I. Title and Scope
1.1 These academic Regulations shall be called “Annamalai University, Faculty of Marine Sciences “B.F.Sc. Academic Regulations 2015” for obtaining Bachelor Degree in the Faculty of Marine Sciences.
1.2 The regulations provided herein shall apply to the students admitted from the academic year 2015-2016 onwards.

2. Definitions
2.1 University: University means Annamalai University, Parangipettai, Tamil Nadu.
2.2 State Government: State Government means the Government of Tamil Nadu.
2.3 Academic Year: An academic year is a period during which a cycle of study is completed. It shall commence on or after 1st July of each year. There shall be two semesters in an academic year.
2.4 Semester: A semester shall consist of 105 working days inclusive of the mid-semester and practical examinations.
2.5 Curriculum: It is series of courses offered to provide learning opportunities to meet the requirements for a degree.
2.6 Course: A course is a unit of instructions, series of classes and work experience extending over a semester. It has a specific prefix, code number, title and credits. Each course is denoted by specific code number, which has specific meaning. The first three alphabets stand for the department offering the
course. First digit is related to the semester; second digit is related to suffixing the semester and the third digit is related to course number in a particular semester i.e “BFSC 201 – Taxonomy of finfish”. BFSc stands for the Bachelor of Fisheries Sciences the first digit (1) stands for the second semester and the third digit stands for serial number of course in a particular semester.

2.7 Credit: It is a measure of quantity of work done in a course. One credit represents one contact hour for theory or two contact hours of laboratory or field work per week. For example, a 1 + 1 course (2 credits) means 1 hour theory and 2 hours practical per week.

2.8 Credit load: It is the number of credits a student undergoes in a semester.

2.9 Grade Point: “Grade Point” means the total marks in percentage divided by 10 and shall be expressed on 10 point scale up to second decimal place.

2.10 Credit Point: A credit point is a product of grade point obtained by a student and number of credits in a course.

2.11 Grade Point Average (GPA): It is a measure of performance of a student in all the courses taken during a semester. The GPA is computed by dividing the total credit points earned by a student in a semester by the total number of credits taken during that semester.

2.12 Calculation of OGPA: To arrive at the “Overall Grade Point (OGPA)” at the end of a semester, the grade point of each course is multiplied by the credit hours of the course to obtain the credit points. Then, the sum of the credit points secured by the students in all the courses taken till the end of that semester is divided by the number of credit hours of the courses, provided that the credit hours and credit points of courses which are repeated are not counted more than once for this purpose.

a. Grade Point of a course: To calculate the grade point of a course, the marks obtained for theory (100 marks) and practical (50 marks) will be revised to 100. The
percentage of mark earned in a course is then divided by 10 and expressed in a 10 point scale up to one decimal place.

b. **Credit point of a course:** It is the product of credit hours and grade points obtained by the student in a course. For example: In a course with credit 2+1, if the grade point is 8.5; then the credit point of the course is 3 x 8.5 = 25.5

c. **Grade point average:** It is quotient of the total credit points obtained by the student in various course at the end of each semester divided by the total credit hours taken by the student in that semester. The grading is done on a 10 point scale.

2.13 **Overall grade point average (OGPA):** It is the quotient of cumulative credit points obtained by a student in all the course from the beginning of the first semester of the degree course divided by the total credit hours of all the courses completed up to the end of the semester. The OGPA shall be rounded off to second digit of decimal point on the basis of third digit. If third digit of decimal point is 5 or more than 5, then second digit will be increased by one. If, however, it is less than 5, it will be ignored. **This will be done at the end of each semester while calculating the OGPA.** Marks or Grade scored in the ELP, All India Study tour and IPT will be taken into account for OGPA calculations.

For example

i. **Total credit hours till the end of last semester:** 18

ii. **Total credit points till the end of last semester:** 140.50

iii. **Total credit hours in the current semester:** 22

iv. **Total credit points obtained in the current semester:** 156
v. Total credit hours including the current semester: \((18+22) = 40\)

vi. Total credit points including the current semester: \(140.50 + 156.00 = 296.50\)

vii. Overall Grade Point Average: \(\frac{296.50}{40} = 7.412\)

viii. Corrected to two decimals: \(7.41/10.00\)

**Classification of Successful Candidates:** The successful candidates who after completion of the graduation requirements, have secured an OGPA of 5.000 or more in the 10.000.00 point scale shall be classified as under (2015-2016 admitted batch)

<table>
<thead>
<tr>
<th>OGPA</th>
<th>Division/Class</th>
</tr>
</thead>
<tbody>
<tr>
<td>5.000 – 5.999</td>
<td>Pass</td>
</tr>
<tr>
<td>6.000 – 6.999</td>
<td>Second</td>
</tr>
<tr>
<td>7.000 – 7.999</td>
<td>First</td>
</tr>
<tr>
<td>8.000 and above</td>
<td>First with Distinction</td>
</tr>
</tbody>
</table>

**Experimental Learning Programme (ELP) and its evaluation**

For ELP, all working days including Sundays, but excluding Government holidays will be counted for the attendance. The attendance requirement shall be 95% in ELP if a student absent himself/herself up to 7 days, the duration of the semester has to be extended accordingly for such students and final evaluation shall be done on completion of the attendance requirements. Evaluation shall be done after the completion of 105 working days as per the evaluation criteria suggested by ICAR. A student should score above 70 marks to get satisfactory grade and below 70 marks is not satisfactory. Those who have obtained “not satisfactory” grade have to repeat the ELP programme when it is offered by the University.

**In Plant Training (IPT) and its Evaluation**

Student who register of IPT during the 8th semester should have completed the ELP Programme and All India Study Tour.
Attendance requirements and evaluation are similar to that given for ELP Programme.

**All India Study Tour**
Students should compulsorily undertake the All India Study Tour during sixth semester for a period of 25 days. The performance will be evaluated by the teacher in charge of the tour at end of 30 days time on the basis of reports submitted by the students.

**Re-registrations:**
Students shall be given any number of attempts to clear the arrear subject keeping the checks for movement from one year to another i.e. students are permitted to register for the succeeding semester even without clearing the course up to 6th semester.

2.14 **“Transcript Card”** is a consolidated report of grades secured by the student in all the semesters, issued by the University.

3. **Admission**
3.1 Admission of the student to BFSc programme in the Faculty of Marine Science shall be on the basis of merit and in accordance with the policy and guidelines of the state government and the University. The minimum admission requirement shall be decided by University and issued from time to time. Decision of the University is final in deciding procedure of admission and finalization of number of seats. Reservation rules shall be made applicable as per norms of the state government.

3.2 **Tuition fees and scholarship:**
The various fees payable by the students will be decided by the University from time to time.

a) In case of new admission, the fees for the semester are payable in advance failing which they will not be admitted.
b) In other cases, the fees are payable within seven working days from the commencement of the semester.

c) In the case of default, a fine as per the University rules will be collected.

d) The students who fail to pay the tuition fees within a month of commencement of the semester will not be allowed to attend the classes and their names will be struck off from the rolls. However, if the defaulting students pay the fees along with the fines in addition to a prescribed readmission fee, they will be permitted to attend the classes. The period for which his/her name is struck off from the rolls will be treated as absence for the purpose of calculating the minimum attendance requirements.

e) Students who are away on study tour, camp activities or other extracurricular activities organized by the University or the Faculty at the Commencement of the semester may, however, pay their semester tuition fees and other fees within the third working day after they return from such programmes, without fine.

f) A student who has been granted scholarships by the Welfare Departments or by the Government of India or by the State Government will, however, be exempted from the levy of fines, provided the fees are paid on the next day after the scholarship amount is actually disbursed to him/her. The concession referred above will apply to those who have actually been granted scholarships and not to those who have only applied and are expecting sanction.

g) The candidate should obtain a Hall ticket from the Controller of Examinations through the Dean after clearing all arrears including the hostel dues before the commencement of each semester final examination.
4. Advisory system
4.1 Dean shall nominate a co-ordinator from amongst the teaching faculty.
4.2 Student ward counsellors will be nominated soon after the students admission. The counsellor shall be nominated from amongst the teaching faculty.

5. Curriculum and programme of study
The students admitted in the University shall be required to follow the curriculum as prescribed, revised by the Faculty and approved by the Academic Council from time to time.

6. Award of Degree, duration and credit requirements
A student is required to complete the duration and credit requirement for the award of degree as decided by Academic Council from time to time.

<table>
<thead>
<tr>
<th>Sl.No.</th>
<th>Degree</th>
<th>Duration requirements</th>
<th>Credit requirements</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>BFSc</td>
<td>8 16</td>
<td>169</td>
</tr>
</tbody>
</table>

7. Medium of Instruction
The medium of instruction in Faculty of Marine Science shall be English.

8. Attendance Requirements
8.1 One hundred percent attendance is expected from each student. A student who fails to secure 80 percent if attendance prescribed for a course (subject) to study, separately in theory and practical shall not be permitted to appear for both theory and practical examinations in that course (subject) and shall be given ‘E’ (incomplete) and will be required to repeat the course (subject) when offered again.
8.2 For the first year first semester students, for calculating 80 per cent attendance the number of working days
will be calculated only from the date of joining of the student.

8.3 If any student is absent for field trips, the student may be marked absent for all the compensating classes on the day of the field trip in addition to the field trip courses.

8.4 The attendance for mid semester examination will be counted as a theory class.

8.5 Students abstaining from the classes by prior permission from the Dean, Faculty of Marine Sciences on official University business, shall be given due consideration in computing attendance requirements.

8.6 However, condonation of attendance deficiency may be considered by the Vice- Chancellor only in case of genuine reasons including indoor hospitalization with evidence in the form of Hospitalization certificate and Discharge summary recommended by the Dean, Faculty of Marine Sciences. The Vice- Chancellor may decide whether or not a condonation fee is required, based on the reason for condonation.

9. Examinations

Students shall have to take up an internal evaluation test between 50th and 60th working days of the semester; a final practical examination towards the end of the semester within 105 working days; and a final theory examination on completion of 105 working days for the successful completion of each course registered in the semester.

For the courses with theory and practical, 100 marks are allotted for theory and 50 marks for practical. Out of 100 marks for the theory, 80 marks are allotted for the final theory examinations and 20 marks for internal evaluation. For the courses with theory alone, 100 marks are allotted for the theory. For the courses with practical alone, out of 100 marks, 25 marks are allotted to record/ assignment, 25 marks of viva- voce and 50 marks for the practical.
Each course shall carry a maximum of **150 marks** for the purpose of grading. The distribution of marks shall be as follows

### 9.1. Course with both theory and practical Marks

- **i)** Mid Semester Examination 20
- **ii)** Practical Examination (Written =35, Record = 10 and Viva-voce = 5) 50
- **iii)** Final theory examination 80

<table>
<thead>
<tr>
<th></th>
<th>Marks</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Total</strong></td>
<td><strong>150</strong></td>
</tr>
</tbody>
</table>

### 9.2 Course with only Theory / practical *

- **i)** Mid semester Examination 20
- **ii)** Final semester Examination 80

<table>
<thead>
<tr>
<th></th>
<th>Marks</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Total</strong></td>
<td><strong>100</strong></td>
</tr>
</tbody>
</table>

* The modality of evaluation of various courses with only practical is given in Regulation 9.4

### 9.3 Evaluation of course work

The results of the course shall be indicated by grade points ranging from 0 to 10.00. The minimum grade point to be secured for the successful completion of a course will be 5.00. Securing a grade point less than 5.00 in a course will be treated as “RA” and the grade point will be 0 for calculating the GPA / OGPA. In case of course with theory and practical, minimum of 50% mark separately in theory and practical with an aggregate of 50 percent is essential. An OGPA of 5.50 shall be the minimum requirement for the award of Degree.

The following symbols shall be used in the grade sheets.
E - Incomplete (due to attendance deficiency)
AB - Absent
RR - Re-registration
RA - Re-appearance
IE - Improvement Examination
EE - Incomplete for reasons other than attendance
R - Reappear
GPA - Grade Point Average
NC - Non Credit Paper

9.4 Evaluation pattern for courses with only practical

The evaluation pattern of courses with only practical is grouped and mark distribution is furnished below.

A. BFSC 509 Communication Skills (0+1)
The students will be evaluated for 100 marks. The course teacher will evaluate the performance and behavior of students in the classes and marks

<table>
<thead>
<tr>
<th>Particulars</th>
<th>Max. marks</th>
</tr>
</thead>
<tbody>
<tr>
<td>Attendance and routine activities</td>
<td>60</td>
</tr>
<tr>
<td>Behavior</td>
<td>15</td>
</tr>
<tr>
<td>Viva – voce &amp; writing skill exercises</td>
<td>25</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>100</strong></td>
</tr>
</tbody>
</table>

B. BFSC 510 FIRST AID TRAINING (0+1)
The students will be evaluated for 100 marks. The course teacher will evaluate the performance and behavior of students in the classes and marks

<table>
<thead>
<tr>
<th>Particulars</th>
<th>Max. marks</th>
</tr>
</thead>
<tbody>
<tr>
<td>Attendance and routine activities</td>
<td>60</td>
</tr>
<tr>
<td>Behavior</td>
<td>15</td>
</tr>
<tr>
<td>Viva- voce &amp; Evaluation by test</td>
<td>25</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>100</strong></td>
</tr>
</tbody>
</table>
C. BFSC 610 ALL INDIA STUDY TOUR (0 +1)

Educational tours for course BFSC 610 All India Study Tour are compulsory. The tours will be undertaken during sixth semester. The duration of BFSE610 shall not exceed 14 days. The tours will be arranged by the department in consultation with the Dean, Faculty of Marine Sciences. The final examination will be conducted separately at the end of the semester by the University. The Marks for the tours are to be awarded as follows.

