebrates.
- Illustrate about the artificial breeding technique in fin fishes and crustaceans
- Awareness on broodstock maintenance, hatchery technology, induced breeding technology and larval rearing of various finfishes and crustaceans.
- Know the different finfishes cultured around the world.

Module I: Introduction**(2 Hours)**

Scope and Global status of Mariculture. Present status of mariculture in India and progress.

Module II: Culture of Finfishes**(20 Hours)**

Criteria for selection of fish for mariculture, Broodstock management, breeding under controlled conditions, Induced breeding and egg incubation of cobia, pompano and grouper. Natural seed resources, Collection acclimatization and transportation of seed, Hatchery production of seed. Larval rearing. Different kinds of grow out culture systems. Finfish mariculture in cages, pens and race ways and running water systems.

Module III: Crustacean Culture**(10 Hours)**

Overview of the crustacean culture in the world. Major species of Spiny lobster, Sand Lobsters, Crabs and Shrimps. Seed production - Natural and Hatchery, Broodstock management, Techniques of Induced breeding. Traditional and modern farming techniques- Extensive, Intensive and Semi intensive. Sea ranching.

Module IV: Culture of Molluscs**(25 Hours)**

Overview of culture of molluscs of the world. Major species of edible oysters, Pearl oysters, Mussels, Clams, Cockles, Scallops, Abalones and Cephalopods used in aquaculture. Broodstock management, induced maturation and spawning. Seed production – Natural seed resources and collection techniques of oysters, Mussels and Clams. Hatchery production of seeds of Oysters mussels and clams. Mussel and Oyster farming – site selection, farm structure and farming techniques. Artificial pearl production techniques. Abalone culture methods, culture of cephalopods. Biofouling in molluscan farms and control measures. Effect of toxic algal blooms.

Module V: Seaweed Culture**(10 Hours)**

Taxonomy of Economically important sea weeds. Seaweed morphology, Reproduction and life cycle. Seaweed propagation methods and culture. Seaweed utilization. Importance of sea grasses.

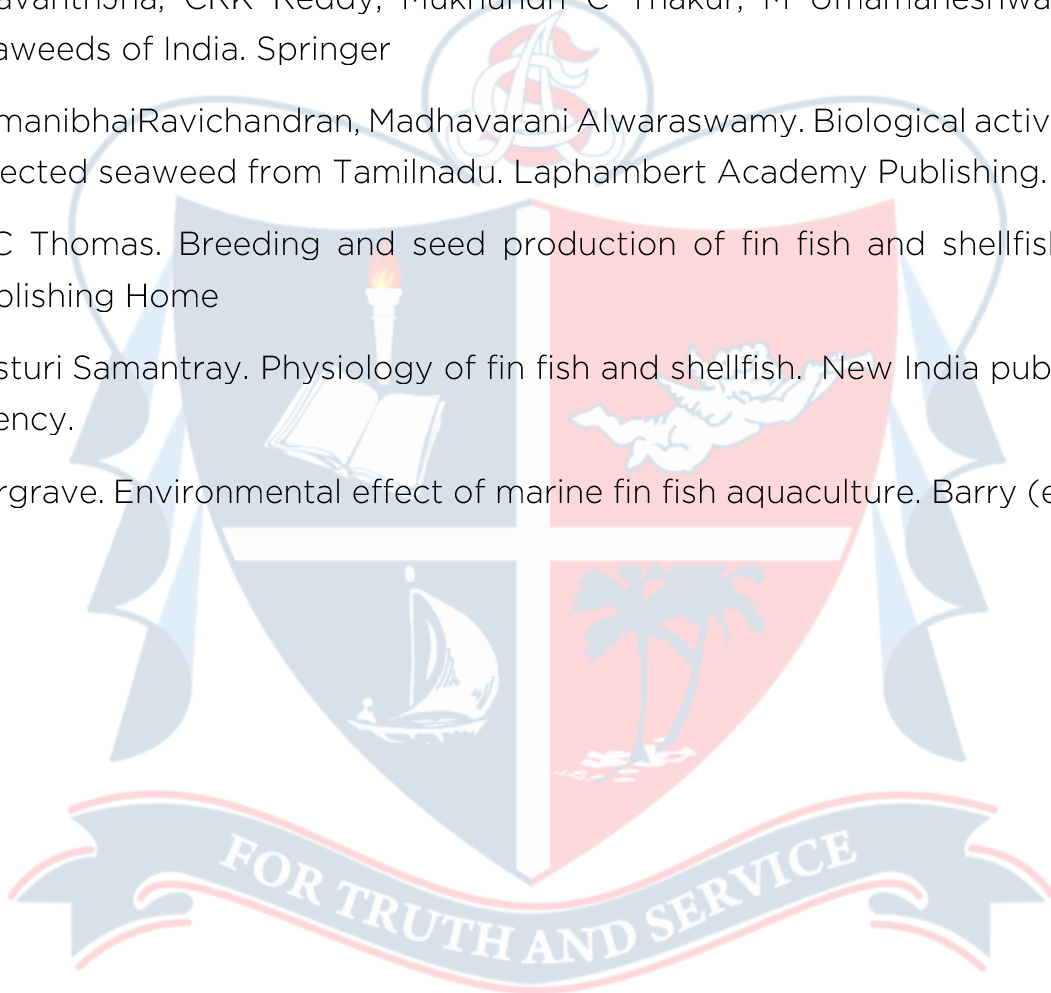
Module VI: Culture of Sea Cucumber**(8 Hours)**

Major species of sea cucumbers and their distribution. Seed production techniques and Culture methods, Culture of sea cucumbers in India.

