

**COLLEGE OF FISHERIES SCIENCE
ACADEMIC REGULATIONS-2024
FOR
BACHELOR OF FISHERIES SCIENCE**

B.F.Sc. Degree Programme

**(As per Minimum Standards of Indian Council of Agricultural Research - Fifth
Deans' Committee)**



**U.P. Pandit Deen Dayal Upadhyaya Pashu Chikitsa
Vigyan Vishwavidyalaya Evam Go-Anusandhan
Sansthan (DUVASU), Mathura – 281 001 (UP)
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**U.P. Pandit Deen Dayal Upadhyaya Pashu Chikitsa Vigyan Vishwavidyalaya
Evam Go-Anusandhan Sansthan (DUVASU), Mathura – 281 001**



OFFICE OF THE DEAN
College of Fisheries Science
U.P.Pt. Deen Dayal Upadhyaya Pashu Chikitsa Vigyan Vishwavidyalaya
Evam Go Anusandhan Sansthan, Mathura. 281001



Dr. Nityanand Panday
Dean

PREFACE

The College of Fisheries Science has started first Academic Session 2024-25 for the Bachelor of Fisheries Science (B.F.Sc.) programme with seven departments. The College has equipped with the necessary facilities for teaching and research with an Instructional Fish and Fish Seed Production Farm. The Academic Regulations for four years B.F.Sc programme have been prepared in accordance of Minimum Standards of Indian Council of Agricultural Research-Fifth Deans' Committee. The Academic Regulations have been split into five parts covering the preliminary information about the course of study, admission to B.F.Sc programme, curriculum structure and organization of courses along with course contents. The document also outlines all the academic requirements that must be followed by the students.

The overwhelming efforts of Prof. Laxmi Prasad, Dr. Srinu R, Dr. Paramveer Singh, Dr. Mukta Singh, Mr. Ambrish Singh and Ms. Sakshee Maurya in compiling this document are very valuable. I am confident that the information available in this document would be of immense help to the students.

I express my sincere thanks to Professor (Dr) Arun Kumar Madan, Registrar for his guidance and valuable support for drafting and finalizing this document.

I express my sincere thanks to Professor (Dr) A. K. Srivastava, Hon'ble Vice-Chancellor, U.P. Pandit Deen Dayal Upadhyaya Pashu Chikitsa Vigyan Vishwavidyalaya Evam Go-Anusandhan Sansthan (DUVASU), Mathura whose leadership and visionary approach has enabled us to compile this document as Academic Regulation 2024- for B.F.Sc degree programme.

(Nityanand Pandey)

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Academic Regulation for B.F.Sc. Degree Programme-2024 of U.P. Pandit Deen Dayal Upadhyaya Pashu Chikitsa Vigyan Vishwavidyalaya Evam Go-Anusandhan Sansthan (DUVASU), Mathura, Uttar Pradesh

(I)	Sanction is accorded to implement the complete syllabus for the B.F.Sc. degree programme in accordance with the ICAR Fifth Deans' Committee Report with the recommendations and approval from Academic Council, DUVASU for the Academic year 2024-25 onwards
(II)	<p>(a) U.P. Pandit Deen Dayal Upadhyaya Pashu Chikitsa Vigyan Vishwavidyalaya Evam Go - Anusandhan Sansthan, Mathura Act, 2001</p> <p>(b) U.P. Pandit Deen Dayal Upadhyaya Pashu Chikitsa Vigyan Vishwavidyalaya Evam Go - Anusandhan Sansthan, Mathura Statutes, 2005</p> <p>(c) Academic Regulation for B.F.Sc. Degree Programme-2024 of U.P. Pandit Deen Dayal Upadhyaya Pashu Chikitsa Vigyan Vishwavidyalaya Evam Go-Anusandhan Sansthan, Mathura</p>

PART-I: PRELIMINARY	
1.	Short Title and Commencement:
(i)	These regulations may be called as “ The Academic Regulations for B.F.Sc. (Bachelor of Fisheries Science) Degree Programme (College of Fisheries Science) -2024 ” of ‘U.P. Pandit Deen Dayal Upadhyaya Pashu Chikitsa Vigyan Vishwavidyalaya Evam Go-Anusandhan Sansthan, Mathura for the award of B.F.Sc. Degree
(ii)	These Regulations are in accordance with the recommendations of Fifth Deans’ Committee of Indian Council of Agricultural Research (ICAR) for B.F.Sc. (Bachelor of Fisheries Science) Degree
(iii)	They shall come in force from the academic year 2024-2025 and shall be applicable to all the student’s getting admission from the year 2024-2025 and onwards
2.	Definitions: In these regulations unless the context otherwise requires:
(a)	“ Act ” means the DUVASU Act, 2001 and subsequent amendment/s made time to time
(b)	“ Advisor ” means an academic staff member who will help a group of the students assigned to him/her in planning of their studies and foster close personal relationship
(c)	“ Course ” means teaching units of a subject to be covered within a semester of a particular academic year as prescribed by the ICAR- Fifth Deans’ Committee in the syllabus of B.F.Sc. Degree
(d)	“ Course Content ” means a concise outline of the subject-matter of a Course
(e)	“ Credit Hour ” means the weekly unit of work recognized for a particular course as per the course catalogue issued by the University. A lecture class of one hour per week shall be counted as one credit whereas a practical class of two hours duration per week shall be counted as one credit
(f)	“ Credit load ” means the quantum of credits undertaken by a student in a semester
(g)	“ Credit Point (CP) ” in a course means the Grade Point (GP) multiplied by the credit hours
(h)	“ Dean ” means the Head of the ‘College of Fisheries Science’
(i)	“ Degree Course ” means the course of study in B.F.Sc. (Bachelor of Fisheries Science) Degree
(j)	“ Guidelines or Instructions ” means the guidelines or instructions issued by the ICAR from time to time for uniform implementation of these regulations