<table>
<thead>
<tr>
<th>Particulars</th>
<th>Max marks</th>
<th>Evaluation by</th>
</tr>
</thead>
<tbody>
<tr>
<td>Attendance</td>
<td>20</td>
<td>Accompanying staff</td>
</tr>
<tr>
<td>Behaviour</td>
<td>20</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Final Examination

<table>
<thead>
<tr>
<th>Particulars</th>
<th>Max marks</th>
<th>Evaluation by</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tour Diary</td>
<td>20</td>
<td>By the organizing staff /</td>
</tr>
<tr>
<td>Tour record</td>
<td>30</td>
<td>Examiner</td>
</tr>
<tr>
<td>Viva – voce</td>
<td>10</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>100</td>
<td></td>
</tr>
</tbody>
</table>

D. BFSC 802 Physical Education (0+1)

The students will be evaluated for 100 marks. The course teacher will evaluate the performance and behavior of students in the classes and marks

<table>
<thead>
<tr>
<th>Particulars</th>
<th>Max. marks</th>
</tr>
</thead>
<tbody>
<tr>
<td>Attendance and routine activities</td>
<td>60</td>
</tr>
<tr>
<td>Behavior</td>
<td>15</td>
</tr>
<tr>
<td>Participation in tournaments</td>
<td>25</td>
</tr>
<tr>
<td>Total</td>
<td>100</td>
</tr>
</tbody>
</table>

E. BFSC 803 SWIMMING (0+1)

The students will be evaluated for 100 marks. The course teacher will evaluate the performance and behavior of students in the classes and marks
10. Mid seminar examination (MSE)

10.1 Writing the mid–semester examination is a prerequisite for writing the final theory and practical examinations. If a student does not appear for MSE, he/she is not eligible to appear for the final examinations. Such candidates have to reappear for the MSE and when the respective examinations are conducted only after getting permission from the Dean, Faculty of Marine Sciences on payment of fee prescribed by the University. MSE will be conducted by the Dean, Faculty of Marine Sciences. The answer scripts will be shown to the student after valuation, and returned to the course teacher. The paper in-charge will be responsible to ensure the distribution of answer papers to the students.

10.2 MSE marks awarded in a course will be added to the supplementary examinations also.

10.3 The MSE marks will be furnished to the Dean, Faculty of Marine Sciences through the course in-charge within 10 days after the conduct of MSE. If the student is not satisfied with the award of the marks, he/she shall appeal to the Dean, within three working days after the announcement of marks. The appeal will be considered and the results reviewed by a Cell consisting of the Dean and the Course in-charge concerned. The decision of the Review Cell shall be final. If the course in-charge himself is the course

<table>
<thead>
<tr>
<th>Particulars</th>
<th>Max. marks</th>
</tr>
</thead>
<tbody>
<tr>
<td>Attendance and routine activities</td>
<td>60</td>
</tr>
<tr>
<td>Behavior</td>
<td>10</td>
</tr>
<tr>
<td>Participation in Swimming, Kayaking &amp; Scuba diving</td>
<td>30</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>100</strong></td>
</tr>
</tbody>
</table>
teacher, one senior member of the department concerned shall be nominated by the Dean.

10.4 The MSE of theory will be two hours duration
For courses with both theory and practical, 20 marks will be apportioned as shown below.

<table>
<thead>
<tr>
<th>Marks</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>i) Fill up the blanks @ ½ marks for 10 questions</td>
<td>5</td>
</tr>
<tr>
<td>ii) True or False @ ½ marks for 10 questions</td>
<td>5</td>
</tr>
<tr>
<td>iii) Match the following @ ½ marks for 10 questions</td>
<td>5</td>
</tr>
<tr>
<td>iv) Choose the best answers @ ½ marks for 10 questions</td>
<td>5</td>
</tr>
<tr>
<td>v) Short notes @ 3 marks for 5 questions</td>
<td>15</td>
</tr>
<tr>
<td>vi) Short answer @ 5 marks for 3 questions out of 5</td>
<td>15</td>
</tr>
<tr>
<td>vii) Essay type @ 10 marks for 3 questions out of 5</td>
<td>30</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>80</strong></td>
</tr>
</tbody>
</table>

The above total marks of 80 to be converted into 20 marks will be apportioned.

10.5 If the student is not able to write the MSE due to deputation by the University he / she may be permitted to take up missing MSE. Such examination should be completed ordinarily within 15 working days after the respective MSE.

10.6 A student who fails to attend a mid-semester examination due to unavoidable circumstances shall be permitted with prior approval of the Dean to take up missing examination of the particulars course, on payment of fee prescribed by the University. Such tests should be completed ordinarily within 15 working days after the respective MSE.
11. Final examination

11.1 The final theory and practical examinations will be of two and three hours duration respectively.

11.2 Theory examinations will be conducted after practical examinations.

11.3 The question papers for the final theory examinations will be set by the external examiners.

The 80 marks will be apportioned as shown below

i) Fill up the blanks @ ½ marks for 10 questions 5
ii) True or False @ ½ marks for 10 questions 5
iii) Match the following @ ½ marks for 10 questions 5
iv) Choose the best answers @ ½ marks for 10 questions 5
v) Short notes @ 3 marks for 5 questions 15
vi) Short answer @ 5 marks for 3 questions out of 5 15
vii) Essay type @ 10 marks for 3 questions out of 5 30

Total 80

11.4 Central valuation of answer books will be done by examiners on the advice of the Chairman, Board of Examiners.

11.5 Practical Examination

Practical examinations will be conducted separately towards the end of each semester. Proper maintenance and regular submission of practical records are required. Those who do not bring with them the certified practical records will not be allowed to appear for the practical examination. The marks awarded for assignments shall be noted in the record, at the time of first appearance and will be taken into account for subsequent appearances. Such marks awarded by the examiner will be furnished to the Head of the Department.
11.6 Two examiners appointed by the University, nominated by Head of the Department and recommended by the Dean will conduct the practical examination.

12. **Re-appearance and improvement examination**

12.1 Re-appearance and improvement examinations are permitted only for the final theory and practical examinations (retaining marks obtained in mid-semester examination) at the time of regular semester examination only, after the payment of fee prescribed by the University. A student is permitted to write reappearance examination for the failed subjects only three times during n+4 years duration excluding the regular final examination. In the event of a student failing to secure a pass in the three re-examinations permitted, he/she has to reregister the course along with juniors.

12.2 A student who failed in a course (subject) or awarded EE can take up re-examination without undergoing regular classes. A student who has not fulfilled attendance requirement should repeat the course to earn attendance before he/she is permitted to proceed to the next semester.

12.3 The student having an OGPA of less than 5.50 only is eligible to improve the grade point only once in courses completed earlier in which he/had obtained grade point of less than 7.99. In case a student fails to secure higher grade point in the subsequent attempts, the higher grade point secured by the student either in regular or improvement examination will be accounted. Improvement and re-examination will not be allowed in courses with only practical and those who fail in these subjects shall have to repeat the course in the subsequent year/years.
12.4 Those who miss the study tours for any valid reason must undertake the tour along with juniors to complete the degree programme.

12.5 A continuing candidate cannot appear for more than six subjects in the reappearance examination at a time. The candidate who has completed the tenure of four years in the B.F.Sc. Degree Programme cannot appear for more than 16 subjects in the reappearance examination at a time.

12.6 The candidates for the reappearance examinations will submit their applications through the Dean, Faculty of Marine Sciences who will scrutinize the applications to ensure compliance of regulation 12.1 and 12.3. The attested copy of all grade sheets pertaining to the reappearance examinations should be enclosed along with the applications.

13. Malpractices in examinations

13.1 The Dean, Faculty of Marine Science shall be responsible for dealing all cases of unfair means by students in writing records, assignments and examinations.

13.2 The invigilator or the course teacher concerned shall report each case of unfair means with full details of the evidence and written explanation of the student concerned to the Dean immediately.

13.3 The Dean shall take appropriate steps on receipt of the report and the report will be sent to the Controller of Examinations for appropriate action as prescribed by the University.

14. Regulations of students conduct and discipline

14.1 Ragging Rules: Students found involved in ragging or in any other misconduct, or if a complaint is received from the affected student(s) to that effect, will be immediately expelled from the current
semester and the Dean shall further constitute a committee to probe and conduct enquiry into the matter and based on the report of the committee, the Dean shall forward the same to the Registrar to pass the final orders on merit of case within three working days.

14.2 **Unlawful Activities**: In case of students found involved in any unlawful activities either within or outside the Hostel/College Campus, besides expulsion both from the Hostel and College, at the discretion of the Dean with the knowledge of the Registrar, the matter will be reported to the Police of the jurisdiction to be dealt with in accordance with the appropriate law in force.

14.3 **Ragging – An offence**

Extract of Tamil Nadu Government Gazette - Extra ordinary dt. 29.01.1997 (Tamil Nadu Prohibition of Ragging Act, 1997)

In this act, unless the context otherwise requires, “Ragging means display of noisy, disorderly conduct, doing any act which causes or is likely to cause physical or psychological harm or raises apprehension or fear or shame or embarrassment to a student in any educational Institution and includes: teasing, abusing or playing practical jokes on or causing hurt to such student or asking the student to so any act or perform something which such student will not, in the ordinary course willingly act or perform. Ragging within or outside any educational institution is prohibited.

Who ever directly or indirectly commits, participates in, abets or propagate “Ragging” within or outside any educational institution, shall be punished with imprisonment for a term which may extend to **two years** and shall also be liable to fine which may **extend to ten thousand rupees**.
Any student convicted of an offence under section 4 shall also be dismissed from the educational institution and such students shall not be admitted in any other educational institution.

Without prejudice to the foregoing provision, whenever any students complains of ragging to the head of an educational institution, or to any other person responsible for the management of the educational institution, such head of the educational institution or person responsible for the management of the educational institution shall inquire in to the same immediately and if found true shall suspend the students who has committed to offence from the educational institution.

On the recommendation of the Dean, Faculty of Marine Sciences, The Registrar will have full powers to punish any student who violates the rules by imposing a fine, suspension or expulsion for the punishment awarded.

These rules will be alerted or amended, and further rules may be added if necessary. All the rules for the time being in force should be observed by the students.

15. Award of Degree

The degree namely (B.F.Sc) shall be awarded during convocation under the seal of the University to the students who have successfully completed all the graduation requirement as detailed below.

The candidates should have undergo successfully the prescribed course of study in the University. They shall further be required to have completed and passed 169 course credits and shall have earned an overall grade point average (OGPA) of 5.50 out of 10 for all courses completed in BFSc degree programme. In addition to the above, students shall in the judgment of the Faculty, possess good conduct and character.
The University shall issue Provisional Certificate (PC) to the candidates after having passed all provisional examinations.

15.1 Class ranking
In calculation of class equivalent for OGPA the following classification shall be adopted

<table>
<thead>
<tr>
<th>OGPA</th>
<th>Division / Class</th>
</tr>
</thead>
<tbody>
<tr>
<td>8.00 and above</td>
<td>First with Distinction</td>
</tr>
<tr>
<td>7.00 – 7.99</td>
<td>First</td>
</tr>
<tr>
<td>6.00 – 6.99</td>
<td>Second</td>
</tr>
<tr>
<td>5.00 – 5.99</td>
<td>Pass</td>
</tr>
</tbody>
</table>

16. Transitory Regulations
Separate time table of course work under old semester system will be arranged by the H.D for students with attendance deficiency in a course/courses provided such course/courses are not currently offered due to the introduction of the revised syllabi with effect from the academic year 2015-2016.

The candidates under old semester system will, however, complete all the examinations with in a period of eight academic years from the year of admission.

17. Removal of difficulties
If any difficulty arises in giving effect to the provisions of these regulations based on the recommendations of the Dean, the Vice-Chancellor may issue necessary orders, which appear to him to be necessary or expedient for removing the difficulty.
Outcomes of the B.F.Sc. Programme

India has a long coastline of 7,515 km spanning from Kanyakumari (Cape Comorin) in the South to West Bengal in the North. Of this, Tamil Nadu has 1,100 km, encompassing various habitats like estuaries, wetlands, mangroves, coral reefs, etc. harbouring a plethora of marine microbial, floral and faunal diversity, including seaweed, shellfish and finfish resources which have direct and indirect values to humankind.

Knowledge outcomes of B.F.Sc. Programme

Broad knowledge/skill development in the following areas of Fisheries and Aquaculture sectors, will be imparted

1) Limnology and Oceanography
2) Modern taxonomy of shell and finfish (Molecular taxonomy)
3) Navigation
4) Swimming and SCUBA diving techniques
5) Crafts and gears used in the fisheries sector.
6) Application of statistics for fishery management.
7) Aquarium keeping and ornamental shrimp and finfish culture.
8) Legislations and Acts regarding the coastal regulation zone, Wild Life Protection Act (1974), Biodiversity conservation, clean coastal environment, etc.
9) Socio-economic status, Government support/schemes for developing entrepreneurship.
10) New technology in preservation and processing of sea foods and value addition for marketing.
11) In plant training and fisheries industry interactions for students to create confidence for entrepreneurship.
12) Progression of B.F.Sc. students to PG and the research programmes in various national and international institutions.
Further, catering to the increasing demand of manpower will be produced through the B.F.Sc., course offered by the CAS in Marine Biology and it will be a great fillip to the fisheries sector, for promotions blue economy. Moreover, the growing demand of manpower in the Aquaculture sector could be met through this course, in addition to the seafood processing industry.

The Human resource developed through this course can help impart training on various capture and culture techniques to the local fisherfolk, thereby livelihood enhancement of the marginal coastal communities, in addition to prepare the fisherfolk for climate change adaptation through alternate livelihood options such as seaweed and ornamental fish culture.

More importantly, the graduates produced by this course are employable in the fisheries sector, in various capacities in different state, national, regional and international institutions and also private sectors, related to fisheries, aquaculture and sustainable coastal environment. These graduates an also became entrepreneurs in these sectors, providing with employment opportunities to the local people.