References

- Applied fisheries. Prasad, I.
- Applied ichthyology. Sandhu, G.
- Fish diversity and dam ecosystem. Shinde, S.
- Fish farming and fish products. Naik, J.
- Fish hatchery management: 2nd edn. Wedemeyer, G.
- Fish, fisheries and aquaculture technology. Naik, J.
- Fisheries and aquaculture technology. Malik, A.
- Frontiers in aquaculture. Sundaray, J. K.
- Handbook of fish and fisheries. Sinha, R. K.
- Marine fish and fisheries. Naik, J.
- Aquaculture in shallow seas: progress in shallow sea culture. Takeo Imai.
- Perspectives in Mariculture. Menon, N.G.

- Development of marine fisheries science in India. Bensam P.
- Breeding and seed production of fin fish and shellfish. Thomas P.C. *et al.*
- Coastal aquaculture: mussel farming: progress and prospects. CMFRI Publ.
- Seaweed research and utilization in India. CMFRI Publ.
- Dinabandhu Sahoo. Common Sea weeds of India. IK International Publication House
- BhavanthJha, CRK Reddy, Mukhundh C Thakur, M Umamaheshwar Rap. Seaweeds of India. Springer
- RamanibhaiRavichandran, Madhavarani Alwaraswamy. Biological activities of Selected seaweed from Tamilnadu. Laphambert Academy Publishing.
- P C Thomas. Breeding and seed production of fin fish and shellfish. Day Publishing Home
- Kasturi Samantray. Physiology of fin fish and shellfish. New India publishing agency.
- Hargrave. Environmental effect of marine fin fish aquaculture. Barry (ed.)



Skill Component: Value added Fishery Products (VCA5CRT0123)

60 Hours

4 Credits

Course Outcomes

On completion of the course the students will have attained the following

- Explain the principles and significance of value addition in the seafood industry
- Give an outline on the preparation of fish mince-based products with special emphasis on surimi production.
- Illustrate the preparation of a number of other value added products such as pickles, wafers, chutney powders, steaks, cutlets etc. from fish or shrimp.
- Know the preparation of by-products like chitin, chitosan, fish silage, fish meal, fish oil etc. for commercial gain.
- Sufficient knowledge on spoilage and quality evaluation in thermally processed products

Module I: Value addition in Sea Foods**(10 Hours)**

Different types of value-added products from fish and shell fish – status of value addition in Indian seafood sector. Advantages of value addition. Significance of value addition in the seafood industry.

Module II: Fish Mince Based Products**(10 Hours)**

Fish mince and Surimi. Production of fish mince – merits and demerits. Analog and fabricated products. Quality assessment of surimi, Equipment, raw material for surimi, Role of cryoprotectants in surimi production.

Module III: Coated Fishery Products**(10 Hours)**

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

Module IV: Fishery Value Added Products and By-Products**(20 Hours)**

Preparation of products- fish / prawn pickle, fish wafers, prawn chutney powder, fish soup powder, fish protein hydrolysate, fish stacks, extruded fish products, fillets, fish curry, fish cutlet, mussel products, marinated products. Production of chitin, chitosan and glucosamine hydrochloride from shrimp shell waste. Preparation of fish silage. Uses of silage. Isinglass, shark fin rays, gelatin from

fish waste, Ambergris, beche-de-mer, squalene, fish meal and oil

Module V: Spoilage and Quality

(10 hours)

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

References

- BALACHANDRAN, K.K., Postharvest technology of fish and fish products
- GOVINDAN, T. K. Fish processing technology
- GOPALAKRISHNA IYER, T S et.al Ed. Quality assurance in seafood processing
- NOLLET, LEO M L ed. Handbook of seafood and seafood products analysis
- FARIDI, A. Z., Convenience products from fish
- GOPAKUMAR, K. Text Book of Fish Processing Technology.
- Hall, G.M. Fish Processing Technology.
- HUI, Y.H., M.D. Pierson & J.R. Gorham Food borne Disease
- SEN D. P. Advances in Fish Processing Technology.
- WHEATON & Lawson Processing Aquatic Food Products.
- WINDSOR, M. & Barlow Introduction to Fishery By products, Fishing



Skill Component: Microbiology and Health Management (VCA5CRT0123)

60 Hours⁴

Credit

Course Outcomes

On completion of the course the students will have attained the following:

- Knowledge on the key concepts of microbiology through historical context and developing their own idea in creative rethinking of learned facts.
- Plan and design fish ponds through introduction of culture beneficial bacteria to improve the water quality and reducing capital running costs.
- Identify and classify different pathogens so as to provide remedial measures for treatment
- Develop ability for revamping risk related consequences in bio security policy according to the situation of environmental health protocols.
- Develop disease management strategies for better survivability of the cultured organisms.

Fish Microbiology

Module I

(10 Hours)

Introduction - History and development of microbiology – Contributions of Louis Pasteur, Koch and Winogradsky –Diversity of microbial community – General characteristics of bacteria, fungi, viruses, algae and protozoans. Microflora of aquatic environment. Autotrophic and heterotrophic microorganisms in aquatic environment. Nutrient regeneration, role of microbes in biogeochemical cycles – Carbon, Nitrogen, Phosphorus and Sulphur cycles. Autochthonous and allochthonous microorganisms in aquatic environment.

Module II

(10 Hours)

Bacteria in Culture Pond and Seafood - Health significant bacteria in culture pond. Culture characteristics and epidemiology of *E. coli*, pathogenic *Vibrios*, *Salmonella*, *Aeromonas hydrophila*, and *Pseudomonas*. Perishability of seafood –Microbial spoilage of fish and shellfish. Spoilage microflora. Intrinsic and extrinsic factors affecting spoilage. Microflora associated with body parts. Food borne pathogens. Sources of contamination.

Module III

(10 Hours)

Isolation and Culture of Microbes - Prokaryotic growth – characteristic features of bacterial growth curve – Effect of environmental factors on growth. Nutrition and growth of bacteria – different types of media for isolation of bacteria and fungi. Isolation and cultivation of microorganisms from water and sediment. Different culture techniques.