(k)	“Grade Point (GP)” in a course means the total marks obtained by a student in a course divided by 10
(l)	“Grade Point Average (GPA)” means the sum of total credit points scored divided by the sum of the credit hours in a respective semester
(m)	“Cumulative Grade Point Average (CGPA)” means the sum of total credit points scored divided by the sum of credit hours till a particular semester
(n)	“Overall Grade Point Average (OGPA)” means the quotient of the total credit points obtained by a student in all courses during the degree programme, divided by the total number of credit hours completed
(o)	“Head of the Department (HoD)” means the academic staff member principally responsible for teaching, research and extension education in the Department of the College
(p)	“In-charge of the department” means the academic staff member who is working as in-charge of the department and is responsible for teaching, research and extension activities of his/her department
(q)	“DUVASU Act, 2001” means the U.P. Pandit Deen Dayal Upadhyaya Pashu Chikitsa Vigyan Vishwavidyalaya Evam Go-Anusandhan Sansthan Act of 2001 and its amendment thereof
(r)	“Programme of the Study” means a series of coherent courses and related activities assigned to a student to meet the requirements of degree
(s)	“Qualifying Examinations” means Higher Secondary (10+2) or equivalent examination conducted by State or Central Board of Education
(t)	“Department” means a unit of teaching and/or research and/or extension education of the college/institute/ center
(u)	“Statute” means the statute made under the U.P. Pandit Deen Dayal Upadhyaya Pashu Chikitsa Vigyan Vishwavidyalaya Evam Go-Anusandhan Sansthan Act of 2001
(v)	“Student” means a candidate who is enrolled in College of Fisheries Science recognized by the University for receiving instructions for qualifying himself for B.F.Sc. degree
(w)	“Syllabus” and “curriculum” means the syllabus and curriculum for courses of study as specified by the ICAR-Fifth Deans’ Committee or any amendments thereof
(x)	“Teaching Experience” means the experience of teaching in the subject concerned in a recognized Fisheries college or provisionally recognized college of Fisheries Science or recognized Fisheries University after obtaining Post graduate qualification in the

	concerned/related subject
(y)	“University” means U.P. Pandit Deen Dayal Upadhyaya Pashu Chikitsa Vigyan Vishwavidyalaya Evam Go-Anusandhan Sansthan, Mathura
(z)	“Semester” means a term consisting of a minimum of 95 instructional days excluding the period of Semester-end Theory Examinations. Condensed semesters with less duration can be sanctioned by the Vice Chancellor based on the proposal from the Dean
(aa)	“Transcript” is the consolidated report of grade points indicating OGPA secured by the student, issued by the University
(ab)	“Student READY Programs (SRP)” means different activities for Rural Entrepreneurship Awareness Development Yojana (READY) , including In-Plant Training, Experiential Learning, Skill-Development, Rural Fisheries Work Experience (RFWE), Project Work, Seminar and Study Tour recommended by ICAR-Fifth Deans’ committee recommendations to the B.F.Sc. students
(ac)	“COE” means Controller of Examinations of the University, responsible for conduct of examination, result compilation and its declaration in consultation with Examination committee panel
Note	Words and expressions used in the Act, Statutes and Regulations and not defined in these Regulations shall have the meaning assigned to them in the Act, Statutes and Regulations as the case may be

PART-II: COURSE OF STUDY	
3.	Degree Course
3.1	A degree programme of B.F.Sc. (Bachelor of Fisheries Science) shall comprise of a course of study consisting of curriculum and syllabus specified by ICAR-Fifth Deans' Committee recommendations applied for four years B.F.Sc. degree including all types of Student READY (Rural Entrepreneurship Awareness Development Yojana) Programmes
3.2	<p>“Student READY Programme” has a total credit load of 40 credits in 2 semesters with following details:</p> <ul style="list-style-type: none"> • In-plant attachment 10 (0+10) credit hours • Rural Fisheries Work Experience Programme 8 (0+8) credit hours • Study Tour (in or outside State) 2 (0+2) credit hours • Experiential Learning Programme 12 (0+12) credit hours • Skill Development 5 (0+5) credit hours • Project work 2 (0+2) credit hours • Seminar 1 (0+1) credit hours
4.	Duration of B.F.Sc. (Bachelor of Fisheries Science) Programme
4.1	The minimum duration of B.F.Sc. degree programme shall be 4 years (8 semesters) . The maximum period allowed for completion of B.F.Sc. (Bachelor of Fisheries Science) degree programme shall be 6 years (12 semesters) . Semester I and II in the First Year of the Programme, Semesters III and IV in the Second Year and Semesters V and VI in the Third Year of the programme and Semesters VII and VIII in the Fourth Year of the Programme.
5.	Academic Calendar and Schedule for Semester
5.1	The Academic Calendar and schedule for semester will be notified by Dean, College of Fisheries Science as per approval by Academic Council from time to time.
5.2	The examinations shall be conducted as per the academic calendar.

PART-III: ADMISSION TO BACHELOR OF FISHERIES SCIENCE DEGREE PROGRAMME IN COLLEGE OF FISHERIES SCIENCE	
6.	Criteria for Admission: A candidate shall not be admitted to Bachelor of Fisheries Science (B.F.Sc.) degree programme unless:
6.1	He/she has fulfilled the age criteria as specified by the University from time to time.
6.2	He/she has passed the qualifying examinations as specified by the University from time to time.
6.3	Admission to B.F.Sc. degree Programme shall be made based on the Undergraduate Entrance Examination (UGEE) by the University and amendments thereof.
6.4	The number of seats for admission to the B.F.Sc. degree programme shall be as per University norms.
7.	Selection of Students
7.1	The selection of the students for admission to Bachelor of Fisheries Science (B.F.Sc.) degree programme in the University shall only be based on merit through UGEE.
7.2	To be eligible for UGEE, a candidate has to pass any of the qualifying examinations as enumerated in the prospectus of University in respective years.
7.3	The qualifying student must appear for the counselling as per the notification by the University and according to merit secured in UGEE.
7.4	Reservation for the seats to Bachelor of Fisheries Science (B.F.Sc.) degree programme shall be as per the criteria notified by the University from time to time.
8.	Enrollment, Registration and Continuance
8.1	Newly admitted students to Bachelor of Fisheries Science (B.F.Sc.) degree programme shall be enrolled on the date of counselling as notified by the Registrar of the University and the student shall deposit the prescribed University fees and other dues prior to registration.
8.2	The date of registration, commencement of instruction/classes, semester-wise examination shall be determined by the Dean as per approval by Academic Council from time to time and notified accordingly.
8.3	Fees levied on account of enrollment, tuition, hostel, examination and other items shall be as determined by the University from time to time.
8.4	Students selected provisionally for admission to B.F.Sc. degree programme shall report to the Dean before the last date notified for this purpose by the Registrar of the University.
8.5	For newly admitted students, the registration is a part of admission process and if any student fails to get registered in the specified period, the admission is liable to be