I. CURRICULUM

1. NORMS:

(1) Degree Nomenclature
   B.F.Sc.: Bachelor of Fisheries Sciences
(2) System of Education
   Formal Education with Semester System
(3) Program Duration
   8 Semesters (4 Academic Years)
(4) Maximum Permissible Course Work Load
   24 Evaluated Credits per semester
(5) Course Curriculum and Credits Requirement
   The total credit requirement for the undergraduate degree programme shall be 166 credits
<table>
<thead>
<tr>
<th>Course Code</th>
<th>Semester/Course title</th>
<th>Credit hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>BFSC 101</td>
<td>Taxonomy of Finfish</td>
<td>3 (1+2)</td>
</tr>
<tr>
<td>BFSC 102</td>
<td>Biology of finfish and Shellfish</td>
<td>3 (2+1)</td>
</tr>
<tr>
<td>BFSC 103</td>
<td>Fundamentals of Microbiology</td>
<td>3 (2+1)</td>
</tr>
<tr>
<td>BFSC 104</td>
<td>Fisheries Statistics</td>
<td>2 (1+1)</td>
</tr>
<tr>
<td>BFSC 105</td>
<td>Information and Communication Technology</td>
<td>2 (1+1)</td>
</tr>
<tr>
<td>BFSC 106</td>
<td>Freshwater Aquaculture</td>
<td>3 (2+1)</td>
</tr>
<tr>
<td>BFSC 107</td>
<td>Soil and Water Chemistry</td>
<td>3 (1+2)</td>
</tr>
<tr>
<td>BFSC 108</td>
<td>Aquatic Ecology and Biodiversity</td>
<td>3 (2+1)</td>
</tr>
<tr>
<td>BFSE 109</td>
<td>Physical Education (Non Credit Compulsory)</td>
<td>1 (0 + 1)</td>
</tr>
<tr>
<td>BFSC 201</td>
<td>Taxonomy of Shellfish</td>
<td>3 (1+2)</td>
</tr>
<tr>
<td>BFSC 202</td>
<td>Anatomy of Finfish and Shellfish</td>
<td>3 (2+1)</td>
</tr>
<tr>
<td>BFSC 203</td>
<td>Limnology</td>
<td>3 (2+1)</td>
</tr>
<tr>
<td>BFSC 204</td>
<td>Marine Biology</td>
<td>3 (2+1)</td>
</tr>
<tr>
<td>BFSC 205</td>
<td>Fish Nutrition and Food Technology</td>
<td>3 (2+1)</td>
</tr>
<tr>
<td>BFSC 206</td>
<td>Culture of fish food organisms</td>
<td>2 (1+1)</td>
</tr>
<tr>
<td>BFSC 207</td>
<td>Aquaculture Engineering</td>
<td>3 (2+1)</td>
</tr>
<tr>
<td>BFSC 208</td>
<td>Principles of Biochemistry</td>
<td>3 (2+1)</td>
</tr>
<tr>
<td>BFSE 209</td>
<td>Swimming (Non-credit Compulsory)</td>
<td>1(0+1)</td>
</tr>
<tr>
<td>BFSC 301</td>
<td>Physiology of Finfish and shellfish</td>
<td>3 (2+1)</td>
</tr>
<tr>
<td>BFSC 302</td>
<td>Ornamental Fish Production and Management</td>
<td>2 (1+1)</td>
</tr>
<tr>
<td>BFSC 303</td>
<td>Fish Genetics and breeding</td>
<td>2 (1+1)</td>
</tr>
<tr>
<td>BFSC 304</td>
<td>Oceanography and Meteorology</td>
<td>3 (2+1)</td>
</tr>
<tr>
<td>BFSC 305</td>
<td>Food Chemistry and fish nutrition</td>
<td>2 (1+1)</td>
</tr>
<tr>
<td>BFSC 306</td>
<td>Fish Canning and Packaging Technology</td>
<td>3 (1+2)</td>
</tr>
<tr>
<td>BFSC 307</td>
<td>Biochemical Techniques and Instrumentation</td>
<td>3 (1+2)</td>
</tr>
<tr>
<td>BFSE 308</td>
<td>Introduction to Environment Sciences (Audit Course compulsory)</td>
<td>3 (3 + 0)</td>
</tr>
<tr>
<td>BFSC 309</td>
<td>Communication Skills (Non Credit Compulsory)</td>
<td>1 (0 + 1)</td>
</tr>
<tr>
<td>BFSC 401</td>
<td>Inland and Marine Fisheries</td>
<td>3 (2+1)</td>
</tr>
<tr>
<td>BFSC 402</td>
<td>Microbiology of fish and fishery products</td>
<td>2 (1+1)</td>
</tr>
<tr>
<td>BFSC 403</td>
<td>Fish Products and by products Technology</td>
<td>4 (2 + 2)</td>
</tr>
<tr>
<td>BFSC 404</td>
<td>Pharmacology</td>
<td>3 (2 + 1)</td>
</tr>
<tr>
<td>BFSC 405</td>
<td>Freshwater Finfish and shellfish breeding and hatchery Management</td>
<td>3 (2 + 1)</td>
</tr>
<tr>
<td>Code</td>
<td>Course Title</td>
<td>Credits</td>
</tr>
<tr>
<td>--------</td>
<td>--------------------------------------------------</td>
<td>---------</td>
</tr>
<tr>
<td>BFSC 406</td>
<td>Fish Gear Technology</td>
<td>3 (2 + 1)</td>
</tr>
<tr>
<td>BFSC 407</td>
<td>Fisheries economics</td>
<td>3 (2 + 1)</td>
</tr>
<tr>
<td>BFSC 408</td>
<td>Disaster Management in Fisheries</td>
<td>1 (1 + 0)</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td></td>
<td><strong>22 (14 + 8)</strong></td>
</tr>
<tr>
<td>BFSE 409</td>
<td>Rural Sociology and Psychology (Non-credit Compulsory)</td>
<td>1(0+1)</td>
</tr>
</tbody>
</table>

**V Semester**

<table>
<thead>
<tr>
<th>Code</th>
<th>Course Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>BFSC 501</td>
<td>Coastal Aquaculture and Mariculture</td>
<td>3 (2+1)</td>
</tr>
<tr>
<td>BFSC 502</td>
<td>Marine Finfish and Shellfish breeding and hatchery management</td>
<td>3 (2+1)</td>
</tr>
<tr>
<td>BFSC 503</td>
<td>Fish diseases and Management</td>
<td>4 (2+2)</td>
</tr>
<tr>
<td>BFSC 504</td>
<td>Fisheries Marketing and Finance</td>
<td>3 (2+1)</td>
</tr>
<tr>
<td>BFSC 505</td>
<td>Fishing Craft Technology</td>
<td>2 (1+1)</td>
</tr>
<tr>
<td>BFSC 506</td>
<td>Navigation and Seamanship</td>
<td>2 (1+1)</td>
</tr>
<tr>
<td>BFSC 507</td>
<td>Fish population dynamics and stock assessment</td>
<td>3 (2+1)</td>
</tr>
<tr>
<td>BFSC 508</td>
<td>Fisheries Administration and Legislation</td>
<td>2 (2+0)</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td></td>
<td><strong>22 (14 + 8)</strong></td>
</tr>
<tr>
<td>BFSE 509</td>
<td>First aid training (Non-credit compulsory)</td>
<td>1 (0 + 1)</td>
</tr>
</tbody>
</table>

**VI Semester**

<table>
<thead>
<tr>
<th>Code</th>
<th>Course Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>BFSC 601</td>
<td>Fish quality assurance</td>
<td>2 (1+1)</td>
</tr>
<tr>
<td>BFSC 602</td>
<td>Fish freezing Technology</td>
<td>3 (2+1)</td>
</tr>
<tr>
<td>BFSC 603</td>
<td>Fisheries Biotechnology and bioinformatics</td>
<td>2 (1+1)</td>
</tr>
<tr>
<td>BFSC 604</td>
<td>Refrigeration and Equipment Engineering</td>
<td>3 (2+1)</td>
</tr>
<tr>
<td>BFSC 605</td>
<td>Introduction to fish Business Management</td>
<td>2 (1+1)</td>
</tr>
<tr>
<td>BFSC 606</td>
<td>Toxicology</td>
<td>2 (1+1)</td>
</tr>
<tr>
<td>BFSC 607</td>
<td>Chemotherapy and drugs in Aquaculture</td>
<td>2 (1+1)</td>
</tr>
<tr>
<td>BFSC 608</td>
<td>Aquatic Pollution and Coastal Zone Management</td>
<td>3 (2+1)</td>
</tr>
<tr>
<td>BFSC 609</td>
<td>Fisheries extension Education</td>
<td>3 (2+1)</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td></td>
<td><strong>22 (13 + 9)</strong></td>
</tr>
<tr>
<td>BFSE 610</td>
<td>All India Study Tour (Non-credit Compulsory)</td>
<td>1(0+1)</td>
</tr>
</tbody>
</table>

**VII Semester**

<table>
<thead>
<tr>
<th>Code</th>
<th>Course Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>BFSC 701</td>
<td>ELP in Aquafarming</td>
<td>10 (0+10)</td>
</tr>
<tr>
<td>BFSC 702</td>
<td>ELP in Fish Post Harvest Technology</td>
<td>10 (0+10)</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td></td>
<td><strong>20 (0 + 20)</strong></td>
</tr>
</tbody>
</table>

**VIII Semester**

<table>
<thead>
<tr>
<th>Code</th>
<th>Course Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>BFSC 801</td>
<td>In plant Training</td>
<td>20 (0 + 20)</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td></td>
<td><strong>20 (0 + 20)</strong></td>
</tr>
<tr>
<td><strong>Grand Total</strong></td>
<td></td>
<td><strong>169 (76 + 93)</strong></td>
</tr>
</tbody>
</table>
BFSC 101. TAXONOMY OF FINFISH (1+2)

THEORY

UNIT I

UNIT II
Major taxa of inland and marine fishes up to family level.

UNIT III
Commercially important freshwater fishes of India and their morphological characteristics.

UNIT IV
Commercially important marine fishes of India and their morphological characteristics.

UNIT V
Other important groups of aquatic vertebrates. Introduction of modern taxonomic tools : karyotaxonomy, protein analysis and DNA polymorphism.

PRACTICAL
Collection and identification of commercially important inland and marine fishes. Study of their external morphology.
and diagnostic features. Modern taxonomic tools - Protein analysis and electrophoretic studies; Karyotaxonomy - chromosome preparation and identification. DNA polymorphism; Visit to fish landing centres to identify commercially important fishes nd catch composition.

**TEXT BOOKS**


**REFERENCE BOOKS**

5. FAO, 2000. DNA Based Molecular Diagnostic Techniques.

**BFSC 102. BIOLOGY OF FINFISH AND SHELLFISH (2+1)**

**THEORY**

**UNIT I**

Food and feeding habits - Categories / classification of fish food - Fish food preferences - Major fish feeding types - Feeding adaptations in fishes - Detection of food by fishes - Feeding periodicity - Food and feeding habits of important finfish and shellfish species / groups.
UNIT II
Gut content analysis - Importance and limitations of gut content analysis - Feeding intensity - Methods of Gut Content Analysis.

UNIT III
Age and growth - Importance of studying age and growth in fishes - Growth model - Methods of age determination by using hard parts and by length frequency analysis.

UNIT IV
Reproductive biology - Different types / modes of reproduction in finfish and shellfish; primary and secondary sexual characters - Maturation and spawning - Different methods of estimation of fecundity - Various reproductive strategies - Parental care - Developmental stages in the life of finfish and shellfish species - General characteristics of eggs and larvae - Different types of eggs / larvae.

UNIT V
Marking and tagging techniques - Purpose of marking and tagging finfish and shellfish species - Group marking techniques - Individual external / internal marking techniques.

PRACTICAL

TEXT BOOKS

REFERENCE BOOKS

BFSC 103. FUNDAMENTALS OF MICROBIOLOGY (2+1)

THEORY
UNIT I
UNIT II

Microscopy - Light Microscopy - Bright field microscope
- Resolution of a microscope - Dark field Microscopy - Phase –
contrast microscopy - Fluorescence Microscope - Electron
Microscope, Sterilization and Disinfection - Red Heat - Dry Heat
- Moist Heat - Filtration – Radiation - Ultra – violet (UV)
radiation - Photodynamic sensitization - Ultrasonic and Sonic
waves - Freezing - Chemical sterilization - Disinfection. Stains
and Staining Reactions - Staining reactions - Simple staining -
Differential Staining - Gram Staining – Principle - Endospore
Staining, Microbial nutrition – Photoautotroph – photo-
heterotrophs - Chemoautotrophs - Chemoheterotrophs -
Chemical requirements - Organic growth factors - Physical
requirements of growth. Microbial growth - Generation Time -
The growth Curve - Continuous culture of microorganisms -
Synchronous culture - Culture Media - Quantification of
microorganisms / Measurement of cell numbers - Plating
techniques - Membrane Filtration Technique - Indirect methods.

UNIT III

Energy yielding reactions - Biochemical pathways of
energy production – Glycolysis - Pentose phosphate pathway –
Respiration - The Krebs cycle - Electron transport chain -
Summary of aerobic respiration - Summary of aerobic
respiration. Fermentation and Biosynthetic Pathways -
Biochemical Pathways of Energy Use ( Anabolism) - Bacterial
Photosynthesis. Enzymes - Enzyme Components - Mechanism
of Enzymatic Action - Factors Influencing Enzymatic Activity.
Microbial Genetics - Importance of microbial Genetics –
Mutation - Genetic recombination or Gene Transfer –
Transformation – Transduction - Transduction – Plasmids -
Protoplasts and Spheroplasts

UNIT IV

Microbial ecology – Symbiosis – Mutualism –
Syntrophism – Commensalism – Predation - Parasitism –
Ammensalism - Competition. Aquatic microbial groups -
Freshwater Microbiota - Estuarine microbiota - Marine

UNIT V

Immunology - General or Non specific host immune defence mechanisms - Characteristics of Immunoglobulin – Immunity - Immunological methods of detection of Microbial pathogens. Viral types and Diseases - Virus – Host Interactions - Viral interference and interferon - Control of viral infections. Pathogenicity and virulence - Diseases Classification - Portals of Entry: Transmission of infectious agents - Bacterial Human Diseases - Fungal human Diseases

PRACTICAL


TEXTBOOKS


REFERENCE BOOKS

BFSC 104. FISHERIES STATISTICS (1+1)

THEORY

UNIT I
Definition of statistics; Fisheries statistics, Basic concepts of population and sample, random sampling; Collection of data, census enumeration and sample surveys, their advantages and disadvantages, preparation of schedules and questionnaires.

UNIT II
Diagrammatic and graphical representation of data – bar diagrams, pie-diagram, histogram, frequency polygon, frequency curve and ogive.

UNIT III
Important measures of central tendency – arithmetic mean, median and mode, relative merits and demerits of these measures; Important measures of dispersion – range, mean deviation, variance and standard deviation, relative merits and demerits of these measures.
UNIT IV
Introduction to statistical inference, general principles of testing of hypothesis - types of errors. Tests of significance based on normal, t, chi-square and F distributions.