Health management

Module IV

(16 Hours)

Review of various diseases of finfish and shellfish significant to aquaculture; diagnostic procedures and their application in aquaculture. Disease monitoring, surveillance, epidemiology, quarantine, certification and import risk analysis. Prophylaxis, hygiene and therapy of fish and shellfish diseases. Commonly used drugs/chemicals in aquaculture, drug delivery. Vaccines and vaccination, probiotics and bio remedial measures; immunostimulants and their role. Advances in disease control and management; Principles of SPF/SPR.

Module V: Parasitology

(14 Hours)

Definition, relevance and scope of fish parasitology. Different types of parasitic infections in fishes- ectoparasites, endoparasites, intermittent parasites, monogenic, digenic, Helminth fish parasite- trematodes, cestode, nematode, acanthocephalan. Crustacean fish parasites- isopods, branchiurans, copepods fish parasites. Annelid, protozoan (ciliates and flagellates) and molluscan parasites. Parasitology - General characteristics of parasites, symptoms, life cycle, diagnosis, prophylaxis, prevention and treatment of parasites. Host - parasite relationship, parasitic adaptations.

References

Microbiology

- FROBISHER, MARTIN *et al*-Fundamentals of microbiology.
- GOPALAKRISHNA IYER, T S *et.al* Ed - Quality assurance in seafood processing.
- SURENDRAN, P K -Seafood safety.
- PATEL, A H - Industrial microbiology.
- DHEVENDARAN, K - Aquatic microbiology.
- ARORA, D R & ARORA, B - Textbook of microbiology.

- PADMA SINGH - Recent trends in microbial biotechnology.
- KHUNTIA, B K - Basic microbiology: an illustrated laboratory manual.
- Books for Reference – Pathology
- David SA, Lee CS & O'Bryen PJ. 2006. Aquaculture Biosecurity-Prevention, Control and Eradication of Aquatic Animal Diseases. World Aquaculture Society. Blackwell.
- Felix S, Riji John K, Prince Jeyaseelan MJ & Sundararaj V. 2001. Fish Disease Diagnosis and Health Management. Fisheries College and Research Institute, T.N. Veterinary and Animal Sciences University. Thoothukkudi.
- Humphrey J, Arthur JR, Subasinghe RP & Phillips MJ. 2005. Aquatic Animal Quarantine and Health Certification in Asia. FAO.
- John P. 1999. Health Maintenance and Principal Microbial Diseases of Cultured Fishes. 2nd Ed. Blackwell.
- Noga EJ. 1996. Fish Disease. Diagnosis and Treatment. Mosby-Year Book.
- Shankar KM & Mohan CV. 2002. Fish and Shellfish Health Management. UNESCO.
- Stoskopf MK. 1993. Fish Medicine. WB Saunders.



Skill Component: Practical: Value Addition, Microbiology and Pathology
(VCA5CRP0123)

60 Hours

4 Credits

Course Outcomes

On completion of the course the students will have attained the following:

- Build the knowledge of value addition and the product trends in recent markets for developing their own generated advance products.
- Recognize the food borne pathogens that can harm the products through the microbiological examinations.
- Gain knowledge on the shellfish and fin fish disease and prophylactic solutions.
- Justify instrumentation techniques of microbiology labs enabling them to assist in food processing disease diagnosis centers.
- Expertise on the preparation of value-added fishery products
 1. Preparation of glucosamine hydrochloride and glucosamine sulphate.
 2. Preparation of isinglass, collagen powder and collagen and chitosan.
 3. Preparation of value added fishery products -fish wafers, prawn curry, fish curry, cutlets fish finger, fish pickling.
 4. Preparation of surimi
 5. Sterilization technique- dry heating, autoclaving
 6. Media preparation
 7. Isolation and maintenance of bacteria from fishes and water.
 8. Gram staining of bacteria
 9. Enumeration of bacteria by TPC method
 10. Enumeration of total coli forms
 11. Identification of various finfish / shellfish disease
 12. Parasite in fishes, protozoan, helminths, crustaceans
 13. Prophylaxis for the prevention of outbreak of fish disease

Skill Component: On the Job Training 3 (OJT 3) (VCA5OJT0123)