	cancelled, and admission will be offered to next candidate in the waiting list.
8.6	<p>Registration shall consist of:</p> <p>(a) The student must remain present himself/herself for the registration and in-absentia registration will not be permitted in any case.</p> <p>(b) Obtaining and filling up registration cards indicating the subjects/ courses offered during the semester duly signed by the student, his/her advisor and course teachers.</p> <p>(c) Payment of University/ College/ Hostel fees including electricity bill, if any, and other fees/ charges by the student.</p> <p>(d) Submission of the registration cards by the student in the office of the Dean within specified time.</p> <p>(e) The Dean may refuse/cancel registration of the student who has indulged in any act of indiscipline or gross misconduct. The registration may also be cancelled by the Vice Chancellor, if allowed by mistake/any other reason, on the recommendation of Dean/DSW/Registrar. Such students must immediately vacate the hostel and leave the campus.</p> <p>(f) Special provision for fresh students: Medical examination shall be compulsory for all the students admitted during the first year from the Civil Surgeon/Medical Officer/Registered Medical Practitioner as directed by the University/Dean on the date of counseling. If a student is medically unfit, the admission shall be denied by the admission committee.</p> <p>(g) At any time during the degree programme, the student may be directed to get himself/herself medically examined by the competent authority(s) as & when it may deem fit.</p>
9.	<p>Late Registration:</p> <p>(a) A student seeking registration in other than the first semester of the first year shall be permitted for late registration by the Dean on payment of a late fee of Rs. 250/- per day or as approved by the Academic Council up to a period of 6 working days excluding the day notified for registration.</p> <p>(b) No registration shall be permitted on the expiry of this period on any ground. After the last day of registration (including the period specified for late registration), the student shall not be permitted to register for that semester.</p> <p>(c) Student having late registration must complete the prescribed required attendance without any relaxation.</p>
10.	<p>Award of Degree and the Residential Requirement</p> <p>For the award of degree of B.F.Sc. (Bachelor of Fisheries Science) the minimum permissible time limit shall be 4 years (8 semesters), while maximum permissible time limit shall be 6 years (12 semesters). Any year washed out on account of withdrawal/dropping by the student of his own due to any reason/failure to register in</p>

	time/ medical grounds/use of unfair means/ dropped for any reason whatsoever shall be counted towards the maximum permissible limit of 6 years.
11.	<p>Re-Admission of the Student:</p> <p>A student whose semester has been washed out for any reason shall be able to resume his/her studies in the subsequent academic year within maximum of 2 years of leaving the college and he/she shall be treated as continuing student for all purposes provided:</p> <ul style="list-style-type: none"> a) He/she has completed a minimum requirement of one semester b) The total period of withdrawal shall not exceed 2 consecutive years including the year in which he/she had withdrawn. c) He/she has obtained permission from the University authorities for withdrawal and re-admission. d) Any student failing to pass in the first year, due to any reason including dropping the semester or having more than 5 repeated courses, shall be allowed to get readmission in next year. However, he/she will be governed by the academic regulations applicable to the academic year in which he/she seeks re-admission. e) Fees of the gap period will be paid by the student at the time of re-registration. f) Such permission and re-admission shall be granted only once during the degree programme by the University authorities.
12	<p>Dropping from the University:</p> <p>Student would be dropped from the University due to the following reason(s):</p> <ul style="list-style-type: none"> (a) If any student has more than two years gap of the discontinuation including the year of the dropping. (b) If his/her registration has been cancelled due to his/her indulging in any act of indiscipline or gross misconduct as University norms prescribed in student's hand book. (c) If student has not completed all courses in prescribed maximum duration of the degree (6 years) including the dropping period.

PART-IV BACHELOR OF FISHERIES SCIENCE CURRICULUM-STRUCTURE AND ORGANIZATION OF COURSES

13	Academic Requirement
13.1	To receive a University B.F.Sc. degree, an enrolled student must complete the prescribed course credits and he/she has an overall grade point average (OGPA) of 5.000 or higher in prescribed period of the degree.
13.2	One (1) course credit means one hour of theory lecture or two hours of laboratory /field /plant practical per week in each semester.
14	System of Teaching
14.1	There shall be eight semesters during which the student shall complete the requirements of course credits under the semester system of teaching and continuous evaluation. The same shall run in four academic year's duration.
14.2	Each academic year shall be divided into two semesters consisting of a minimum of 95 instructional days per semester excluding the period of semester-end examinations.
14.3	The semester shall be announced in every academic calendar year by the Dean of the College. Suitable adjustment in a semester shall be made to accommodate festival vacation, summer vacation and other holidays as may be notified by the University /State Government.
14.4	The medium of instructions shall be English.
15	Advisory/Counselling system
15.1	Each student shall be assigned to an advisor by the Dean during the first semester. The advisor shall help the student in carrying out the programme of his/her studies. The students are expected to keep in constant touch with their advisors to monitor their progress and guide them as and when needed during the B.F.Sc degree programme.
15.2	The advisor shall bring to the notice of the Dean the problem cases needing special measures.
16	Curriculum and Courses
16.1	The details of the courses, credits and curriculum of the course shall be as approved and determined by the Academic Council on the proposal by Board of Faculty of College of Fisheries Science from time to time. The distribution of courses for each semester shall be such, as may be decided by the Academic Council from time to time.
16.2	A student enrolled in the university for B. F. Sc. degree programme shall be required to pursue the prescribed curriculum and courses.

16.3	A course includes lecture and/or practical classes in a particular subject and Student READY programme (SRP) including In-Plant Training, Experiential Learning, Skill-Development, Rural Fisheries Work Experience (RFWE), Project Work, Seminar and Study Tour in the specified semesters.										
16.4	A student shall be required to study all the courses including compulsory non-credit courses (CNC) and to earn total credits (180) specified for the degree programme inclusive of the Student READY programme. However, credits of CNC will not be included in OGPA of the degree.										
17	<p>Attendance:</p> <p>The minimum percentage of attendance required to appear in the Semester-End Examination shall be 75 percent in each course separately in theory and practical classes.</p> <p>The maximum relaxation in attendance for NCC/NSS/NSO, Co-curricular activities and medical ground or any other permitted leave is 25% from the competent authority. However, 75 percent attendance is essential to appear in the Semester-end Examination after the relaxation.</p> <p>A student whose attendance in a course falls short of the requirements shall be deemed to have dropped the course and will be declared Fail in that course. He/she will not be allowed to appear in the Semester-end Theory Examination of the concerned course(s) and shall have to repeat the course(s).</p>										
18	<p>Division and Honors:</p> <p>The award for B.F.Sc. (Bachelor of Fisheries Science) degree programme and division shall be based on the OGPA score obtained by the candidates and governed by the following criteria:</p> <p>A student shall secure qualifying marks of 50% in theory and practical separately to pass. To be qualified to earn degree he/she must secure an OGPA of minimum 5.000 on 10-point scale.</p> <p>OGPA and Division:</p> <table border="1"> <tr> <td>8.000 and above</td> <td>First division with distinction</td> </tr> <tr> <td>7.000 –7.999</td> <td>First division</td> </tr> <tr> <td>6.000 – 6.999</td> <td>Second division</td> </tr> <tr> <td>5.000 – 5.999</td> <td>Pass</td> </tr> <tr> <td>Less than 5.000</td> <td>Fail</td> </tr> </table>	8.000 and above	First division with distinction	7.000 –7.999	First division	6.000 – 6.999	Second division	5.000 – 5.999	Pass	Less than 5.000	Fail
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Less than 5.000	Fail										
19	Examination and Evaluation										