UNIT V
Bivariate data, scatter diagram, simple linear correlation, measure and properties; simple linear regression, equation and fitting; relation between correlation and regression. Length weight relationship in fishes; applications of linear regression in fisheries. Methodology for estimation of marine fish landings in India, Estimation of inland fish production in India and problems encountered.

PRACTICAL
Construction of questionnaires and schedules, presentation of data using different diagrams and graphs, computation of different measures of central tendency and dispersion of fisheries data. Test of hypothesis based on normal, t, chi-square and F distributions. Simple correlation and regression. Fitting of length-weight relationship in fishes.

TEXT BOOKS

REFERENCE BOOKS

BFSC 105. INFORMATION AND COMMUNICATION TECHNOLOGY (1+1)

THEORY

UNIT I


UNIT II

UNIT III


UNIT IV

Data communication networks - Stand-alone and communication modes – telecommunication – data communication — communication using modem - Computer networks: Local Area network, Wide Area Network, Metropolitan Area Network, intranet - Internet - Client-server networks - Peer-to-peer networks - Value-added networks - Network topologies: Hierarchical (or tree) topology - Linear bus (or horizontal) topology - Star topology - Ring (or hub) topology - Hybrid (or mesh) topology- Network Protocols and software - Network Applications: Bulletin board service (BBS) - Information services – Telecommuting -Teleconferencing - Workgroup computing - Electronic funds transfer (EFT) - Electronic data interchange (EDI) - Electronic commerce.

UNIT V


PRACTICAL

Exercises on binary number system, algorithm and flow chart; MS Word; MS Excel; MS Power Point; Internet applications: Web Browsing, Creation and operation of Email account; Analysis of fisheries data using MS Excel.
TEXT BOOKS

REFERENCE BOOKS

BFSC 106. FRESHWATER AQUACULTURE (2+1)

THEORY

UNIT I

UNIT II
fertilizers application method and schedule – culture of fish food organisms in pond system / water cultivation technique.

UNIT III
Selection criteria of quality seeds – transportation technique of fish seeds – Acclimatization of seeds – Traits of important cultivable fish and shellfish.

UNIT IV

UNIT V

PRACTICAL

TEXT BOOKS
REFERENCE BOOKS

BFSC 107. SOIL AND WATER CHEMISTRY (1+2)

THEORY

UNIT I

UNIT II
Water analysis: Collection and preservation of water samples. Measurement of temperature, transparency, turbidity, pH, electrical conductivity, salinity, chlorinity, total solids (TDS, TSS, TVS, TVDS); Determination of dissolved oxygen free CO2, total alkalinity, total hardness, calcium, magnesium, ammonia, nitrite, nitrate and phosphorus.

UNIT III
Soil characteristics: Soil origin, nature and formation of soils. Physical properties of soil: Soil texture, Soil structure, Soil colour, pore size, bulk density. water holding capacity; Soil types and their distribution. Chemical properties of soil: Soil
colloids, cation exchange, soil fertility and organic carbon: Nitrogen ratio; Soil reactions, soil acidity, soil alkalinity, conductivity, redox potential.

UNIT IV

**Submerged soils:** Peat soils, wet lands, fluxes between mud and water, methane and H2S, saline soils, alkaline soils, acid sulphate soils, iron pyrites and soil reclamation. **Soil and water amendments:** Amendments — lime, manure fertilizers, micronutrients, zeolites, alum, gypsum: environment amelioration — chlorination deodorizers, bacterial formulation

UNIT V

**Soil analysis:** Collection and preparation of soil samples: determination of soil texture, PH water holding capacity, conductivity: soil organic carbon, nitrogen, phosphorus lime requirement. **Soil and water quality criteria:** Soil and water quality criteria / requirement for aquaculture.

PRACTICAL


TEXT BOOKS

4. ICAR, 2006. Handbook of Fisheries and Aquaculture. ICAR.

REFERENCE BOOKS

BFSC 108. AQUATIC ECOLOGY AND BIODIVERSITY (2+1)

THEORY

UNIT I

UNIT II
Energy Environment; Energy flow, Concepts of Productivity; Measurement of primary productivity; Trophic
Levels, and Examples; Ecological Pyramids. Biogeochemical Cycles; Patterns and Basic types, cycling of organic nutrients; Pathways, Limiting factors and governing laws. Ecological Indicators.

UNIT III
Community Ecology; The biotic community, Ecological Dominance; community analysis; species diversity in communities; patterns in communities, ecotones, Population ecology; population group properties, population density and indices of relative abundance. Types of interaction – animal association- Symbiosis, commensalisms, parasitism, etc., Autoecology: Concepts of habitat and ecological Niche; Natural Selection; Artificial Selection.

UNIT IV

UNIT V

PRACTICAL
Visit to a lake, natural pond\estuaries\swamp\marsh\river\flood plain\reservoir and marine protected areas. Study of the habitat, biotic communities, and species diversity and their adaptive characters\associations. Visit to a mangrove forest, collection and identification of mangrove flora and
fauna. Visit to a rocky shore to study zonation and physico-chemical conditions. Collection and identification of Rocky shore flora and fauna. Visit to a sandy shore shore to study zonation and physico-chemical conditions. Collection and identification of sandy shore flora and fauna. Visit to a muddy shore to study zonation and physico-chemical conditions. Collection and identification of muddy shore flora and fauna. Visit to coral structures on the coast, collection and identification of Borers and Fouler organisms, assessment of the damages and appraisal of remedial measures. Visit to a marine park/sanctuary. Understanding the steps involved in protecting endangered habitats and species (Horse shoe crab, Marine turtles, sharks and marine mammals.)

**TEXT BOOKS**


**REFERENCE BOOKS**

II SEMESTER
BFSC 201. TAXONOMY OF SHELLFISH (1+2)

THEORY

UNIT I
Study of external morphology and meristic characteristics of crustacean.

UNIT II
Study of external morphology and meristic characteristics of Mollusca-Gastropoda, Monoplacophora, Amphineura.

UNIT III
Study of external morphology and meristic characteristics of Mollusca-Bivalvia, Cephalopod, Scaphopoda.

UNIT IV
Classification of crustacean up to the level of species with examples of commercially important species.

UNIT V
Classification of mollusca up to the level of species with examples of commercially important species.

PRACTICAL
Study of external morphology. Collection, preservation and identification of commercially important prawns, shrimps, crabs, lobsters, bivalves, gastropods, cephalopods from natural habitats. Field visits for collection and identification of commercially important shellfishes.

TEXT BOOKS

REFERENCE BOOK

BFSC 202. ANATOMY OF FINFISH AND SHELLFISH (2+1)

THEORY

UNIT I
External anatomy; Oral region and its associated structure; Digestive system and its associated glands - Cell structure, tissue and body organization - External anatomy of teleost; elasmobranch; crustacean (Eg. Palaemon prawn / penaeid shrimp), gastropod (Eg. Apple snail), bivalve (Eg. Freshwater mussel) and cephalopod (Eg. Cuttlefish) - Oral region and its associated structures; digestive system and associated digestive glands of teleost; elasmobranch; crustacean (Eg. Palaemon prawn / penaeid shrimp), gastropod (Eg. Apple snail), bivalve (Eg. Freshwater mussel) and cephalopod (Eg. Cuttlefish).

UNIT II
Circulatory System - Circulatory system of teleost; elasmobranch; crustacean (Eg. Palaemon prawn / penaeid shrimp), gastropod (Eg. Apple snail), bivalve (Eg. Freshwater mussel) and cephalopod (Eg. Cuttlefish).

UNIT III
Respiratory and Skeletal systems - Respiratory system of teleost; elasmobranch; crustacean (Eg. Palaemon prawn / penaeid shrimp), gastropod (Eg. Apple snail), bivalve (Eg. Freshwater mussel) and cephalopod (Eg. Cuttlefish) - Skeletal system of teleost / elasmobranch.
UNIT IV
Reproductive & Excretory systems (Urino-genital system) and Endocrine system - Reproductive and Excretory systems (Urino-genital system) of teleost; elasmobranch; crustacean (Eg. Palaemon prawn / penaeid shrimp), gastropod (Eg. Apple snail), bivalve (Eg. Freshwater mussel) and cephalopod (Eg. Cuttlefish) - Endocrine systems of teleost; elasmobranch; crustacean (Eg. Palaemon prawn / penaeid shrimp), gastropod (Eg. Apple snail), bivalve (Eg. Freshwater mussel) and cephalopod (Eg. Cuttlefish).

UNIT V
Nervous system and Sense organs - Nervous system of teleost; elasmobranch; crustacean (Eg. Palaemon prawn / penaeid shrimp), gastropod (Eg. Apple snail), bivalve (Eg. Freshwater mussel) and cephalopod (Eg. Cuttlefish) - Sense organs of teleost; elasmobranch; crustacean (Eg. Palaemon prawn / penaeid shrimp), gastropod (Eg. Apple snail), bivalve (Eg. Freshwater mussel) and cephalopod (Eg. Cuttlefish).

PRACTICAL
Dissection of different shellfishes and finfishes to understand their internal organs – digestive, respiratory, excretory, nervous, circulatory and skeletal systems and also on sensory organs. Structure of endocrine glands.

TEXT BOOKS

REFERENCE BOOKS
BFSC 203. LIMNOLOGY (2+1)

THEORY

UNIT I
Introduction – Definition, Division, History, Development of Limnology, Early freshwater investigation; Inland water – Types, Identities and distribution, Lotic and lentic environments and their dynamics; Ponds, lakes, streams, rivers; Lakes – Origin, size, depth, Lake margins; Diversity; Famous lakes of the world and India.

UNIT II
Nature of inland water environments – Physical conditions and related phenomena; Morphometry, Physical features of water; Pressure, Compressibility, Density; Mobility, Buoyancy, Movements of water; Surface film, Temperature; Light, Colour of water, Turbidity; Chemical conditions and related phenomena – Dissolved gases, Dissolved solids; Dissolved inorganic solids, Dissolved organic matter; Hydrogen ion concentration – Acidity, Alkalinity, Neutrality; Biological relations – Influence of physical and chemical conditions on living organisms in inland waters: Shoreline; Productive volume, flotation phenomena, Body form adjustments; Relations of organisms to movements of water, surface film relations, temperature relations, light relations; Relations of dissolved oxygen, relations of carbon dioxide; Relations of other dissolved gases – Methane, Hydrogen sulfide; Nitrogen, Ammonia, Carbon monoxide, Dissolved solids, other elements, dissolved organic matter etc..

UNIT III
Plankton - Planktonic organisms, Classifications of plankton; Distribution of plankton – General geographic distribution; Horizontal distribution, Vertical distribution; Seasonal changes of body form in planktonic organisms; Food of planktonic organisms, Primary productivity; Aquatic plants – Character, Classification, Zonation, Seasonal relations; Quantity produced, Chemical composition, Distribution in different waters, Limnological role.
UNIT IV
Nekton – Composition, Distribution, movements; Benthos – Classification of benthic regions, Periphyton, Zonation, Distribution of benthos; Quantitative and qualitative movements and migrations of benthos, Seasonal changes in benthos, Origin and performance of profundal bottom fauna; Biological productivity – Circulation of food material, classification of lakes based on productivity; Laws of minimum, Biotic potential and environmental resistance, Quantitative relations in a standing crop; Trophic dynamics, Successional phenomena, Indices of productivity in Lakes, Artificial enrichment

UNIT V
Lotic environments – Running waters in general, Physical conditions; Water movements, Temperature, Turbidity, Light, Classifications of lotic environments; Biological conditions, Productivity features of lotic environments, Influence of currents, Plant growths; Plankton, Nekton, Benthos, Temporary and head water streams, General ecological succession.

PRACTICAL
Morphometry of lakes, ponds and streams; Determination of physical characteristics of lentic water bodies; Determination of chemical characteristics of lentic water bodies; Determination of physical characteristics of lotic water bodies; Determination of chemical characteristics of lotic water bodies; Collection and identification of freshwater phytoplankton; Enumeration and biomass estimation of freshwater phytoplankton; Estimation of primary productivity in fresh water bodies; Collection and identification of freshwater zooplankton; Enumeration and biomass estimation of freshwater zooplankton; Collection and identification of benthos from lakes and ponds, streams, canals; Enumeration and biomass estimation of benthos from lakes, ponds, streams and canals; Collection and identification of aquatic plants from different freshwater bodies; Methodology for collection and identification of bacteria in freshwater bodies; Enumeration and biomass estimation of bacteria in freshwater bodies.
TEXT BOOKS

REFERENCE BOOKS

BFSC 204. MARINE BIOLOGY (2+1)

THEORY

UNIT I
Division of marine environment; General account of major groups of phytoplankton Classification of diatoms and their reproduction; Classification of dinoflagellates and their importance; Major zoo plankton groups.

UNIT II
Environmental factors affecting life in the ocean; Primary production and factors affecting primary production; Geographical and seasonal variation in plankton production; Marine food chains; Energy flow and food web, Marine food chains.
UNIT III
Vertical migration of zooplankton; Phytoplankton – Zooplankton relationship. Plankton and fisheries Benthos in rocky, sandy and muddy shore; Intertidal ecology- Introduction; Ecology of rocky intertidal zone; Ecology of sandy shore; Ecology of muddy shore; Mud banks.

UNIT IV
Mangroves; Seaweeds – classification and their uses; Coral reefs; Factors affecting coral reef distribution; Boring and fouling organisms; Nekton, outline - composition of nekton, habitats of nekton; Bioluminescence and indicator species; Red tides.

UNIT V
Biology, significance and classification in mammals; Adaptation in pinnipeds and cetaceans for breeding; Different communities of whales and their characteristic features; Adaptation in marine mammals for conserving body heat and submersion for long dive.

PRACTICAL
Study of common instruments used for collection of phytoplankton, zooplankton and benthos. Collection, preservation and analysis of phytoplankton, zooplankton, sea weeds, nekton and benthos.