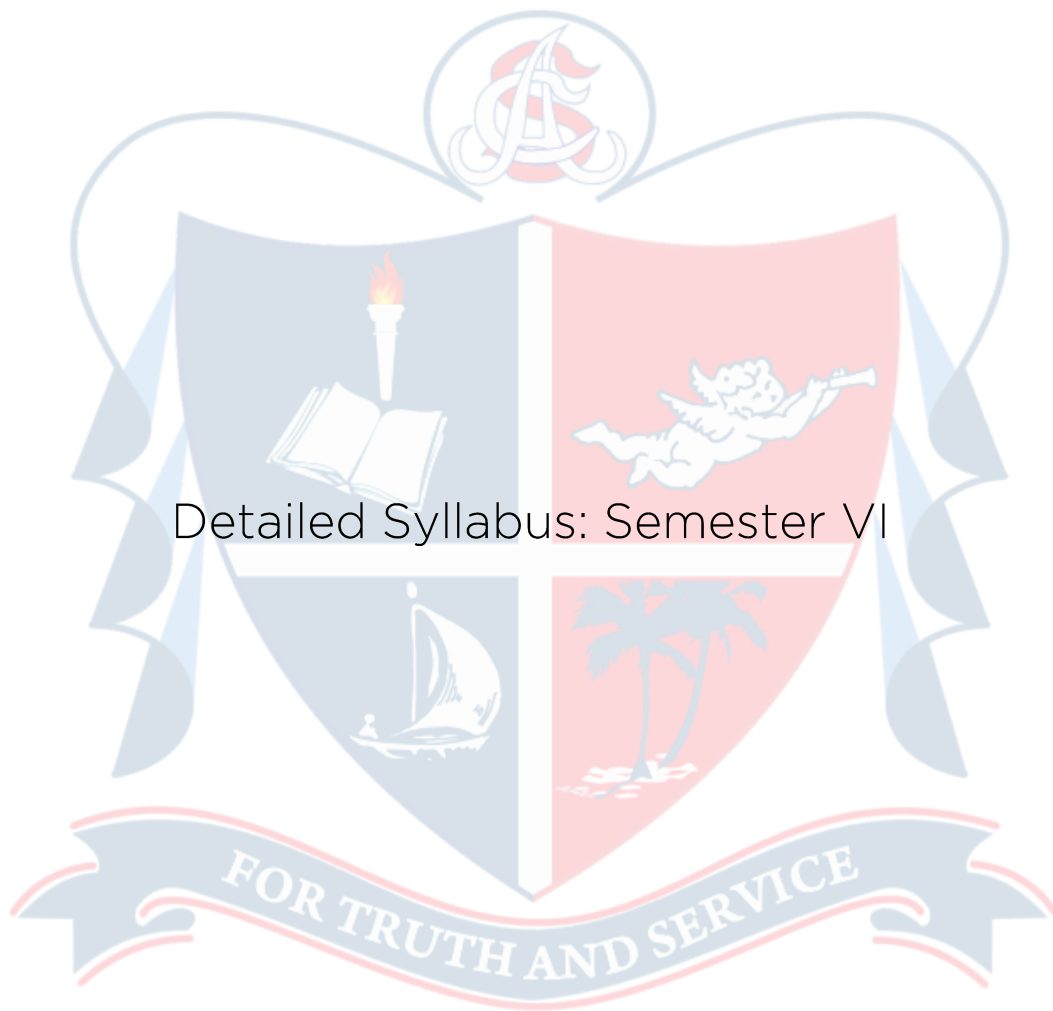
4 Credits

Course Outcomes

- Create awareness on the basic ideas in fish diseases, their prophylactic measures and different microbiological techniques in aquaculture
- Ability to understand the principles and importance of value addition in the seafood industry.

Students have to undergo On Job Training in a recognized state/central government organization/research institute/processing plant for two weeks in value addition/ microbiological techniques/ fish pathology. Each student has to submit a comprehensive report and present the report with the aid of PPT to the corresponding teachers. Student should also produce a certificate of training from the organization. All the above details should be submitted to the Department for evaluation.





Detailed Syllabus: Semester VI

General Component: Corporate Readiness Programme (VCA6CMT0123)

5 hours

Course Outcomes

On completion of the course the students will have attained the following:

- Make use of SWOT test for self-analysis
- Adapting to new business correspondence, communication and presentation skill
- Develop abilities for interview and Group discussion skills
- Develop unique abilities for planning and networking
- Ability to discern job related issues and recommend solutions.

Module I: Understanding Self (15 Hours)

Where We Came from (Brainstorming about self), What is important to the students, what he is good at, SWOT analysis,

Module II: Career Assessment (15 Hours)

Career Assessment: Setting Goals, Career researching and job lead resources, Job Analysis, Values, writing skills (Business correspondence), Business communication and presentation skills

Module III: The Work World (10 Hours)

The Work World: How Do People Really Get Jobs: Beliefs about how people get jobs; Job discrimination; What Are Different Jobs Like: Interviews in different job fields;

Module IV: Identifying problems on the job (10 Hours)

Identifying and Coping With Problems on the Job: Identifying potential problems, Developing solutions; The Management and Organizational Skills: Getting organized, Time Management

Module V: Interview and Group Discussion: (15 Hours)

Interview and Group Discussion: Importance, Need, advantages and disadvantages, methods, types, Do's and Don'ts, Etiquette: Physical and Digital Etiquette

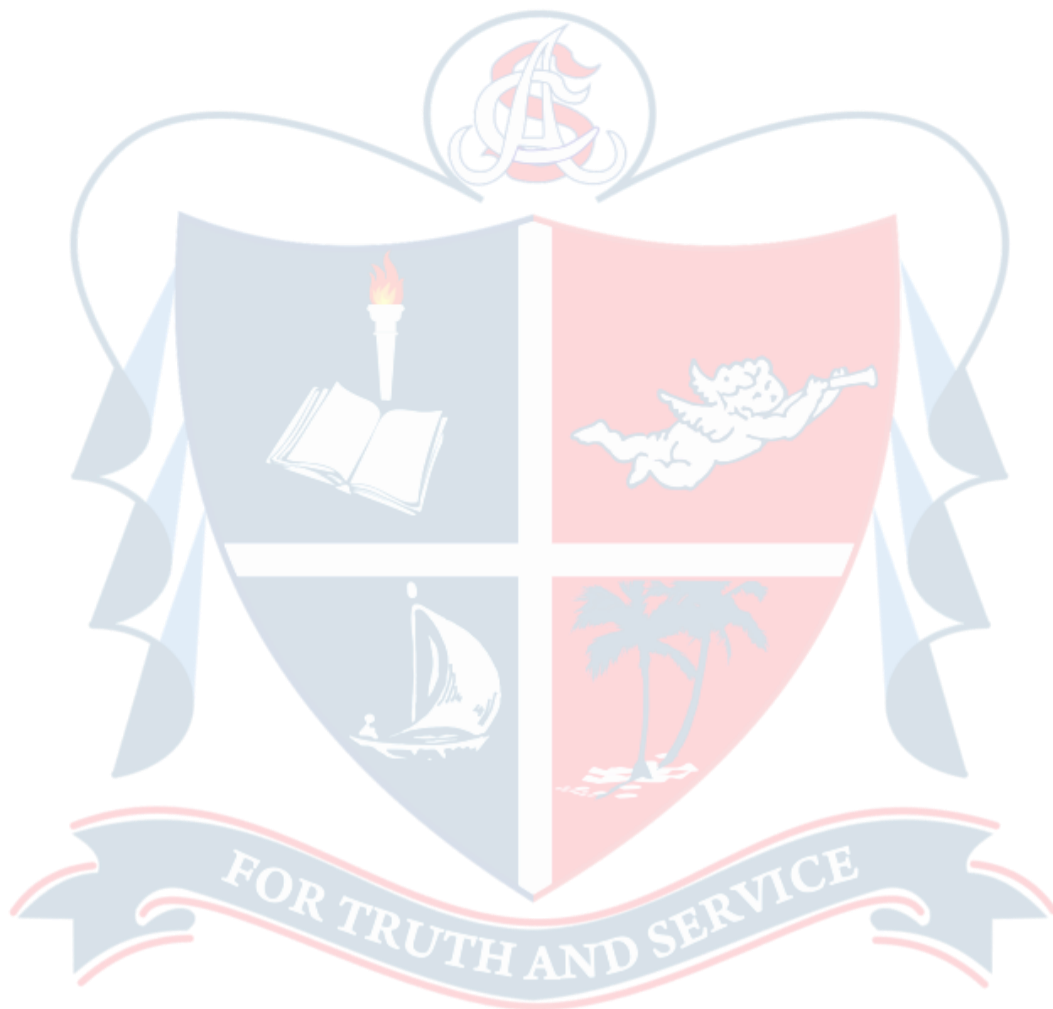
Module VI: Campus to Corporate (10 Hours)