19.1	<p>The types of examination as per the credit hours is as under:</p> <ol style="list-style-type: none"> 1. Mid-term Theory Examination: After completing the 50% syllabus 2. Semester-End Practical Examination: At the end of the semester 3. Semester-End Theory Examination: At the end of the semester 4. Examination or evaluation for the ‘Student READY’ Programme: It shall be conducted by the constituted committee by the Dean at the end of each activity under SRP. 																																																					
19.2	<p>The marks distribution for each type of examination as per the credit hours would be as under:</p> <table border="1"> <thead> <tr> <th rowspan="2">Credit Hours</th> <th colspan="2">Internal Examinations</th> <th>External Examinations</th> <th rowspan="2">Maximum Marks</th> </tr> <tr> <th>Mid-term Theory Exam (Marks)</th> <th>Semester-End Practical Exam (Marks)</th> <th>Semester-End Theory Exam (Marks)</th> </tr> </thead> <tbody> <tr> <td>0+1</td> <td>-</td> <td>100</td> <td>-</td> <td>100</td> </tr> <tr> <td>1+0</td> <td>50*</td> <td>-</td> <td>50</td> <td>100</td> </tr> <tr> <td>2+0</td> <td>50*</td> <td>-</td> <td>50</td> <td>100</td> </tr> <tr> <td>1+1</td> <td>30</td> <td>20</td> <td>50</td> <td>100</td> </tr> <tr> <td>2+1</td> <td>30</td> <td>20</td> <td>50</td> <td>100</td> </tr> <tr> <td>1+2</td> <td>30</td> <td>20</td> <td>50</td> <td>100</td> </tr> <tr> <td>3+1</td> <td>30</td> <td>20</td> <td>50</td> <td>100</td> </tr> <tr> <td>3+2</td> <td>30</td> <td>20</td> <td>50</td> <td>100</td> </tr> <tr> <td>2+2</td> <td>30</td> <td>20</td> <td>50</td> <td>100</td> </tr> </tbody> </table> <p>S/US abbreviates Satisfactory/ Un-Satisfactory for compulsory non-credit (CNC) courses viz., NSS/NCC/NSO/physical education etc. * (Internal Pre-mid-term quiz of 10 marks, Mid-term exam of 30 marks & Post mid-term quiz of 10 marks) Note: Grade “S” or “US” shall have no significance in calculating GPA/ CGPA/ OGPA</p>	Credit Hours	Internal Examinations		External Examinations	Maximum Marks	Mid-term Theory Exam (Marks)	Semester-End Practical Exam (Marks)	Semester-End Theory Exam (Marks)	0+1	-	100	-	100	1+0	50*	-	50	100	2+0	50*	-	50	100	1+1	30	20	50	100	2+1	30	20	50	100	1+2	30	20	50	100	3+1	30	20	50	100	3+2	30	20	50	100	2+2	30	20	50	100
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2+2	30	20	50	100																																																		
19.3	<p>Duration and pattern of examinations:</p> <ol style="list-style-type: none"> a. Mid-term Theory Examination shall be for 1 hour and Semester-End Practical Examination shall be for 2 hours. However, Semester-End Theory Examination shall be for 3 hours duration. Internal Pre-mid-term quiz after 30% syllabus and Post mid-term quiz after 70% syllabus shall be conducted for 30 mins. b. Mid-term Theory Examination and Semester-end Practical Examination will be conducted as per schedule decided by COE during the instructional days, however, Semester-End Theory Examination shall be conducted as per notification from the COE according to the schedule at the end of the semester. c. For theory examinations (both Mid-term Theory and Semester-End Theory Examinations), the question paper shall consist of 40% objective and 60% descriptive. 																																																					

	<p>The pattern of the question paper for different types of the examination is as under:</p> <p>(1) Internal Mid-term Theory Examination: Objective questions (Part A) shall be of 12 Marks for 20 minutes Descriptive questions (Part B) shall be of 18 Marks for 40 minutes Examination shall be conducted under the instructions and supervision of the COE. Internal Pre-mid-term quiz and Post- mid-term quiz shall be conducted by the course instructor for 10 marks each.</p> <p>(2) Internal Semester-End Practical Examination: Semester-End Practical Examination shall be of 100 marks for courses with (0+1) credit, 20 marks for courses with (1+1, 2+1, 1+2, 3+1, 3+2 & 2+2) credits. However, Practical course will not be conducted for the courses having only theory credits (1+0 & 2+0). Course instructor will decide the pattern of Practical examination for evaluating the practical skills including laboratory exercise, assignment, practical record, viva-voce, etc.</p> <p>(3) External Semester-End Theory Examination: Semester-End Theory Examination shall be of 100 Marks for courses with (1+0, 1+1, 2+0, 2+1, 1+2, 3+1, 3+2 & 2+2) credits subjected to conversion into 50 marks. Objective questions (Part A) shall be of 40 Marks for 45 minutes Descriptive questions (Part B) shall be of 60 Marks for 135 minutes</p> <p>(4) Student READY Programme (SRP): Examination or evaluation for the ‘Student READY’ Programme: It shall be conducted by the constituted committee by the Dean at the end of each activity under SRP.</p>
19.4	System of Evaluation.
19.4.1	The evaluation of a student shall be carried out on the basis of the marks obtained in Mid-term Theory, Semester-End Practical, and Semester-End Theory Examinations including Student READY Programme (SRP).
19.4.2	<p>Evaluation of Answer-books of Internal Mid-term Theory and Semester-End Practical Examinations:</p> <p>The Answer-books of Mid-term Theory and Semester-End Practical Examinations shall be evaluated by the concerned course teacher. Course teacher will submit the marks in the prescribed format to the Controller of Examinations (COE) through HoD/In-charge and Dean of the College.</p>
19.4.3	<p>Evaluation of Answer-books of External Semester-End Theory Examination:</p> <p>The Answer-books of Semester-End Theory Examination shall be evaluated by the Internal examiner as appointed by the COE and the results shall be submitted in the prescribed format to the COE through HoD/In-charge and Dean of the College.</p>