TEXT BOOKS

REFERENCE BOOKS

BFSC 205. FISH NUTRITION AND FEED TECHNOLOGY (2+1)

THEORY
UNIT I

UNIT II

UNIT III
Different Forms of Feeds - Feeds based on life-cycle of fish- Product quality feeds- Larval feeds- Flakes- Farm-made
feeds - Feed additives - Binders - Antioxidants - Enzymes - Pigments - Growth promoters - Feed stimulants - Immunostimulants - Non-conventional feed ingredients and anti-nutritional factors - Digestive enzyme, digestibility and factors affecting digestibility - Protein digestion - Fat digestion - Carbohydrate Digestion - Microbial digestion - Factors affecting digestibility.

UNIT IV

UNIT V

PRACTICAL

REFERENCE BOOKS
BFSC 206. CULTURE OF FISH FOOD ORGANISMS (1+1)

THEORY

UNIT I
Candidate species of phytoplankton and zooplankton as live food organisms of fresh water and marine habitats.

UNIT II
Biology and culture of microalgae- blue green algae- spirulina -green algae-diatoms-flagellates- harvesting and processing.

UNIT III
Biology, reproduction and feeding habits of zooplankton, culture requirements of important live feed organisms- infusoria-rotifers-cladocerans-tubifex.

UNIT IV
Artemia- biology- ecological significance- culture for cyst- biomass production-Culture-use of salt pans for artemia culture.

UNIT V
Culture of chironomids-Culture of earthworms-Bait fish and forage fish- Tropic potentials- of different fish food organisms- proximate composition of fresh water and marine species of live feed.

PRACTICAL
Methods of isolation and identification of different live feed organisms - Laboratory scale culture (batch and continuous) of selected live feed organism - Evaluation of live feed organisms - Decapsulation technique and hatching method of brine shrimp cysts.

TEXT BOOKS

REFERENCE BOOKS

BFSC 207. AQUACULTURE ENGINEERING (2+1)

THEORY

UNIT I
Introduction to aquaculture engineering - Basics of the Aquaculture engineering – the need and the significance - Role of civil and mechanical engineering applications in aquaculture - Calculation and estimations –estimation of area and volume of different shapes.

UNIT II
Soil parameters, site selection and Surveying - Soil quality and its role in the success of the aquafarms - Soil
characters – their importance in the farming - Sampling methods and texture analysis. Classification of soil (based on particle size, chemical properties and biological nature) - Selection of a soil for aquafarm. Estimations and calculating earth work – ponds, dykes and other structures. Factors influencing the selection of sites for the coastal aquafarms. List of site selection criteria - How the individual criterion influences the selection? - Factors that can be rectified and overcome in the farm operation - Tide fed and pump fed farms - Other types of coastal fish farming – farm designing and construction aspects - Different types of surveying and their uses - Interpretation of survey data and preparation of topo sketch - Tools used for the survey and their technical details - Trapezoidal rule and Simpson’s rule.

UNIT III
Types of farms and their construction - Classification of farms - Based on source water - type of organism - method of culture - management aspects. Different models of aquafarms. (Coastal, freshwater, intensive and open water farms) - Coastal farms and seafarms - Semi-intensive and intensive farm designs. Cage and pen designs. Designing and construction of freshwater fish farms - Different structures in the farm (primary and secondary) - Positioning different structures - Bund classification - Designing of bund structures - Designing and construction of a complete farm - Location, designing and construction of hatcheries, race ways and nursery complexes - Different tanks- their design and construction.

UNIT IV
Water flow and control devices - Importance of water flow in aqua farms. Types of inlets and outlets = Design of sluices and gates - Merits and demerits of different water flow controlling devices. Water budgeting and distribution for aquafarms. How to calculate the water requirement for a fish farm? - Factors influencing the water volume in the farm - Types of pumps and their selection for aquafarm.
UNIT V

Mechanical units and Machineries - their application in farms - Water filtration devices and purification methods for aquafarms - Various filtration methods (Physical, chemical and biological methods) - Mechanical filtration devices - Filtration processes in the farm - Water transportation structures in an aquafarm. Their design and construction - Importance of drain canals and drainage systems - Merits and demerits of different water transportation structures - Different pumps and their application in aqua farms - Types of pumps, principles and their use - Operation and maintenance aspects - Selection of pumps for the farms - Aerators, principles, classification and placement. Factors deciding the selection of aerators for the farm - Aeration process in aqua farm - Various types of aerators and their application in aqua farms - Operation, maintenance and placement of aerators – Considerations and implications.

PRACTICAL

Visit to aqua farms – Estimation of soil parameters – observation of soil qualities and seepage parameters - Contour survey and mappings - handling different valves – their operation – shutters and sluices - Designing of fresh and brackish water fin and shellfish farms - Designing of hatcheries - Estimation of construction parameters – determination of bund construction and other features of the ponds – Preparation of lay out of the farm - Cement and FRP nursery and hatchery units - Supply channel and drainage systems, gravitational flow – aerators – their operation and positioning - Estimations in the farm construction - Planning and designing of different farms.

TEXT BOOKS

REFERENCE BOOKS
   House.

BFSC 208. PRINCIPLES OF BIOCHEMISTRY (2+1)

THEORY

UNIT I

UNIT II

UNIT III
UNIT IV

Nucleic acid – Structure of nucleic acid – ribonucleic acid (RNA), transfer RNA (tRNA), messenger RNA (mRNA), ribosomal RNA (rRNA), difference between DNA and RNA. Recombinant DNA and genetic engineering. Transcription – genetic code, Translation/Protein synthesis – activation of tRNA, elongation, termination. Mutation.

UNIT V


PRACTICAL


TEXT BOOKS


REFERENCE BOOKS

III SEMESTER

BFSC 301. PHYSIOLOGY OF FINFISH AND SHELLFISH (2+1)

UNIT I
Physiology - introduction - The Hydrological Cycle or water cycle - Water as a habitat - Physical, chemical and biological properties - Biological Characteristics of water - Water as a major cell constituent.

UNIT II
UNIT III

Importance of reproductive physiological studies - Types of reproduction -Male reproductive system-Female reproductive system - Ovarian follicle - Oogenesis -Sexual differentiation -Maturation and spawning - Modes of reproduction -Hormonal control of reproduction -Life histories vary from the simple to the complex within the different groups of Crustacea-Hormones involved in reproduction and their sources transaction of external signal - Muscle physiology - Structure of various muscles -Smooth muscle or non striated muscle - Muscle metabolism and function -Composition and metabolism of dark and white muscle -Specialized muscles - Sound producing muscle - Sense organs - Introduction - Chemoreception -Electro-reception -Photoreception/vision - Pineal gland.

UNIT IV


UNIT V


PRACTICAL


TEXT BOOKS

REFERENCE BOOKS
BFSC 302. ORNAMENTAL FISH PRODUCTION AND MANAGEMENT (1+1)

THEORY

UNIT I
Introduction-Benefits of ornamental fish keeping as a hobby-Origin of keeping ornamental fishes as pets-Status of ornamental fish farming in India-Commercially important ornamental fishes - exotic species-Indigenous species-Marine Ornamental fishes.

UNIT II
Different types of fish tanks-Materials required for construction of tanks-Construction of all glass aquarium glass tank- Steps involved in setting up of aquarium-Equipments and accessories needed for small scale unit-Equipment and accessories needed by large scale ornamental fish production unit-Aerator- Filters- Types of Filter-Canister filter (external or internal type)-Trickle filter Resource-Submersible power filter (box filter / corner filter) - Uses of Aquatic plants-Types of plants- Important aquarium plants.

UNIT III

UNIT IV

UNIT V
Diseases of ornamental fishes- Bacterial diseases - Protozoan diseases- Fungal diseases- Parasitic diseases-
Selective breeding- Selection- Crossbreeding -Hormonal induction of sex reversal- Quarantine- Transportation of ornamental fish- Fish packaging system- Ornamental fish trade.

PRACTICAL
Identification of common ornamental fishes - Identification of common ornamental plants — Fabrication of all glass aquariums - Setting up of aquariums - Aquarium accessories and equipments - Conditioning and packing of ornamental fishes - Feed preparation – Culture of live food organisms- Breeding of live bearers - Breeding of egg layers - Identification of ornamental fish diseases.

TEXT BOOKS

REFERENCE BOOKS
BFSC 303. FISH GENETICS AND BREEDING (1+1)

THEORY

UNIT I
UNIT II


UNIT III


UNIT IV

Mutation - Migration - Selection - Small populations - Genetic drift - Consequences of random genetic drift - Change of gene frequency due to sampling - Quantitative genetics - Genetics of qualitative and quantitative phenotypes - Qualitative traits - Quantitative phenotypes - Correlated traits - Heritability - Properties of heritability - General combining ability - specific combining ability - Heterosis or hybrid vigour - Phenotypic value - Genotypic value - Environmental deviation - Average effect of gene - Breeding value.

UNIT V

PRACTICAL


TEXT BOOKS


REFERENCE BOOKS

BFSC 304. OCEANOGRAPHY AND METEOROLOGY (2+1)

THEORY

UNIT I
The earth and the ocean basin, distribution of water and land; relief of seafloor., Major feature of topography and terminology; major divisions. Relief in Indian oceans. ocean waves: Definition and terms, classification; difference between surface and long waves, wave theories, surface wave generation, spreading growth, Beaufort scale, spilling and breaking waves, long waves, Tsunamis, seiches, internal waves.

UNIT II
Ocean tides, definition, tidal phenomenon, elementary tidal definition, tidal inequalities; tide producing forces, types of tides, tidal bores, tide prediction. Ocean currents: definitions and features; measurements of currents; direct and indirect methods forces acting on sea waters, drift currents, Ekman spirals, upwelling, sinking, gradient currents, thermohaline circulation, characteristics; course; and significance of some major ocean currents of world, El Nino.

UNIT III
Physical properties of seawater, salinity and chlorinity, temperature, thermal properties of seawater, Colligative and other properties of seawater; Residence time of constituents in seawater. Properties of sea ice; transmission of sound; absorption of radiation; eddy conductivity; diffusivity and viscosity. General distribution of temperature, salinity and density; salinity and temperature of surface layer (SST), subsurface; distribution of temperature and salinity; The T-S diagram; water masses of Indian oceans.

UNIT IV
Chemistry of seawater: Constancy and composition; elements present in seawater; artificial seawater; dissolved gasses in seawater, CO2 system and alkalinity; inorganic
agencies affecting composition of seawater, distribution of phosphorus, nitrogen compounds, silicates and manganese in the oceans, factors influencing their distribution.

UNIT V

Nature of atmosphere, process of water cycle in the atmosphere, tropical cyclones-Hurricanes, hurricane warning.

PRACTICAL

Operation of oceanographic instruments, Nansen reversing water sampler, Bathy thermograph, Grabs, corers, current meters, tidal gauges, echo-sounder. Determination of DO, COD, Alkalinity, nitrates, phosphates and silicates in seawater.

TEXT BOOKS


REFERENCE BOOKS

BFSC 305. FOOD CHEMISTRY AND FISH IN NUTRITION  
(1+1)

THEORY

UNIT I

UNIT II

UNIT III

UNIT IV
Food additives – types and their chemical nature – enzymes, vitamins and amino acids, emulsifier, antimicrobial
additives, sequestrants, flavour enhancer, surface active compounds, non nutritive sweeteners, colour additives.

UNIT V

PRACTICAL

TEXT BOOKS

REFERENCE BOOKS

BFSC 306. FISH CANNING AND PACKAGING TECHNOLOGY (1+2)

THEORY

UNIT I

UNIT II
Thermal processing – heat resistance of microorganisms, heat penetration, graphical method of formulation. Fo-value.

UNIT III
Canning of commercially important fishes, shellfishes and other food products – salient features. Retort pouch packing – principles and techniques; HTST process and aseptic packing – principle and technique.

UNIT IV

UNIT V
Introduction to food packaging – objectives and requirements. Characteristics of various packaging materials – metals, paper and paper board, corrugated fibreboard, plastics, multiplayer and testing of packaging materials and containers.

PRACTICAL

TEXT BOOKS
BFSC 307. BIOCHEMICAL TECHNIQUES AND INSTRUMENTATION (1+2)

THEORY

UNIT I

Principles and applications of Spectrophotometry – UV-Vis spectrophotometer and its instrumentation.

UNIT II

Basic principles and applications of chromatographic techniques – LC - Gel filtration, Affinity chromatography, Ion exchange chromatography; Thin Layer Chromatography; Gas Chromatography; High Performance Liquid Chromatography.
UNIT III
ELISA – Components and Types - Direct, Indirect, Sandwich, Competitive; Radio isotopes - Radio Immuno Assay; Centrifugation – Types, Rotors - Ultracentrifugation.

UNIT IV
PCR – its components and application; Blotting- southern, northern, western techniques.

UNIT V
Plasmid isolation; Cell culture – Types and manipulations; Hybridoma technology; Cloning – Molecular, Cellular and Organism cloning.

PRACTICAL

TEXT BOOKS

REFERENCE BOOKS

IV SEMESTER
BFSC 401. INLAND AND MARINE FISHERIES (2+1)

UNIT I
Status of the Capture Fisheries of the World and India - Inland and Marine Environment - FAO’s Major fishing areas of the world - Major fish species composition of the major fishery regions of the world - World inland/marine capture fisheries production - Problems and management of world inland fisheries - Inland and marine capture fisheries resources in India - Potential of Indian EEZ - Status of inland/marine capture fisheries production in India.

UNIT II
Major inland fisheries in India - Riverine Fisheries in India - Ecology, classification and fish production potential of rivers in India - Fish and fisheries of Himalayan/peninsular riverine systems in India - Impacts of dams on riverine fisheries - Impact of inter-river basin linkages on fisheries - Reservoir fisheries in India - Ecology, classification and fish production potential of reservoirs in India - Fish and fisheries of major reservoirs in India - Natural vs Man-Made lakes fisheries - Estuarine/Brackish water lake/Backwater Fisheries in India - Fish and fisheries of estuaries of the east and west coast of India - Fish and fisheries of major brackish water lakes and backwaters in India - Shellfish fisheries of brackish water bodies - Floodplain wetland fisheries in India - Ecology and classification of flood plain wetlands (Beels) of India - Fish and Fisheries of floodplain wetlands (Beels) in India - Cold water fisheries in India - Fish and fisheries of cold water bodies in India - Sport fisheries in India.
UNIT III
Major marine finfish fisheries in fisheries in India - Deep sea fisheries in India.