Campus to Corporate: Building a Resume, Job Search, Applying for a Job,

Identifying the Barriers to Success, My Career Plan, Networking

References

- Robbins, Judge & Sanghi, Organizational Behaviour, 12th Ed. Prentice Hall India
- McShane, Glinow, Organizational Behaviour, Tata McGraw Hill
- Don Helirigeji; John W Slocum; Richard W. Woodman, Organizational Behaviour, 8th Ed, south-Western



General Component: Marketing Management (VCA6CMT0220)

75 Hours

Credits

Course Outcomes

On completion of the course the students will have attained the following:

- Summarize of the fundamental marketing concept
- Get a skill to illustrate consumer and market data to make decisions.
- Interpret the concept of social responsiveness and its benefits
- Show how to solve issues related to marketing of fishery products.
- Recognize the emerging trends in marketing

Module I: Introduction to Marketing Management (15 Hours)

Introduction- Definition of marketing and marketing management- Marketing concepts and functions-Marketing research – marketing mix.

Module II: Market Segmentation (15 Hours)

Concept-Need- Basis-Market targeting-Market Positioning -Understanding consumer behaviour- Buying motives- Factors influencing consumer buying decisions

Module III: Marketing of Products (8 Hours)

Product- Meaning- Product development- Product mix- PLC- Branding-Brand equity-Brand loyalty-Trade mark.

Module IV: Packaging and Labelling (8 Hours)

Packaging and labelling - Pricing of products-Factors influencing pricing-Pricing policies and Strategies-Types of pricing.

Module V: Logistic and Supply Chain Management (15 Hours)

Its elements-Channel of distribution types- Factors affecting the choice of a channel of distribution.

Module VI: Emerging Trends in Marketing (15 Hours)

Modern marketing- Direct marketing- E Marketing- Tele marketing-Viral marketing -Relationship marketing-Social marketing-Demarketing - Remarketing- Synchro marketing-Service marketing.



References

- Chaston I. 1983. Marketing in Fisheries and Aquaculture. Fishing News Books.
- Dholakia, A.D. 2004. Fisheries and Aquatic Resources of India. Daya Publ. Hse., Delhi,
- Grafton QR, Kirkley J, Kompas T & Squire D. 2006. Economics for Fisheries Management. Ashgate Publ. Co.
- Ian C. 1984. Marketing In Fisheries and Aquaculture. Fishing News Books.
- Munro GR & Scott A. 1984. The Economics of Fisheries Management. University of British Columbia.
- Palanisamy K, Paramasivam P & Renganathan CR. 2002. Agricultural Production Economics, Analytical Methods and Applications. Associated Publ. Co.
- Sathiadas, R. 2012. Marine Fishery Marketing in India. CMFRI, Cochin, 276pp.
- Shang YC. 1981. Aquaculture Economics. Westview Press.



Skill Component: Aquaculture Engineering (VCA6CRT0123)

75 Hours

5 Credits

Course Outcomes

On completion of the course the students will have attained the following:

- Expertise the technologies used in the aquaculture industry for the design of fish farms.
- Illustrate the design and construct recirculatory aquaculture systems.
- Make use of different types of filtration and aeration devices in aquaculture.
- Demonstrate the engineering aspects of fish and shrimp hatchery along with farm machinery operations and maintenance.
- In depth Knowledge on different feeding systems and methods

Module I: Introduction (10 Hours)

Introduction and relevance to aquaculture engineering. Site selection for aquaculture; surveying and levelling, earthwork calculations. Design of dykes, sluice, channels.

Module II: Types of Aquaculture Systems (10 Hours)

Tide fed farms; studies on water supply; aquaculture in open systems design of cages, rafts, pens, rakes, ropes etc.

Module III: Instruments and Culture Systems (10 Hours)

Fluid mechanics, pumps, flow estimation and measurement; aquaculture in ponds, raceways and tanks.

Module IV: Recirculatory Aquaculture Systems (20 Hours)

Recirculating aquaculture system; aeration, sterilization and disinfection, ponds, tanks and other impounding structures; filtration. Aeration – Gases in water. Gas transfer – Theory of oxygenation – Types of aerations. Efficiency of Aerators. Recirculation and water – Reuse systems – water exchange – water reuse methods – Recirculation – Advantage – Designs of re-use systems.

Module V: Fundamentals of Aquaculture (10 Hours)

Fundamentals of concrete; building materials, cement, RCC. Engineering aspects of fish and shrimp hatchery. Farm machinery operation and maintenance. Pond sealing techniques. Shapes roof design – Load carrying

system. Floors, walls, ventilation.