19.4.4	<p>Evaluation of ‘Student READY’ Programme:</p> <p>The evaluation of students in Student READY programs (SRP) shall be done on the basis of his/her performance in the different activities, including In-Plant Training, Experiential Learning, Skill-Development, Rural Fisheries Work Experience (RFWE), Project Work, Seminar and Study Tour. Dean of the college shall constitute a committee in consultation with COE, including the activity instructor and other faculty members for evaluation of the students in respect to different activities as given below:</p> <table border="1"> <thead> <tr> <th colspan="5">VII SEMESTER (Marks distribution for 20 Credit Hours of SRP)</th> </tr> <tr> <th rowspan="2">Evaluation criteria</th> <th colspan="4">Distribution of Marks (%)</th> </tr> <tr> <th>In-Plant Training (0+10) credits</th> <th>Rural Fisheries Work Experience (0+8) credits</th> <th colspan="2">Study Tour (0+2) credits</th> </tr> </thead> <tbody> <tr> <td>Record Keeping/ Viva - Voce</td> <td>25</td> <td>25</td> <td colspan="2">-</td> </tr> <tr> <td>Documentation of Report & presentation</td> <td>75</td> <td>75</td> <td colspan="2">100</td> </tr> <tr> <td>Total</td> <td>100</td> <td>100</td> <td colspan="2">100</td> </tr> <tr> <th colspan="5">VIII SEMESTER (Marks distribution for 20 Credit Hours of SRP)</th> </tr> <tr> <th rowspan="2">Evaluation criteria</th> <th colspan="4">Distribution of Marks (%)</th> </tr> <tr> <th>Experiential Learning Programme (0+12) credits</th> <th>Skill Development (0+5) credits</th> <th>Project Work (0+2) credits</th> <th>Seminar (0+1) credits</th> </tr> <tr> <td>Preparation and Implementation of Project</td> <td>20</td> <td>10</td> <td>20</td> <td>-</td> </tr> <tr> <td>Daily Work Diary</td> <td>50</td> <td>10</td> <td>10</td> <td>-</td> </tr> <tr> <td>Documentation & Report</td> <td>30</td> <td>20</td> <td>20</td> <td>-</td> </tr> <tr> <td>Presentation/ Seminar</td> <td>-</td> <td>10</td> <td>10</td> <td>100</td> </tr> <tr> <td>Practical Evaluation</td> <td>-</td> <td>50</td> <td>50</td> <td>-</td> </tr> <tr> <td>Total</td> <td>100</td> <td>100</td> <td>100</td> <td>100</td> </tr> </tbody> </table> <p>Activity Instructor shall submit the marks to COE through HoD/In-charge and Dean.</p>	VII SEMESTER (Marks distribution for 20 Credit Hours of SRP)					Evaluation criteria	Distribution of Marks (%)				In-Plant Training (0+10) credits	Rural Fisheries Work Experience (0+8) credits	Study Tour (0+2) credits		Record Keeping/ Viva - Voce	25	25	-		Documentation of Report & presentation	75	75	100		Total	100	100	100		VIII SEMESTER (Marks distribution for 20 Credit Hours of SRP)					Evaluation criteria	Distribution of Marks (%)				Experiential Learning Programme (0+12) credits	Skill Development (0+5) credits	Project Work (0+2) credits	Seminar (0+1) credits	Preparation and Implementation of Project	20	10	20	-	Daily Work Diary	50	10	10	-	Documentation & Report	30	20	20	-	Presentation/ Seminar	-	10	10	100	Practical Evaluation	-	50	50	-	Total	100	100	100	100
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20	<p>Scrutiny of Semester-End Theory Examination Results:</p> <p>i. There shall be a provision of scrutiny of marked Answer-book(s) of Semester-End Theory Examination only.</p>																																																																									

	<p>ii. A student may apply for scrutiny as per the notification of COE and after paying the prescribed fee.</p> <p>iii. Scrutiny will be done for only totaling of marks and for unchecked questions only for Semester-End Theory Examination.</p>
21	Credits and Grade Point
21.1	Grading and Evaluation will be in “ Ten-point scale ”.
21.2	The grade point for a course is obtained by dividing the combined marks of all examinations by ten and correcting it to the Third decimal .
21.3	The minimum grade point required for passing a course shall be 5.000. A student getting less than 5.000 shall be deemed to have failed in that course and ‘ F ’ shall be indicated in the grade report against the actual grade point obtained.
21.4	<p>The calculation for GPA/CGPA/OGPA will be as follows:</p> <p>The percentage-marks obtained by the student in each course is converted to Grade Points by dividing the total marks with ten.</p> <p>To calculate the Grade Point Average (GPA) of a semester, the grade points of respective course is multiplied by its credit hours to obtain credit points. The sum of the credit points in all courses is divided by the total number of credit hours will be the GPA of the semester.</p> <p>To calculate the Cumulative Grade Point Average (CGPA) till the end of current semester, the sum of the credit points secured by the student in all the courses registered up to the current semester is divided by the total number of credit hours of all the courses registered up to the current semester.</p> <p>To calculate the Overall Grade Point Average (OGPA) at the end of last semester, the sum of the credit points secured by the student in all the courses registered in all the semesters is divided by the total number of credit hours of all the courses registered in all the semesters.</p>
22	Promotion of Students
22.1	<p>A student shall not be promoted to the next year, if, he/she fails to clear more than five courses (excluding CNC courses) in a year.</p> <p>A student who is not able to full fill the attendance in a course shall be declared fail in that course.</p> <p>Withdrawal/ absence for any reason from the semester practical examination and or semester-End examination of any course(s) shall be counted as failure in the said course/ courses.</p> <p>It is mandatory to score satisfactory in all the CNC courses for the award of the degree.</p> <p>If, he/ she does not score satisfactory in CNC course/courses then he/she has to re-register same course/courses as and when offered.</p>