UNIT IV
Major marine shellfish fisheries in India. India - Pelagic fisheries in India - Demersal fisheries in India - Crustacean fisheries in India.

UNIT V
Conservation and management of capture fisheries resources in India - Introduction of exotic fish species and Impacts of exotic fish species on aquatic biodiversity in India - Conservation of inland and marine fisheries resources in India - Application of GIS and Remote sensing System in fisheries.

PRACTICAL
Visit to inland and marine fish landing centres; sampling, collection and familiarization of commercially important groups viz., marine and freshwater teleosts, elasmobranchs, crustaceans, molluscs and seaweeds; observation and analysis of marine catches by major crafts and gears; observation and analysis of species composition of commercial inland fish catches at landing and assembling centres; observation and experimental operations of selected fishing gears in inland / estuarine waters; Maintenance of records of marine and inland fish catch data; GIS and Remote Sensing in capture fishery.

TEXT BOOKS
REFERENC BOOKS

BFSC 402. MICROBIOLOGY OF FISH AND FISHERY PRODUCTS (1+1)

THEORY

UNIT I
Introduction - History of microorganisms in foods; Role and significance of microorganisms in foods.

UNIT II
Parameters affecting microbial growth - intrinsic parameters and extrinsic parameters.

UNIT III

UNIT IV

UNIT V
Other biological hazards like mycotoxins, parasites, viruses, marine toxins, etc. Faecal indicator organisms – Faecal coliforms, Faecal streptococci.
UNIT VI

Study of microorganisms in food by conventional and rapid techniques; Encapsulation – endospores, formation of cell aggregates.

PRACTICAL


TEXT BOOKS


REFERENCE BOOKS

BFSC 403. FISH PRODUCTS AND BY-PRODUCTS TECHNOLOGY (2+2)

THEORY

UNIT I


UNIT II

Fish preservation by smoking- chemical composition of wood smoke and their role in preservation. Methods of smoking and equipments used for smoking. Carcinogenic compound in wood and methods to remove them. Hurdle
technology in fish preservation and processing. Marinaded and fermented fish products – role of acids in marinades.

**UNIT III**

Fish and prawn pickles, fish sauce and fish paste, traditional Indian fermented products. Principles and methods of preparation of various fish paste products like fish sausage, fish ham, surimi, fish cake, kamaboko etc. Fish muscle structure, myofibriller protein and their role in elasticity formation. Extruded products – theory of extrusion, equipments used, advantages of extruded products, methods of preparation of extruded products.

**UNIT IV**

Fish meal and oil. Dry reduction and wet reduction methods. Fish maws, shark leather, chitin, chitosan, fish glue, fish gelatin, isinglass, pearl essence, shark fin rays, beach demer. Utilization of seaweeds - agar agar, alginin, carrageenan.

**UNIT V**

Fish protein concentrate. Fish hydrolysate, partially hydrolysed and deodorised fish meat, functional fish protein concentrate and their incorporation to various products. Diversified fish products: battered and braided products – fish finger, fish cutlet, fish wafer and fish soup powder etc and imitation products. Value addition, HACCP in safe products production.

**PRACTICAL**

Preparation of diversified and value added fish products - preparation of prawn & fish pickles - preparation of surimi and surimi based products.

TEXT BOOKS

REFERENCE BOOKS

BFSC 404. PHARMACOLOGY (2+1)

THEORY
UNIT I
Introduction to pharmacology, pharmacological terms and definitions, sources of drugs. Introduction to considerations for appropriate use of drugs. Drug laws and regulations. Drug delivery routes and methods of application. Water area and dosage calculation. Storage and shelf life of drugs.
UNIT II

UNIT III
Pharmacodynamics, concept of drug receptor, Receptors and drug-receptor interactions Quantitative aspects of drug-receptor interactions dose response relationship, (the dose-response curve), half-life and withdrawal period, threshold dose, therapeutic dose, maximal dose, toxic dose and lethal dose, factors affecting drug effect and dosage, principles of drug safety in terms of species and environment, efficacy of drugs. Factors affecting membrane transport of drugs Partitioning and transformations of drugs/chemicals in aquatic environment.

UNIT IV
Systemic pharmacology, Drugs acting on nervous system; anesthetics. Drug interactions, molecular mechanisms of drug action. Adverse effects of drugs, antibiotics residues. Recent advances in Pharmacology, Role of Biostatics, Pharmaceutical Industry, Drugs used in fish transportation.

PRACTICAL
Antibiotic residual assays; Studies on histopathological changes caused due to chemotherapy. Bioassays for clinical evaluation of drugs. Important anesthetics and their mode of action.

TEXT BOOKS
BFSC 405. FRESHWATER FINFISH AND SHELLFISH BREEDING AND HATCHERY MANAGEMENT (2+1)

THEORY

UNIT I

Freshwater fish seed resources of the world – freshwater finfish seed resources of India – Freshwater fish seed resources potential and present production in Tamil Nadu – Natural breeding of finfish in freshwater ecosystems – Monsoon and breeding of finfish – Types of breeding in finfish & shellfish. Selection of riverine spawn collection sites – gears used for collection of finfish & shellfish spawn – Method for temporary storage of collected spawn – spawn quality and quantity indices – Advantages and disadvantages of wild seed collection from rivers.

UNIT II

Seed maturity and breeding season of various cultivable freshwater finfish & shellfish species – gonadal stages – gonad development and gamete development in male and female fish – Type of fish eggs and embryonic development
UNIT III
Methods of breeding of cultivable freshwater finfish & shellfish– Bundh breeding – Wet and dry bundh – Collection of eggs and hatching in bundh breeding – Factors influencing bundh breeding – Advantages and disadvantages of bundh breeding.

UNIT IV
Induced breeding of warm water cultivable finfish & shellfish species – Environmental factors affecting spawning and breeding – Hypophysation of fishes – Fish pituitary gland – its structure, collection, preservation and preparing of pituitary extract and injecting – Dosage calculation of pituitary extract and administration – Brood stoke management and transportation of brood fish – Synthetic hormones used for induced breeding of carps.

UNIT V

PRACTICAL
TEXT BOOKS

BFSC 406. FISHING GEAR TECHNOLOGY (2+1)

THEORY
UNIT I
Introduction; classification of fishing gears of world and India; Factors that determine selection of fishing gears. Gears used in relation to fish and fishing area; FAO classification of fishing gears and methods.

UNIT II
Types of gear material - Classification – natural and synthetic- yarns, twines, ropes – their properties and identification methods, meshes, Braiding, Netting – types of knots, knotless netting, braiding ropes, floated ropes. Yarn numbering system - Direct system, indirect system-Tex , Denier, Metric systems; inter conversions, Runnage; Twist in twines and ropes; effect of twist. - Care maintenance of fishing gears - Maintenance and storage of gears and gear materials-different preservation methods.

UNIT III
Shaping of webbing by braiding , baiting, All bar braiding-fly mesh- Shaping of webbing by cutting -tailoring, N
cut, T cut ; mounting of webbing – different methods, hanging coefficient, take up ratio; joining-assembling of nets.

UNIT IV

Accessories for fishing gear. Floats – buoys – materials, types, properties and buoyancy; Sinkers – types, materials, properties – negative buoyancy; bobbins, tickler chain; Wire ropes – wires, strands, cores – selection of wire ropes, breaking strength, specification, Thimbles, shackles, rings, Otter board, types-principle parts-G-links; Kelly’s eye, stopper link, butterfly, Hooks; types, materials, specification numbering system, jigs, spoon hooks.

UNIT V

Design, construction and operation of various fishing gears; Selection of materials for different fishing gears; Parts of a trawl net, purse seine, gill net and tuna long lines; Modern commercial fishing methods-Operation and classification of trawling, purse seining, lampara net fishing, gill netting, line fishing; light fishing, Squid jigging, electrical fishing- Selective fishing.

PRACTICAL

Handling of net braiding tools, making different knots, bends, hitches, net braiding using different knots- shaping, creasing, baiting, fly mesh tailoring – T-cuts, N-cuts, B-cuts. Calculations- joining of netting, lacing, seaming; Mounting methods, direct, indirect methods, related calculations-assembling of netting, mending of net, identification of synthetic and natural fibers twines, ropes, iron wares, fish hooks; Calculation of buoyancy, specification of ropes, wire ropes, rigging materials, methods. Seining, boat seines, beach seines, gill netting, drift set, trammel net fishing; Line fishing – pole and line, tuna long lines, squid jigging; Falling gear – cast nets; Lift nets, Chinese dip nets; Fishing experience in operation of traditional and modern fishing methods; Familiarization of various fishing accessories on board.
TEXT BOOKS

REFERENCE BOOKS

BFSC 407. FISHERIES ECONOMICS (2+1)

THEORY
UNIT I
Income and Cross – Types of elasticity of demand - Supply, supply schedule, supply curve, law of supply, supply function – Elasticity of supply – Types of elasticity of supply - Price – Market equilibrium price – Cob-web Theorem – Consumer’s surplus – Indifference curves.

UNIT II

UNIT III
Farm planning and budgeting: Definition, Objectives, Importance and Types – Farm credit proposals - appraisal techniques – Record keeping – Farm financial management: Basic accounting procedures, double entry and single entry, financial statement analysis for solvency and Liquidity - Profit and Loss account – Income and Expenditure statement - Classification of assets and liabilities – Balance sheet - Profit maximisation – Risk and uncertainty.

UNIT IV

UNIT V
Socio-economic aspects of fisherfolk: Importance and meaning – Definitions of gross and net disposable income and per capita income – Income distribution and Lorenz curve –
Consumption – Consumption function for a fisherman’s family
- Engel’s law – microfinance and SHG : Definition– women empowerment – Gender Equity - Livelihood development.

**PRACTICAL**
- Determination of market equilibrium for fish and fishery products, Estimation of price, income and cross elasticities, Determination of Break-even point for a Fisheries enterprise, Preparation of income statement, Preparation of Balance Sheet, Product curves, Production function analysis in capture fisheries, Production function analysis in culture fisheries, Preparation of enterprise budget.

**Field visit:**
- Data collection on economic analysis of capture fisheries, Data collection on economic analysis of culture fisheries, Estimation of Consumption expenditure for a fisherman’s family, Study on socio economic status of fisherfolk.

**TEXT BOOKS**

**REFERENCE BOOKS**
BFSC 408. DISASTER MANAGEMENT IN FISHERIES (1+0)

THEORY

UNIT I
Basic concepts - Basic concepts: Hazard, risk, vulnerability, disaster, capacity building. Multi-hazard and disaster vulnerability of India.

UNIT II
Various disasters - Types of natural and manmade hazards in fisheries and aquaculture - cyclones, floods, droughts, tsunami, El-nino, algal blooms, avalanches, pollution, habitat destruction, over fishing, introduction of exotic species, landslides, epidemics, loss of bio-diversity etc. Causes, characteristics and impact of various disasters.

UNIT III
Disaster Management strategies - Management strategies: pre-disaster, during disaster and post-disaster.
Pre-disaster: prevention, preparedness and mitigation; different ways of detecting and predicting disasters; early warning, communication and dissemination, community based disaster preparedness, structural and non-structural mitigation measures.

UNIT IV
Response and recovery systems - During disaster: response and recovery systems at national, state and local, coordination between different agencies, international best practices. Post-disaster: Methods for assessment of initial and long term damages, reconstruction and rehabilitation.

UNIT V
Agencies in disaster management - Prevalent national and global management practices in disaster management. Agencies involved in monitoring and early warnings at district, state, national and global levels. Sea safety and health.

REFERENCE BOOKS
8. Pardeep sahni, Alka dhameja, Uma medury (2010), Disaster mitigation: experiences and reflections, PHI learning (p) ltd.
14. Ministry of Home Affairs, GOI (2011) Disaster management in India

V SEMESTER
BFSC 501. COASTAL AQUACULTURE AND MARICULTURE (2+1)

THEORY

UNIT I

Global aquaculture production - Status of farming of selected species - Marine finfish, Crustaceans - Shrimps, spiny lobsters, Molluscs, Sea cucumbers, Sponges, Corals, Seaweeds. Resources for shore-based aquaculture and seafarming in India - Status of Coastal Aquaculture, Aquaculture Diversification Programmes, Major constraints, Diversification of Coastal Aquaculture. Seed resources of finfish and shellfish - Finfish
Seed Resources and Shellfish seed Resources. Traits of important cultivable species - Grey Mullets, Milkfish, Pearlspot, Asian seabass, Groupers, Snappers, Shrimps, Lobsters and Crabs.

UNIT II

UNIT III

UNIT IV
Shrimp Culture - List of commercially important penaeid shrimps - Culture systems - Characteristics of shrimp culture systems - Considerations and Site selection - Grow-out operations - Pond preparation - Selection of shrimp fry (post larvae) - Stocking - Feeding - Water quality management and Aeration and Harvesting. Mud Crab Culture - Culture methods.

UNIT V
Oyster Culture - Culture techniques - Oyster culture in India. Mussel Farming - Grow-out - Seed collection and Growth and production. Culture of Pearl Oysters - Biology - Culture of Seaweeds - Main groups of algae cultivated for food - Culture systems.
PRACTICAL

TEXT BOOKS

REFERENCE BOOKS

BFSC 502. MARINE FINFISH AND SHELLFISH BREEDING AND HATCHERY MANAGEMENT (2+1)

THEORY
UNIT I
Introduction to breeding of marine finfish and shellfishes - Marine finfish and shellfish seed resources - Commercially important marine crustaceans and molluscs -
their breeding possibilities - Hormonal control of marine crustacean reproduction - Reproductive physiology of marine crustaceans, molluscs and Echinoderms - Natural breeding process and seed availability. Life cycle of Penaeids, Crabs, Lobsters and craw fishes - Life cycle of marine bivalves and gastropods - Life cycle of Holothurians and Seahorses - Sexual maturity and breeding season of different marine finfish and shellfishes - Natural habitats for marine finfish and shellfish seed collection - Collection methods for different marine finfish and shellfish seeds - Identification characters of different marine finfish and shellfish seeds at various stages.