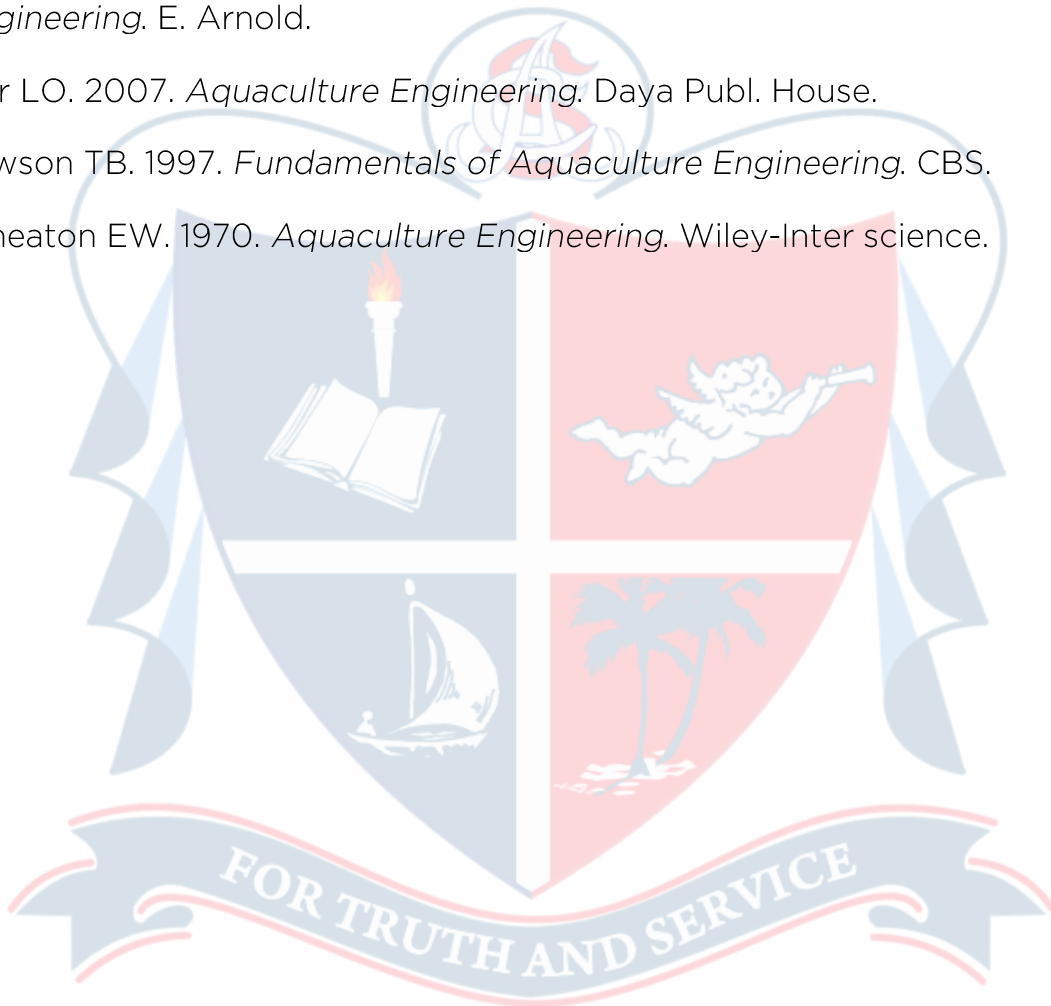
Module VI: Feeding and transportation

(15 Hours)

Automatic feeding system – Feed dispensers – Demand feeders. Design and construction of aquaculture system pond construction – water transportation system – Pump houses – Inlet and outlet structures – Water treatment plants.

References

- Bose AN, Ghosh SN, Yang CT & Mitra A. 1991. *Coastal Aquaculture Engineering*. E. Arnold.
- Ivar LO. 2007. *Aquaculture Engineering*. Daya Publ. House.
- Lawson TB. 1997. *Fundamentals of Aquaculture Engineering*. CBS.
- Wheaton EW. 1970. *Aquaculture Engineering*. Wiley-Inter science.



Skill Component: Fisheries Governance and Socio- Economics
(VCA6CRT0223)

60 Hours4

Credits

Course Outcomes

On completion of the course the students will have attained the following:

- Provide an outline about the economic principles applicable in fisheries
- Find out the cooperative societies and their role in promoting the development of the fisheries sector
- List out the central and state legislative provisions relating to aquaculture including Indian Fisheries Act
- Know the concepts and theories of business applicable in fisheries industry
- Interpret the theories of production, demand, supply and return in terms of fishery industry

Module I: Importance of fisheries sector in Indian economy (10 Hours)

Fisheries administrative set up at Centre and States - sphere of responsibilities of Central and State governments/agencies for fisheries development. Fisheries legislation in India: background, Indian Fisheries Act of 1897 and subsequent Amendments.

Module II: Marine capture fisheries: (20 Hours)

comparative study of Marine Fishery Regulation Acts of coastal Indian States - licensing/registration of vessels and mechanization - declaration of closed season, protection of endangered species, prohibition of destructive fishing methods, regulation of mesh size, filing of return on fish catch and income. Features of MPEDA Act and Rules, 1972 - guidelines for operation of Indian deep sea fishing vessels in Indian EEZ - Maritime Zone of India (regulation of fishing by foreign vessels) Act 1981 - aquatic exotics and quarantine regulations - Marine Fisheries Policy, 2004. Coastal Aquaculture Authority.

Module III: Aquaculture Regulations (10 Hours)

Guidelines under CRZ notification of 1991 and its Amendments, land leasing policies, regulations on use of chemicals and antibiotics - features of

Aquaculture Seed (Quality Control) Relevant Central/state legislative provisions of Environment, Wildlife, Water, Biodiversity: (riverine, reservoir and aquaculture), processing in different States.