22.2	Student shall re-register the course/courses as and when offered in which he/she fails. He/she shall attend the class on regular basis and appear in all examinations of that course. The maximum credit load in a semester shall not exceed 26 credits (with a margin of adjustment of one credit only) including course/courses registered as re-examination. However, he/she has to clear all courses in maximum of six Academic years for the award of the B.F.Sc. degree. Failing which he/she shall be discontinued as an enrolled student of the University.												
22.3	If any student is failing in any course of the Student READY programme (SRP), he/she has to re-register for that course.												
22.4	For re-registration of repeat courses, decision shall be taken by the Dean.												
23	<p>Eligibility for the Degree:</p> <p>A student is deemed to have completed the requirement for graduation and shall be eligible for the award of Under Graduate Degree from University provided, if</p> <ul style="list-style-type: none"> (i) He/she has satisfied all the rules of evaluation as prescribed by the University. (ii) He/she has undertaken all the courses as required in each semester and has obtained required grade points in the concerned courses. (iii) He/she has completed all the courses in defined period of time including Student READY Programme and study tour. (iv) He/she has paid all fees prescribed by the University. (v) He/she has satisfactorily completed the training of NCC/NSS/NSO or physical education, wherever necessary. (vi) There is no case of indiscipline pending against him/her. (vii) He/she has completed the minimum residential requirement of eight semesters excluding any dropped semester. 												
24	<p>Medals and Awards:</p> <table border="1"> <thead> <tr> <th>S. No.</th> <th>Medals</th> <th>Qualifications</th> </tr> </thead> <tbody> <tr> <td>1</td> <td>Gold Medal</td> <td>Student who has secured first highest OGPA during B.F.Sc degree in first attempt without any conduct of probation or any disciplinary action.</td> </tr> <tr> <td>2</td> <td>Silver Medal</td> <td>Student who has secured second highest OGPA during B.F.Sc degree in first attempt without any conduct of probation or any disciplinary action.</td> </tr> <tr> <td>3</td> <td>Bronze Medal</td> <td>Student who has secured Third highest OGPA during B.F.Sc degree in first attempt without any conduct of probation or any disciplinary action.</td> </tr> </tbody> </table>	S. No.	Medals	Qualifications	1	Gold Medal	Student who has secured first highest OGPA during B.F.Sc degree in first attempt without any conduct of probation or any disciplinary action.	2	Silver Medal	Student who has secured second highest OGPA during B.F.Sc degree in first attempt without any conduct of probation or any disciplinary action.	3	Bronze Medal	Student who has secured Third highest OGPA during B.F.Sc degree in first attempt without any conduct of probation or any disciplinary action.
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25	Disqualification for Award of the Degree Students who have been convicted by any cognizable offence(s) as per the University rules, shall be debarred from receiving degree.
26	Student's Discipline: As per University Student's Handbook
27	Unfair Means: As per University Student's Handbook
28	Students' Responsibilities: As per University Student's Handbook
29	Maintenance of the Discipline Among the Students: As per University Student's Handbook
30	Prohibition and Prevention of Ragging: As per University Student's Handbook
30.1	Ragging constitutes one or more of any of the following acts: As per University Student's Handbook
30.2	Actions to be taken against students for indulging and Abetting Ragging As per University Student's Handbook
31	Protection Against Harassment to Girl Students: As per University Student's Handbook
32	Amendment to the Regulation: This regulation is based on the minimum standard of education and recommendations of the ICAR-Fifth Deans' committee and any amendments which may be made by the Academic Council, DUVASU from time to time shall be incorporated in this regulation.

PART-V: COURSES AND COURSE CONTENTS

33. Courses

33.1 Departments

- I. Department of Aquaculture (AQC)
- II. Department of Fisheries Resource Management (FRM)
- III. Department of Aquatic Animal Health Environment (AAH)
- IV. Department of Aquatic Environment Management (AEM)
- V. Department of Fish Processing Technology (FPT)
- VI. Department of Fisheries Engineering (FEG)
- VII. Department of Fisheries Extension Economics & Statistics (FES)

33.2 Department wise distribution of proposed courses for B.F.Sc. degree

1. Department of Aquaculture (AQC)

Sl. No	Course title	Credit load
1.	Principles of Aquaculture	2(1+1)
2.	Freshwater Aquaculture	3(2+1)
3.	Ornamental Fish Production and Management	2(1+1)
4.	Coastal Aquaculture and Mariculture	3(2+1)
5.	Finfish Hatchery Management	3(2+1)
6.	Shellfish Hatchery Management	2(1+1)
7.	Aquaculture in Reservoirs	2(1+1)
8.	Fish Nutrition and Feed Technology	3(2+1)
9.	Fish Food Organisms	2(1+1)
10.	Introduction to Biotechnology & Bio-informatics	2(1+1)
11.	Genetics and Breeding	2(1+1)
12.	Fundamentals of Biochemistry	3(2+1)
	Total	29(17+12)

2. Department of Fisheries Resource Management (FRM)

Sl. No.	Course title	Credit load
1.	Taxonomy of Finfish	3(1+2)
2.	Taxonomy of Shellfish	2(1+1)
3.	Anatomy and Biology of Finfish	3(2+1)
4.	Anatomy and Biology of Shellfish	2(1+1)
5.	Physiology of Finfish and Shellfish	3(2+1)
6.	Inland Fisheries	3(2+1)
7.	Marine Fisheries	3(2+1)
8.	Fish Population Dynamics and Stock Assessment	3(2+1)
9.	Aquatic Mammals, Reptiles and Amphibians	1(1+0)
	Total	23(14+9)

3. Department of Aquatic Animal Health Management (AAH)

Sl. No.	Course title	Credit load
1.	Fish and Shellfish Pathology	3(2+1)
2.	Microbial and Parasitic Diseases of Fish and Shellfish	3(2+1)
3.	Pharmacology	3(2+1)
4.	Therapeutics in Aquaculture	2(1+1)
5.	Fish Toxicology	2(1+1)
6.	Fish Immunology	2(1+1)
7.	Fundamentals of Microbiology	3(2+1)
	Total	18(11+7)

4. Department of Aquatic Environment Management (AEM)

Sl. No.	Course title	Credit load
1.	Meteorology, Climatology and Geography	2(1+1)
2.	Soil and Water Chemistry	3(2+1)
3.	Limnology	3(2+1)
4.	Fishery Oceanography	2(1+1)
5.	Marine Biology	3(2+1)
6.	Aquatic Ecology, Biodiversity and Disaster Management	3(2+1)
7.	Aquatic Pollution	2(1+1)
8.	Coastal Zone Management	2(1+1)
	Total	20(12+8)