UNIT II
Qualities of different marine finfish and shellfish brooders, identification of sex and health parameters - Collection methods and selection procedure for marine finfish and shellfish brooders - Transportation process and procedure to be followed during the transport of brooders - Captive brood stock development, nutrition and water quality issues in the brooder maintenance - Identification of maturity stages in marine finfish and shellfishes - Maturation diet and importance of live feed in the brooder development - Seasonal factors influencing brooders - Quarantine of the brooders and disinfection processes.

UNIT III
Site selection for the construction of the marine finfish and shellfish hatcheries - Designs and construction of hatcheries for different marine crustaceans - Different tanks, their specifications and utility for the seeds production - Brood stock inducing methods for shrimps, prawns and crabs - Eyestalk ablation techniques and protocols - Different larval rearing techniques for shrimps, prawns, crabs and lobsters - Estimation of hatchability, larval biomass and counting the larvae - Post larvae settlement, collection, segregation and rearing - Designs and construction of marine hatcheries for different molluscs and holothurians - Brood stock maintenance and different inducing methods for molluscs and holothurians - Different larval rearing techniques - Estimation of hatchability, larval biomass and post larvae settlement and segregation.
UNIT IV

Water quality issues for different marine finfish and shellfish species, their management and maintenance - Feeds, selection of feed and feeding management for different marine finfish and shellfishes - Live feed culture, different species of live feeds, their nutritive value and utility in marine finfish and shellfish larval rearing - Health management and different disease conditions in seed production of different marine finfish and shellfishes - Disinfection protocol in hatcheries and water filtration and treatment processes.

UNIT V

Genetic aspects and selective breeding in marine crustaceans - Genetic improvement and hybridization in marine crustacean breeding - Feed biotechnology and development of novel feeds for larvae - Economic analysis of various marine finfish and shellfish seed production techniques,

PRACTICAL

Collection of information on different marine finfish and shellfish seed resources (Penaeids, Panulurids, Crabs, Molluscs and Holothurians) - Collection of different marine finfish and shellfish seeds from natural waters. Identification of different marine finfish and shellfish seeds - Identification of different larval stages of marine finfish and shellfishes - Visit to shrimp hatchery - Visit to bivalve hatchery - Construction of biofilter - Identification of different live feeds used in the marine shellfish hatchery - Preparation of larval feeds and feeding - Different marine shellfish hatchery models and layout preparations - Preparation of Spirulina based feed for brood stock and larvae - Packing of marine finfish and shellfish seeds and transportation - Visit to live feed production unit in CMFRI - Observation of different disease conditions in brood stock and larvae - Artemia nauplii production and feeding for larvae - Experiments on enrichment of Artemia.
TEXT BOOKS

REFERENCE BOOKS

BFSC 503. FISH DISEASES AND MANAGEMENT (2+2)

THEORY

UNIT I
Significance of fish diseases in relation to aquaculture. Disease development process in fish and shellfish. Host, pathogen and environment interaction. Pathophysiology of fish diseases. Systematic pathology of fish and shellfish (integumentary system, respiratory system, circulatory system, digestive system, excretory system, nervous system, musculoskeletal system, reproductive system, endocrine system).
UNIT II

UNIT III

UNIT IV
Defence mechanism in finfish and shellfish- specific and non specific immune system. Role of stress and host defence mechanism in disease development. Principles and methods of vaccine production and fish immunization. Fish vaccines & delivery mechanisms.

UNIT V

PRACTICAL

**TEXT BOOKS**

**REFERENCE BOOKS**
5. Roberts, R.J., 2001. Fish Pathology. 3nd Ed. WB Saunders.
BFSC 504. FISHERIES MARKETING AND FINANCE (2+1)

UNIT I
Market and marketing: Definition – Approaches to the study of marketing: product, functional, participant and decision making – Classification of markets: based on location, time, position of sellers, volume of business transactions and competition – Market structure: product market, factor market – Marketing functions: exchange, physical supply and facilitating.

UNIT II

UNIT III

UNIT IV
Export markets: meaning and definition – Export and import procedures – Pattern and performance of fishery product
export from India – Trade liberalisation and fisheries exports – Role of MPEDA in fish and fishery product export development.

UNIT V
Fisheries credit – Classification and types based on repayment period – 3 R’s of credit – Credit requirements of fisherman – Sources of credit / finance: indigenous and institutional – Sources of institutional finance; commercial banks, regional rural banks, financial institutions of state and central.

PRACTICAL

TEXT BOOKS

REFERENCE BOOKS
BFSC 505. FISHING CRAFT TECHNOLOGY (1+1)

THEORY

UNIT I
Introduction: History & development of fishing crafts
Classification of fishing crafts based on fabrication, dimension, nature of fishing, depth of operation etc. Traditional fishing crafts of India- History & development of mechanization of fishing crafts.

UNIT II
Boat building materials- their preparation, seasoning, preservation & their advantages & disadvantages; Choice of construction material; comparison of mechanical properties; relative advantages and disadvantages.
Basic mathematics & Hydrostatics for designing of fishing vessels -Form co-efficient & proportionality ratios; Calculation of displacement, water plane area. Simpson’s rules-Design procedure: Displacement- weight equation; estimation of light weight ship.

UNIT III
Important terminologies of fishing vessel & related to fabrication; Drawing conventions in naval architecture; Deck layout – trawlers purse seiners, long liners, gill netters and combination fishing.

Boat construction methods
Construction of wooden boats steel boats, fiber glass boat, aluminum and Ferro-cement boat; Boat maintenance and common fouling and boring organisms.
Stability of fishing vessel

Longitudinal, transverse; various equilibrium of ships – stable, unstable and neutral; Resistance of boats.

UNIT IV


UNIT V


PRACTICAL

Study on Traditional crafts & various boat building materials. Introduction to engineering drawing: Lettering & dimensions; Projection & its styles. Simple projection & complex projection of an object; Drawing of traditional crafts: catamaran & Satpati, etc; Drawing of backbone assembly & U & V bottom hull of boat. Lines plan drawing of small fishing vessel: body plan, profile & half breadth plan; Drawing of deck lay outs of various fishing crafts: trawlers, gill netters, long liners, squid jiggers etc; Designing of fishing vessel from a parent vessel; Study of propeller & stern gear assembly. Study on marine fouler & borers; Visiting harbors, boat building yards & dry docking yard; Basic calculations on marine engineering – Diesel and Petrol engines; Two stroke and four stroke engines – IC engine – Parts of IC engines – various system of marine engines – study of starting system – fuel system – cooling system – lubrication system – propellers-Rudder assembly.
TEXT BOOKS

REFERENCE BOOKS

BFSC 506. NAVIGATION AND SEAMANSHIP (1+1)

THEORY

UNIT I
Introduction to Navigation and Seamanship
- Earth & its co-ordinates- Definition & importance of Equator, latitude, longitude, Great circle, small circle, Rhumb line.
- Distance & Direction in navigation. Rhumb line – Rules of the
Road – Rule No. 3 – General definitions, Rule No. 21, Lights Definition – Mast head light, side light, stern light, all rounds light, towing light, Rule No. 26, Rules for fishing vessels.

**Navigational Charts**
Map Vs chart – importance of charts – types of charts - Definitions of world chart, Ocean chart, coastal charts & Plan charts– chart projection – chart description – chart symbols and abbreviations – chart reading.

**UNIT II**

**Navigational Aids**

**UNIT III**

**Sounding Equipments & speed logs**
**Lead line:** Types – construction and Markings of lead line – operation.

**Echo sounder:** Working principle – Block diagram –Transducer – Transmitter – Receiver – Recorder / display unit – working of echo sounder – special features such as white line technique & Time Varied Gain (TVG) – Uses of Echo sounder in Fisheries.

**SONAR:** working principle – Block diagram – parts of SONAR – Uses of SONAR in Fisheries.

**Net Sonde / Trawl eye:** working principle – parts of Net sonde – uses in trawl net preparation.

**Speed logs:** PRM meter – patent log – ship / chip log – Doppler log –Pilot tube / hydrostatic log – Electromagnetic log –
impeller log – working principle – Advantages and disadvantages.

**GPS:** Global Positioning system – working principles – segments of GPS – Space segment, Ground controlling and monitoring segments & Receiving system – Operation and features of GPS – Advantages of GPS – Uses of GPS in Fisheries.

**Direction Finder:** working principle – parts – Advantages and Disadvantages.

**UNIT IV**

**Signals & Communication:** Navigational signals – Importance of signals – Types of signals – flag, sound, light, Distress signals – Day and Night signals for fishing vessels – Procedure for sending distress signals by Radio Telephony.

**Marine buoyage system:** Lateral Marks, cardinal marks, safe water marks, Isolated danger marks, New danger marks, VHF Marine communication system – working principle – importance – utility for fishing vessels.

**RADAR:** Working principle – Block diagram – parts – functioning – uses.

**Unit V: Sea safety and Seamanship**

**Fire Fighting** – Fire triangle – Types of Fire – Types of Fire extinguishers.


**Manning regulation in Fishing vessels Anchors** – Types & Anchoring, Mooring – Definition and methods Man over Board procedures – Methods Action during stranding Bad weather preparation & weather warning signals.

**PRACTICAL**

Chart reading – position fixing – chart symbols – Changing from true course to compass and from compass course to true course with or without wind; finding the course
to steer time required from and to given positions; Finding position reached after steering a given course and speed. To find the position of the vessel by the different methods and to find compass error and deviation by transit bearing of two shore objects. Magnetic compass – sextant; To study different types of knots and bends and their use at the sea; Operation of echo sounder, V.H.F. SONAR, Radar, Global Positioning System. Signals, Navigational lights – Flag signals, life saving appliances.

TEXT BOOKS

BFSC 507. FISH POPULATION DYNAMICS AND STOCK ASSESSMENT (2+1)

UNIT I

UNIT II

UNIT III
Estimation of total, fishing and natural mortality. Monte Carlo simulation model and ECO PATH model.

UNIT IV
The concept of yield, yield in number and yield in weight. Yield per recruit, yield curve. Yield models. The concept of Maximum Sustainable Yield and Maximum Economic Yield. Analytical models of fish stock.
UNIT V


PRACTICAL


TEXT BOOKS


REFERENCE BOOKS

BFSC 508. FISHERIES ADMINISTRATION AND LEGISLATION (2+0)

THEORY

UNIT I
Introduction to public administration – Definition – Principles and scope of Administration Public Enterprises – Importance and characteristics units of organisation and organisation chart.

UNIT II
Fisheries Division – Organisation chart – Centrally sponsored fisheries schemes – Ministries dealing Fisheries activities – State Fisheries Department : organisation chart and Implementation details of fisheries schemes – BFDA and FFDA activities.

UNIT III
National Fisheries Development Board- ICAR Institutes – Board – Institutes of Fisheries Division, Government of India – Coastal Aquaculture Authors – State Fisheries Corporation – Cooperative federation and societies.

UNIT IV
Fisheries resources and utilisation – Need for Fisheries legislation – Fisheries legislations - Indian Fisheries Act 1897 – Marine Fishing Regulation Act.

UNIT V

REFERENCE BOOKS


VI SEMESTER
BFSC 601. FISH QUALITY ASSURANCE (1+1)

THEORY

UNIT I

UNIT II
Spoilages and quality indices in chilled fish – microbial, enzymatic, non-enzymatic; Spoilages and quality indices in frozen fish – microbial, enzymatic, non-enzymatic; Spoilages and quality indices in canned and retort pouch processed fish – microbial, enzymatic, non-enzymatic; Spoilages and quality indices in cured fish (salted, dried and smoked) – microbial, enzymatic, non-enzymatic; Spoilages and quality indices in fermented fish and value added fish products – microbial, enzymatic, non-enzymatic...

UNIT III
Assessment of quality of fish and fishery products – sensory/ subjective, objective – physical - instrumental, chemical/ biochemical, microbiological, statistical methods

UNIT IV
Concept of Quality Management; TQM, GMP; HACCP; FSMS; Quality standards – National -BIS- EIC – FSSAI; International – ISO, USFDA, EU and Codex.

UNIT V
Process water quality; Fish plant sanitation- SSOP- SCP-GHP- Disinfectants, detergents and cleaning schedule. CIP; Waste management in fish processing industries.
PRACTICAL


TEXT BOOKS


REFERENCE BOOKS

BFSC 602. FISH FREEZING TECHNOLOGY (2+ 1)

THEORY

UNIT I
Introduction to freezing technology, characteristics of fish and shell fishes: structure and function of fish muscle-lipids, proteins, n – containing extractives, vitamins and minerals - changes in fish after death - changes in raw fresh fish - changes in eating quality - autolytic changes - autolysis and nucleotide catabolism - spoilage of fish, spoilage and pathogenic microorganism - native bacterial flora of fishes - factors that influence the growth of microorganisms.

UNIT II
Handling fresh fish; sanitation in processing plants; principles of low temperature preservation - chilling of fish – methods and equipment for chilling; icing – quality of ice, ice-making; block ice - flake ice - plate ice - tube ice - slurry ice in fish preservation - super chilling - advantages of chilling of fish with ice - chilled storage - storage method - bulking - shelving - boxing - refrigerated or chilled sea water; chilling rate; calculation of the ice requirement for cooling - heat requirements - calculation of the ice requirement for the storage of fish - spoilage of fish during chilled storage; use of antibiotics and chemicals - use of chlorine in fish processing - factor influencing sterilization of water by chlorine.
UNIT III
Freezing of fish – fundamental aspects; heat units; freezing point depression, eutectic point; freezing rate; methods of freezing; types of freezer - cryogenic, immersion freezing, calculation of freezer refrigeration load - freezing time - calculation of freezing times - physio-chemical changes that occurs during freezing – mechanism of ice-crystal formation; preparation of fish for freezing - freezing of fish freezing of prawns (shrimps) - freezing of lobsters, freezing of crab - freezing of cuttlefish and squid - product name - frozen cuttlefish - freezing process of tuna.

UNIT IV
Coding, packing and storage - changes that occur during frozen storage – microbiological, physical and chemical changes; protein denaturation, fat oxidation, dehydration, drip.

UNIT V
Protective treatments – polyphosphate, glazing, antioxidants, packaging; thawing of frozen fish – method of thawing - thawing in air - water thawing - thawing between heated plates – HACCP.