Module IV: Economic theories and growth models (10 Hours)

Economic theories and growth models of fish resource development and exploitation; Fishery resource management; Maximum Sustainable Yield (MSY), Maximum and Net Economic Yield (M/NEY), Optimum Sustainable Yield (OSY), Static Maximum Economic Yield (SMEY), Dynamic Maximum Economic Yield (DMEY)

Module V: Socioeconomics (10 Hours)

Socioeconomics - An overview of the socio economic status of the fisherfolk in India, overview of various welfares schemes, Disaster management. Role of fisheries cooperatives, corporation and NGOs in the development of the fisherfolk. Social, economic and cultural context in which NREGA is implemented Labour market relation: wage, work opportunity, migration, livelihood security, income generation.

References

- Gaisford JD & Kerr WA. 2001. Economic Analysis for International Trade Negotiations. John Wiley & Sons.
- Green D & Griffith M. 2002. Dumping on the Poor: The Common Agricultural Policy, the WTO and International Development. CAFOD, London.
- Sikdar S. 2003. Contemporary Issues in Globalisation - An Introduction to Theory and Policy in India. Oxford University Press.
- Tussie D & Glover D. 2000. The Developing Countries in World Trade - Policies and Bargaining Strategies. Lynne Rienner.
- Weber ML. 2001. From Abundance to Scarcity: A History of U.S. Marine Fisheries Policy. Island Press.

Skill Component: Practical: Aquaculture Engineering and Fisheries
Governance and Socioeconomics (VCA6CRP0120)

75 Hours

5 Credits

Course Outcomes

On completion of the course the students will have attained the following:

- Familiarize with the different instruments used in aquaculture farms.
 - Recognize the operations of accessories used in culture systems
 - Explain the designing of pump house, pump installation and computation of water requirement.
 - Summarise the computation of various resource efficiency measures and estimation of socio-economic growth of the fisher folks.
 - Gain knowledge on licensing/registration of vessels and gears.
1. Instruments used in aquaculture farms.
 2. Operations of aerators, filters, water supply systems.
 3. Calculations related to earth requirement aerated efficiency and pump selection.
 4. Pump installations.
 5. Design of pump house.
 6. Computation of water requirement, pump and pumping rates.
 7. Licensing/registration of vessels and gears.
 8. Estimation of socio-economic parameters of fisherfolk in India.
 9. Computation of various resources efficiency measures.
 10. Review of the socio-economic growth of the fisherfolks.

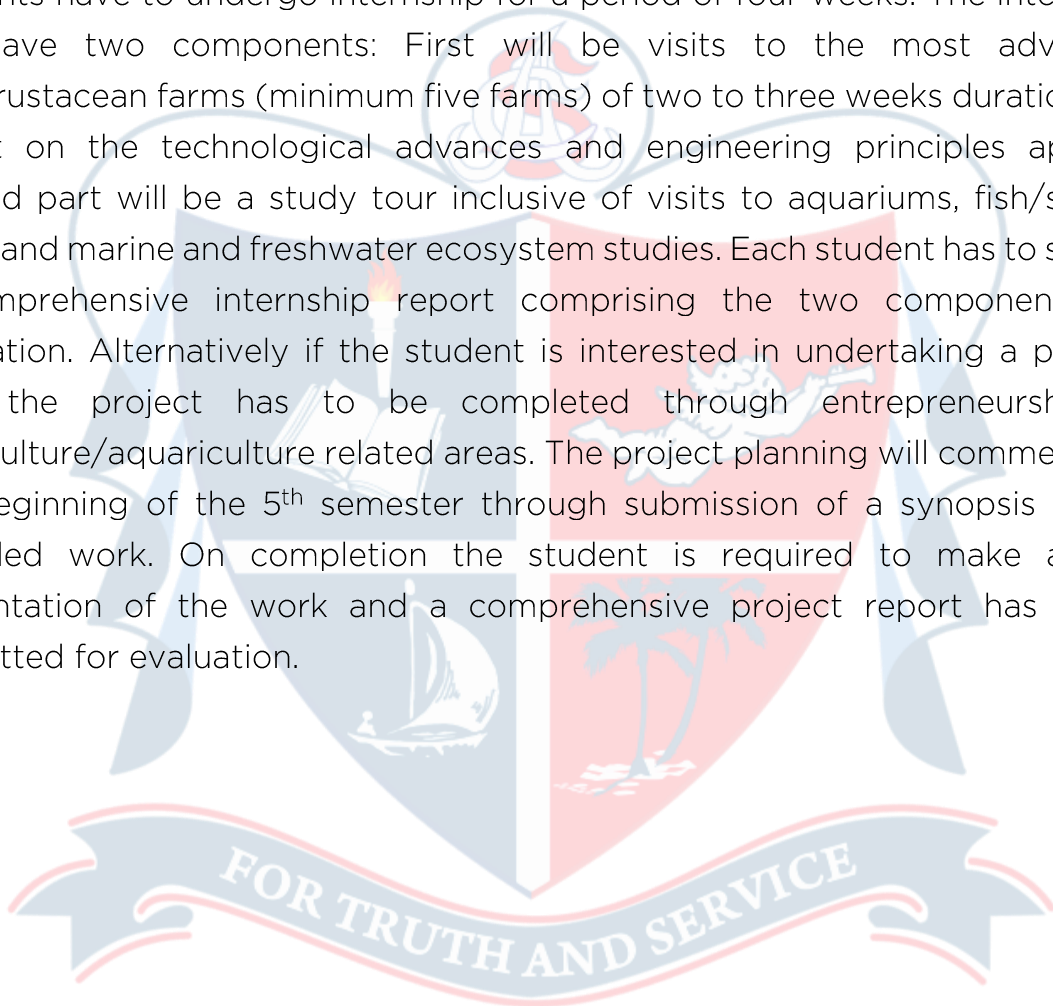
Skill Component: Internship with Project (VCA6CPR0123)