5. Department of Fish Processing Technology (FPT)

Sl. No.	Course title	Credit load
1.	Fish in Nutrition	1(1+0)
2.	Food Chemistry	3(2+1)
3.	Freezing Technology	2(1+1)
4.	Fish Canning Technology	2(1+1)
5.	Fish Packaging Technology	2(1+1)
6.	Fish Products and Value Addition	3(2+1)
7.	Fish By-Products and Waste Utilization	2(1+1)
8.	Microbiology of Fish and Fishery Products	3(2+1)
9.	Quality Assurance of Fish and Fishery Products	3(2+1)
	Total	21(13+8)

6. Department of Fisheries Engineering (FE)

Sl. No	Course title	Credit load
1.	Aquaculture Engineering	3(2+1)
2.	Refrigeration and Equipment Engineering	3(2+1)
3.	Fishing Craft Technology	2(1+1)
4.	Navigation and Seamanship	2(1+1)
5.	Fishing Gear Technology	2(1+1)

6.	Fishing Technology	2(1+1)
	Total	14(8+6)

7. Department of Fisheries Extension, Economics and Statistics (FES)

Sl. No	Course title	Credit load
1.	Statistical Methods	3(2+1)
2.	Fisheries Economics	3(2+1)
3.	Fisheries Policy and Law	1(1+0)
4.	Fisheries Co-operatives and Marketing	2(1+1)
5.	Fisheries Business Management and Entrepreneurship Development	1(1+0)
6.	Information and Communication Technology	2(1+1)
7.	Fisheries Extension Education	2(1+1)
8.	Communication Skills and personality development	1(0+1)
	Total	15(9+6)

33.3 Compulsory Non-Credit Courses. At least one class per week (CNC)

1. Swimming (0+1)
2. Physical Education, First Aid & Yoga Practice (0+1)

33.4 Summary of the department wise courses for B.F.Sc. degree

Sl. No.	Department	No. of courses	Credit load
1	Aquaculture (AQC)	12	29(17+12)
2	Fisheries Resource Management (FRM)	9	23(14+9)
3	Department of Aquatic Animal Health Management (AAH)	7	18(11+7)
4	Aquatic Environmental Management (AEM)	8	20(12+8)
5	Fish Processing Technology (FPT)	9	21(13+8)
6	Fisheries Engineering (FEG)	6	14(8+6)
7	Fisheries Extension, Economics and Statistics (FES)	8	15(9+6)
8	Comp. Non-credit courses (Swimming & Phy. Edn) (CNC)	2	-
	Sub total	61	140(84+56)
1.	Student READY In-Plant Attachment Programme	1	10(0+10)
2.	Student READY Rural Fisheries Work Experience Programme	1	8(0+8)
3.	Study Tour (in and outside State)	1	2(0+2)
4.	Student READY Experiential Module (Skill development & ELP)	1	17(0+17)
5.	Project Work	1	2(0+2)
6.	Seminar	1	1(0+1)
	Total	06	40(0+40)
	Grand Total	67	180(84+96)

34. Semester wise distribution of courses

I Semester

Sl. No.	Course Code	Course Title	Credit hour
1	AQC 111	Principles of Aquaculture	2 (1+1)
2	AQC 112	Fundamentals of Biochemistry	3 (2+1)
3	AAH 111	Fundamentals of Microbiology	3 (2+1)
4	FRM 111	Taxonomy of Finfish	3 (1+2)
5	FRM 112	Taxonomy of Shellfish	2 (1+1)
6	AEM 111	Meteorology, Climatology and Geography	2 (1+1)
7	AEM 112	Soil and Water Chemistry	3 (2+1)
8	FPT 111	Fish in Nutrition	1 (1+0)
9	FES 111	Statistical Methods	3 (2+1)
10	*CNC 111	Swimming	1 (0+1)
	Total		22 (13+9)

*CNC= Compulsory non-credit course.

II Semester

Sl. No.	Course Code	Course Title	Credit hour
1	AQC 121	Freshwater Aquaculture	3 (2+1)
2	AQC 122	Aquaculture in Reservoirs	2 (1+1)
3	AQC 123	Genetics and Breeding	2 (1+1)
4	FRM 121	Anatomy and Biology of Finfish	3 (2+1)
5	FRM 122	Inland Fisheries	3 (2+1)
6	AEM 121	Limnology	3 (2+1)
7	AEM 122	Marine Biology	3 (2+1)
8	FPT 121	Food Chemistry	3 (2+1)
9	FES 121	Information and Communication Technology	2 (1+1)
10	*CNC 121	Physical Education, First Aid & Yoga Practices	1 (0+1)
	Total		24 (15+9)

*CNC= Compulsory non-credit course.

III Semester

Sl. No.	Course Code	Course Title	Credit hour
1	AQC 211	Fish Food Organisms	2 (1+1)
2	AQC 212	Ornamental Fish Production and Management	2 (1+1)
3	AAH 211	Fish Immunology	2 (1+1)
4	FRM 211	Physiology of Finfish and Shellfish	3 (2+1)
5	FRM 212	Aquatic Mammals, Reptiles and Amphibians	1 (1+0)
6	AEM 211	Aquatic Ecology, Biodiversity and Disaster Management	3 (2+1)
7	AEM 212	Fishery Oceanography	2 (1+1)
8	FPT 211	Freezing Technology	2 (1+1)

9	FEG 211	Refrigeration and Equipment Engineering	3 (2+1)
10	FES 211	Fisheries Economics	3 (2+1)
		Total	23 (14+9)

IV Semester

Sl. No.	Course Code	Course Title	Credit hour
1	AQC 221	Coastal Aquaculture and Mariculture	3 (2+1)
2	AQC 223	Shellfish Hatchery Management	2 (1+1)
3	AAH 221	Fish and Shellfish Pathology	3 (2+1)
4	AAH 222	Therapeutics in Aquaculture	2 (1+1)
5	FRM 221	Marine Fisheries	3 (2+1)
6	AEM 221	Aquatic Pollution	2 (1+1)
7	FPT 221	Fish Canning Technology	2 (1+1)
8	FPT 222	Fish Packaging Technology	2 (1+1)
9	FEG 221	Fishing Craft Technology	2 (1+1)
10	FES 221	Fisheries Extension Education	2 (1+1)
11	FES 222	Communication Skills and Personality Development	1 (0+1)
		Total	24 (13+11)