PRACTICAL
Sanitation and plant housekeeping; chilling and freezing equipment, instruments; packages and product styles; methods of icing fish; cooling rate; preservation by chilled sea water; freezing and thawing curves; freezing of different varieties of fish and shellfish; estimation of drip; determination of quality changes during frozen storage; inspection of frozen fishery products; visits to freezing plants.

TEXT BOOKS

**REFERENCE BOOKS**

**BFSC 603. FISHERIES BIOTECHNOLOGY AND BIOINFORMATICS (1+1)**

**THEORY**

**UNIT I**

UNIT II


UNIT III

Cell culture and Cell lines - Adherent cultures Resource - Suspension cultures - Types of cell culture - Primary cell culture - Continuous cell cultures - Commonly used media for fish cell culture - Requirements of cell culture - Preparation of fish for explants - Storage - Long-term storage - Application of fish cell cultures - Isolation and identification of fish viruses - Marine invertebrate tissue culture. Hybridoma Technology - Production of monoclonal antibodies - Application of Monoclonal Antibodies in Fish Farming - Specificity and commercial availability of monoclonal antibodies for use in aquaculture. Molecular Techniques - PCR: Principles and applications in Fisheries - Different versions of PCR - Applications of PCR - Molecular and Immunological

UNIT IV

UNIT V
Biofilters in aquaculture - Characteristics of real biofilters - Aquatic plant systems - Fluidized bed sand filters - Bead filters - Biodisks or RBC (Rotating Biological contractors) - Trickling filters - Submerged bed filters - Submerged filters. Biofertilizers - Potentials of Azolla - Application of Azolla in aquatic system - Cultivation of Azolla - Applications in fish farming – Probiotics - The use of probiotics in aquaculture - Probiotic preparation - Bacillus spp. - Saccharomyces cerevisiae - Safety and evaluation of probiotics - Prebiotics. Biosensor - Advantages (bioavailability, etc) and concept -

PRACTICAL
Isolation and quantification of DNA. Electrophoresis. ELISA, Immunodots, PCR, Western blot, immunofluorescence, immunoperoxidase, DNA hybridisation, Setting of biofilters, Bioprocessing of organic wastes. Practicals on genebank sequence database.

TEXT BOOKS

REFERENCE BOOKS

BFSC 604. REFRIGERATION AND EQUIPMENT ENGINEERING (2+1)

THEORY
UNIT I
construction of Fish processing plants – freezing plant currences, cold stores – Anteroom, Air lock. Ice Manufacturing Units – Block, Flake, tube and plate, ice.

UNIT II

Vapour Compression and vapour Absorption Refrigeration Systems.


Types of Compressors – Types of Condensers – Types of Expansions devices, Types of evaporators – oil accumulators and Driers.

UNIT III

Defrosting, Refrigerants and heat load

Methods of defrosting – Refrigerant charging.


Refrigeration – effect, efficiency, COP, Ton of Refrigeration, Heat load calculation.

Insulation Materials – Types – Properties – Advantages and disadvantages – Cork, Thermocole, PUF, Glass wool etc.

UNIT IV

Processing Machineries

Maintenance and safety aspects of fish processing equipment and Processing plants.

UNIT V
Fishing Vessel Machineries

Fishing Vessel general layouts - Power transmission system in fishing vessels – Gears, belt and chain systems.

Winches – Types and Working.

Deck Fittings and Fishing accessories – Net haulers, Line haulers, gurdy, power blocks, Fish pumps, Bilge pumping system.

Drives – Mechanical, Hydraulic, Pneumatic and Electrical Systems.

PRACTICAL
Graphically represented symbols used in refrigeration; Calculation on thermodynamics; temperature scale conversion; handling and operation of refrigerants, compressors, condensers, evaporators and expansion valves; defrosting in refrigeration system; Calculations on refrigeration effect and cooling estimate; Calculation on heat load, wall heat gain load and air change load; Studies on power transmission; Refrigeration machinery maintenance and safety precaution. Ice making and harvesting; Ice requirement calculation; Visit to a processing plant refrigeration unit; Conventional representation of common engineering component and features; Operation and maintenance of ice making machinery, canning machinery, fish products machinery and packing machinery. Study on different types of gallows. Visit to a fish products machinery and packing machinery; Study on different types of gallows. Visit to a fish processing unit to study the equipment used in different types of processing.

TEXT BOOKS

REFERENCE BOOKS
BFSC 605. INTRODUCTION TO FISH BUSINESS
MANAGEMENT (1+1)

THEORY
UNIT I

UNIT II

UNIT III

UNIT IV
Fisheries project – Definition – Project cycle – 5 stages – Project preparation criteria – Project appraisal and evaluation – undiscounted criteria – SRR and Pay back period – Discounted Criteria – NPV, BCR and IRR.

UNIT V
Fish business – Definition and objectives – Types of small business – Forms of business organizations – steps for starting a small scale business – business location, incentives, subsidies, sickness and insurance – business ethics.

PRACTICAL
Identification of fish business- Guidelines to start a small business- ratio analysis – project appraisal by discounted criteria - project appraisal by undiscounted criteria – Break –
even analysis of a small business-visit to successful fish business units- SWOT analysis of a business enterprise.

TEXT BOOKS

REFERENCE BOOKS

BFSC 606. TOXICOLOGY (1+1)

THEORY
UNIT I

General toxicology. Toxicity and metabolism: Factors influencing toxicity-environmental, genetic and nutritional; Measurement and evaluation of the ecological effects of toxicants; Metabolism of toxic substances by aquatic organisms - consequences, synergistic and antagonistic effects; Acute poisons and accumulative poisons; Bioaccumulation and
biomagnification; Systemic effects of toxic metals, pesticides and herbicides; Effect of select toxicants on aquatic life and detoxification. Toxicity of drugs.

UNIT II

Unit III
Genotoxicity; adaptation and inheritance. Mutagens and teratogens.

PRACTICAL
Toxicity evaluation of heavy metals on selected organisms by bioassay techniques; Estimation of LD50 and ED50. Demonstration of drug toxicity. Toxicity assessment of pesticides, PCBs and oil on selected organisms; Analysis of heavy metals from aquatic ecosystems; Toxicity testing methods.

REFERENCE BOOKS
BFSC 607. CHEMOTHERAPY AND DRUGS IN AQUACULTURE (1+1)

THEORY

UNIT I

UNIT II
Antibacterial agents: general principles, classification. Antibiotics of different classes, cell wall synthesis inhibitors, inhibitors of protein synthesis, Bacterial DNA gyrase and topoisomerase inhibitors and other miscellaneous antibiotics. (Sulfonamides, Fluoroquinolones, Metronidazole, Penicillins, Cephalosporins, Polypeptide and glycopeptide antibiotics, Aminoglycosides, Tetracyclines, Chloramphenicol & relatives, Macrolides, Nitrofurans). drug-resistance and environmental factors.
Antifungal agents, (Polyene antibiotics, Synthetics) antiprotozoan drugs and antihelmintics, Dyes.

UNIT IV
Antiseptics and disinfectants. Herbal formulations, Phytotigments, growth promoters Osmoprotectants.

UNIT V
Immunostimulants, vaccines probiotics and bioremediators – Principles, Mechanism of action, sources development of formulations. Steps in vaccine production and recent advances in vaccine research.

PRACTICAL
Antibiogram preparations; Pharmacy Preparation of different drugs, disinfectants and chemicals; Estimation of MIC
and MCC. Estimation of different antibiotics in water, blood and tissues. Experiments on withdrawal time from fish tissues.

**Suggested Readings:**

**BFSC 608. AQUATIC POLLUTION AND COASTAL ZONE MANAGEMENT (2+1)**

**THEORY**

**UNIT I**

**UNIT II**
Pesticide types and categories; inorganic pesticides, Organi-chlorine compounds, Organo-phosphorous compounds; Polychlorinated biphenyls (PCBs); Bioaccumulation and impact on aquatic fauna and human health; toxicology. Heavy metals: Interaction of heavy metals with water and aquatic organisms. Bioremediation and phytoremediation. Oil pollution; Crude oil and its fractions; Sources of oil pollution; Treatment of oil
spills at sea; Beach Cleaning; Toxicity of Petroleum Hydrocarbons; Ecological Impact of Oil pollution – Case studies.

UNIT III
Microbial pollution: Types of aquatic microbes; autotrophs and heterotrophs; saprotrophs and necrotrophs; Sewage Fungus Complex; Transmission of Human Pathogenic Organisms; Zoonosis; Development of Antibiotic Resistance and its impact; Biofilms and Biocorrosion; Radioactivity and background radiation of earth: Radionuclide polluting, special effects of radioactive pollution. Thermal pollution and its effects, Physical and chemical nature of possible effluents from major industries in India. Monitoring and control of pollution: Biological indicators of pollution.

UNIT IV
Environmental Impact Assessment for fisheries and aquaculture projects. Anthropogenic activities and their impact on coastal zones; aquaculture, waste disposal, property and infrastructure development, ports and shipping, tourism (beach and excavations, water supply projects. Goals and purposes of CZM. Management methods and information: public awareness and environment policy, general coastal zone programs, shore lands management, coastal water basin protection, coastal water quality protection, harvestable resources, and ecosystem restoration. Coastal Regulation Zone (CRZ) Act. Integrated Coastal Zone Management (ICZM). International treaties and conventions. Preparation of projects bases on the provided Guidelines and Standards for Coastal Projects aquaculture, agriculture, estuarine fold protection, sewage treatment systems, solid waste disposal, Urban run off, Power plants disasters, etc..

PRACTICAL
Physical characteristics of polluted waters; Colour, Odour, Turbidity, Determination of pH, salinity, alkalinity, hardness, BOD, COD, Hydrogen sulphide, Phosphates, Ammonia, Nitrates, Heavy metals and Oil and grease in water. Determination of pH, conductivity, organic carbon, nitrogen, phosphorus, heavy metals in sediments. Study of pathogenic

**TEXT BOOKS**


**REFERENCE BOOKS**

BFSC 609. FISHERIES EXTENSION EDUCATION (2+1)

THEORY

UNIT I
Introduction to extension education and fisheries extension – concepts, objectives and principles extension education-formal and informal education. History and role of fisheries extension in fisheries development.

UNIT II
Fisheries extension methods-individual, group and mass contact methods and their effectiveness Audio visual aids-definitions advantages and disadvantages Classification and choice of audio visual aids Cone of experiences of experiences and criteria for selection and evaluation of audio visual aids Video conferencing- factor influencing their selection and use.

UNIT III
Technology- Characteristics of technology, transfer of technology process. Important TOT Programmes in fisheries. Role of NGO’s and SHG’s in Fisheries. Fisheries co-management.

UNIT IV
Adoption and Diffusion of innovation-adopter categories and barriers in diffusion of fisheries innovations. Communication process-Berlo’s model and barriers to communication.

UNIT V
Extension programme planning and evaluation-steps and importance-participatory planning process. Basic concepts in rural sociology and psychology and their relevance in fisheries extension –social change-social control –social problems and conflicts in fisheries Gender issues in fisheries Theories of learning –learning experience –learning situation.
PRACTICAL


TEXT BOOKS


REFERENCE BOOKS

2. Scott, M., 2001. Distance Education and Distance Learning: A Framework for the Food and Agriculture Organization of the United Nations. Sustainable Development Department, FAO.

NON CREDIT COURSES (COMPULSORY)

BFSE 109. PHYSICAL EDUCATION (0+1)

Introduction to physical education: definition, scientific principles, objectives, scope, history, development and importance; physical culture, training and health; Fartlek training and Circuit training. Body mechanism and body type: Kretchmark’s and Sheldon’s classification. Theories of learning; Exercises for good posture; exercises to develop physical fitness -components, speed, strength, endurance, power, flexibility, agility, coordination and balance; Test and measurement in physical education: physical fitness test, motor fitness test, cardiovascular efficiency test and physical fitness index; aerobic and anaerobic exercises; Calisthenics, weight training, circuit training, interval training, far trek training, pressure training and resistance training; Importance of Asanas and Surya namaskar. Free hand exercises and Yoga. Recreation: definition, agencies promoting recreation, camping and recreation. Governance of sport in India; Conduct of sporting event, important national events; Drawing of fixtures and organisation tournaments; Rules and regulations, Coaching and skills development of major games; Rules and regulations, coaching and skills development of athletic events.

BFSE 209. SWIMMING (0+1)

History, hazards in water and safety precautions; pool maintenance and water quality control. Learning swimming, understanding and practice of ducking the head, kicking action, holding breath under water and various strokes (free style, breast stroke, butterfly, back stroke); competitive swimming-
relays and medleys, lap time practice, swimming and floating aids and their uses; diving - styles of diving, rules, regulations and precautions. Methods of life saving in water; Boating, canoeing and sailing: types, maintenance, skill development, rules and regulations and practice.

**BFSE 308. INTRODUCTION TO ENVIRONMENTAL SCIENCES**

(3+0)


**BFSE 309. COMMUNICATION SKILLS (0+1)**

Structural and functional grammar; meaning and process of communication, verbal and non-verbal communication; listening and note taking, writing skills, oral presentation skills; field diary and lab record; indexing, footnote and bibliographic procedures. Reading and comprehension of general and technical articles, précis writing, summarizing, abstracting; individual and group presentations, impromptu presentation, public speaking; Group discussion. Organising seminars and conferences.
BFSE 409. RURAL SOCIOLOGY AND PSYCHOLOGY (1+0)

Rural Sociology: meaning, scope and importance, features of rural society Anthropology, socio-economic and demography of fishers, migration and patterns of settlement Social groups and Social classes. Caste and Class among fishers. Value system - Norms, Customs among fishers and their importance. Social values and Culture among fishers and their importance. Village level institutions - meaning, types and role in fisheries development. voluntary organizations - meaning, types and role in fisheries development. Leadership – meaning, identification and training, qualities and roles of leaders and use of local leaders in fisheries development. Social change and Social control. Social problems and Conflicts in fisheries. Gender issues in fisheries. Psychology: concepts, principles, scope and importance in fisheries extension. Intelligence - meaning, scope, types and importance. Personality - meaning, scope, types and importance. Perception - meaning, scope, types and importance. Motivation - meaning, scope, types and importance. Learning, learning experience, learning situation.

BFSE 509. FIRST AID TRAINING (0+1)