6 Credits

Course Outcome

- Knowledge on the major components of fish and shrimp farms
- Explain the technical aspects of a shrimp or fish farm
- Gain knowledge on fresh water and marine ecosystem

Students have to undergo internship for a period of four weeks. The internship will have two components: First will be visits to the most advanced fish/crustacean farms (minimum five farms) of two to three weeks duration and report on the technological advances and engineering principles applied. Second part will be a study tour inclusive of visits to aquariums, fish/shrimp farms and marine and freshwater ecosystem studies. Each student has to submit a comprehensive internship report comprising the two components for evaluation. Alternatively if the student is interested in undertaking a project, then the project has to be completed through entrepreneurship in aquaculture/aquariculture related areas. The project planning will commence at the beginning of the 5th semester through submission of a synopsis of the intended work. On completion the student is required to make a PPT presentation of the work and a comprehensive project report has to be submitted for evaluation.



Gist of Changes

SEMESTER CHANGES	
EXISTING	PROPOSED
<p><u>From Semester 3</u></p> <p>General Component: Research Methodology (VCA3CMT0120) 60 Credits 4 Credits</p>	<p><u>To Semester 5</u></p> <p>General Component: Research Methodology (VCA 5CMT0123) 60 Credits 4 Credits</p>
<p><u>From Semester 5</u></p> <p>General Component: Business Entrepreneurship (VCA5CMT0120) 60 Credits 4 Credits</p>	<p><u>To Semester 3</u></p> <p>Business Entrepreneurship (VCA3CMT0123) 60 Credits 4 Credits</p>
EXISTING	PROPOSED
<p>Semester I</p> <p>Principles of Aquaculture and Hatchery Technology VCA1CRT0120</p> <p>Module III FFDA, BFFDA, FIRMA, NRCCWF</p>	<p>Semester I</p> <p>Principles of Aquaculture and Hatchery Technology VCA1CRT0120</p> <p>Module III RGCA, NIFAM, KUFOS, SAF, DCFR</p>
<p>Biology of Fishes VCA1CRT0223</p> <p>Module I Feeding behaviours-Carnivores - macrophagous feeding, microphagous feeding, benthophagous, planktivores (type: Mullet, Penaeus indicus, freshwater mussel)</p> <p>Module III Deleted- (Types: Shark and Mullet) (Type: shark)</p>	<p>Biology of Fishes VCA1CRT0223</p> <p>Module I Litopenaeus culturabile</p> <p>Module II Fish population dynamics and stock assessment- Growth models, mortality parameters, surplus production models, Analytical models.</p>

<p>Module IV Endocrinology and Migration</p>	
<p>Semester II Freshwater and Brackish water Aquaculture VCA2CRT0123</p> <p>Module V - Penaeus cultured</p>	
<p>Semester III Sustainable Aquaculture VCA3CMT0323</p> <p>Module I</p> <p>Significance of fish disease to aquaculture. Sustainability and development Systems approach and its application in aquaculture with special reference to resource-poor systems. Physical environment - temperature, rainfall, water quality and quantity. Social factors - traditions, customs, religious beliefs. Institutional factors - Governmental policy, planning, training, extension services and financial assistance. Role of aquatic resources in food and nutrition. Factors influencing aquaculture production- planning and management, inputs, aquaculture operations and costs. Marketing factors - planning and management, demand, operations and revenues. Aquatic resource and</p>	<p>Semester III Sustainable Aquaculture VCA3CMT0323</p> <p>Module II</p> <p>Technical dimension of sustainable aquaculture Carrying capacity; Factors influencing carrying capacity in water- water quality, fish species and size, feed, nutrients, Factors influencing growth rate- water quality, age and genetics, fish health, size, stocking density, production rate. Factors influencing yield rate and economics- survival, harvest frequency and restocking, economics.</p> <p>Module III</p> <p>Technical aspects of aquaculture farming: Site selection, construction of ponds and water reservoir-surveying tools and types of measurement, pond construction plan, building the pond, dams for fish pond construction. Seed production, nutrition and feed-</p>

<p>livelihood systems.</p> <p>Module III Commercial and recreational loss of fisheries. Implementation of appropriate laws and policies, setting of protected areas, restoring collapsed fisheries, educating stakeholders and public, development of independent certification programmes. Role of biotechnology and traceability.</p> <p>Module IV Consequences related to reputation damage, heightened regulatory pressure, legal action, consumer boycotts and operational stoppages. Overpopulation, malnutrition, unemployment and underemployment, migration, marginalisation, low level of education, low agricultural productivity, unequal distribution of income, low internal capital accumulation.</p> <p>Module VI Holmenskollen Guidelines for Sustainable Aquaculture.</p>	<p>Management of seed production. Aquaculture hygiene and monitoring of fish health-major hazards, sanitary and disease control in aquaculture, harvesting, storage and transportation of live fish, packing, documentation and registration.</p> <p>Module IV Impacts of exotic fish introduction.</p> <p>Module V Economic dimension of sustainable aquaculture-Factors affecting economics and production, record keeping, capital. Budgeting, accounting and business plan in aquaculture.</p> <p>Module VI Governance- aquaculture governance, trends, issues. Pillars and Principles of governance- Introduction to social acceptability-meaning, concept</p>
<p style="text-align: center;">Semester IV Aquaculture biotechnology VCA4CMT0223 Module 1 quantitative changes, qualitative changes Food habits of hybrid and filtering apparatus, growth pattern.</p>	
<p style="text-align: center;">Semester V Business Entrepreneurship VCA1CRT0223 Policies for North Eastern Region; Vision</p>	

2020 of Sikkim.	
Semester VI Corporate Readiness Program VCA6CMT0123 Module V - Penaeus cultured	Semester VI Corporate Readiness Program VCA6CMT0123 Ability to discern job related issues and recommend solutions