V Semester

Sl. No.	Course Code	Course Title	Credit hour
1	AQC 311	Finfish Hatchery Management	3 (2+1)
2	AQC 312	Fish Nutrition and Feed Technology	3 (2+1)
3	AAH 311	Pharmacology	3 (2+1)
4	AAH 312	Fish Toxicology	2 (1+1)
5	FRM 311	Anatomy and Biology of Shellfish	2 (1+1)
6	FPT 311	Fish Products and Value Addition	3 (2+1)
7	FEG 311	Fishing Gear Technology	2 (1+1)
8	FEG 312	Fishing Technology	2 (1+1)
9	FES 311	Fisheries Co-operatives and Marketing	2 (1+1)
		Total	22 (13+9)

VI Semester

Sl. No.	Course Code	Course Title	Credit hour
1	AQC 321	Introduction to Biotechnology and Bio-informatics	2 (1+1)
2	AAH 321	Microbial and Parasitic Diseases of Fish and Shellfish	3 (2+1)
3	FRM 321	Fish Population Dynamics and Stock Assessment	3 (2+1)
4	AEM 322	Coastal Zone Management	2 (1+1)
5	FPT 321	Microbiology of Fish and Fishery Products	3 (2+1)
6	FPT 322	Fish By-Products and Waste Utilization	2 (1+1)
7	FEG 321	Navigation and Seamanship	2 (1+1)
8	FEG 322	Aquaculture Engineering	3 (2+1)

9	FES 321	Fisheries Policy and Law	1 (1+0)
10	FES 322	Fisheries Business Management and Entrepreneurship Development	1 (1+0)
		Total	22 (14+8)

VII Semester

Sl. No.	Course Code	Course Title	Credit hour
1	SRP 411	Student READY Programme In-plant attachment (for 8 weeks)	10 (0+10)
2	SRP 412	Rural Fisheries Work Experience Programme (for 8 weeks)	8 (0+8)
3	SRP 413	Study Tour (in and outside State) (for 4 weeks)	2 (0+2)
		Total	20 (0+20)

VIII Semester

Sl. No.	Course Code	Course Title	Credit hour
1	FPT 421	Quality Assurance of Fish and Fishery Products	3 (2+1)
2	SRP 421	Student READY Experiential Learning Programme (concurrent with the semester) This will include capacity building and skill development of the students in planning, development, formulation, monitoring and evaluation of project for entrepreneurial proficiency.	12 (0+12)
2	SRP 422	Skill Development for one week) Experiential Learning Programme	5 (0+5)
3	SPR 423	Project Work	2 (0+2)
4	SRP 424	Seminar	1 (0+1)
		Total	23 (2+21)

Total Credit Hours 180 (84+96) +2 Compulsory Non-Credit Course

* Student READY Programme

35. Student READY Programme:

a) **Skill Development (for one week):** Aquarium fabrication, Analysis of soil and water quality parameters, Preparation of Fish products or in any appropriate applied aspect of fisheries

b) **Experiential Learning Programme:**

A minimum of two areas should be decided by Dean, College of Fisheries Science, DUVASU, Mathura Areas of specialization for Experiential Learning Programme are

1. Ornamental fish culture
2. Seed production

3. Trade and export management

4. Aqua-Clinic

5. Post Harvest technology

6. Aqua farming.

A total of 12 credits are allotted for Experiential Learning Programme and the evaluation of the same will be conducted by the Committee appointed by the Dean of the College.

c) **Project work:** Student will select relevant or interested area of specialization such as:

Fish pathology, Fish diagnosis, Fish pharmacology, Fish Toxicology, Fish nutrition, Fish immunology, Fish genetics and breeding, Ornamental fish production, Genomics in Aquaculture, Fish stock assessment, Aquatic pollution, Fish value addition, Fish in nutrition, Fish processing waste management, Quality control and quality assurance, Fish products and by-products etc. He/she will prepare a research project plan, and it will be presented in-front of committee appointed by the Dean of the respective college. Also, for each student, one advisor will be provided, who will guide the student in completion of proposed research plan.

A total of Two credits are allotted for project work and One credit for (completed project work presentation) seminar. The evaluation for the same will be conducted by the committee appointed by the Dean of the College.

36 : Course Contents

36.1 Department of Aquaculture

36.1.1 Course Title: AQC 111-Principles of Aquaculture

Credit hours: 2(1+1)

A. Theory

Unit 1: Basics of aquaculture, definition and scope. History of aquaculture: Present global and national scenario. Aquaculture vs Agriculture. Systems of aquaculture - pond culture, pen culture, cage culture, running water culture and zero water exchange system.

Unit 2: Extensive, semi-intensive, intensive and super intensive aquaculture in different types of water bodies viz., freshwater, brackish water inland saline and marine water. Principles of organic aquaculture. Pre-stocking and post stocking pond management. Carrying capacity of pond, factors influencing carrying capacity. Criteria for selection of candidate species for aquaculture.

Unit 3: Major candidate species for aquaculture: freshwater, brackish-water and marine. Monoculture, polyculture and integrated culture systems. Water and soil quality in relation to fish production. Physical, chemical and biological factors affecting productivity of ponds.

B. Practicals

Aquaculture production statistics- world and India. Aquaculture resources of world and India. Components of Aquaculture farms. Estimation of carrying capacity. Practices on pre- stocking and post stocking management. Growth studies in aquaculture system. Study on waste accumulation in aquaculture system (NH₃, Organic matter, CO₂). Analysis of manure.

36.1.2 Course Title: AQC 121-Freshwater Aquaculture

Credit hours: 3(2+1)

A. Theory

Unit 1: Major species cultured, production trends and prospect in different parts of the world. Freshwater aquaculture resources-ponds, tanks, lakes, reservoirs etc. Nursery, rearing and grow- out ponds preparation and management-control of aquatic weeds and algal blooms, predatory and weed fishes, liming, fertilization/manuring, use of biofertilizers, supplementary feeding. Water quality management.

Unit 2: Selection, transportation and acclimatization of seed. Traits of important cultivable fish and shellfish and their culture methods-Indian major carps, exotic carps, air breathing fishes, cold water fishes, freshwater prawns, mussels.

Unit 3: Wintering ponds, quarantine ponds and isolation ponds. Sewage-fed fish culture. Principles of organic cycling and detritus food chain. Use of agro-industrial waste and biofertilizer in aquaculture.

Unit 4: Composite fish culture system of Indian and exotic carps-competition and compatibility. Exotic fish species introduced to India. Culture of other freshwater species. Medium and minor carps, catfish and murrels.

Unit 5: Species of fish suitable for integrated aquaculture. Integration of aquaculture with agriculture/horticulture. Integration of aquaculture with livestock. Cultivation of aquatic macrophytes with aquaculture (makahana). Paddy cum Fish/Shrimp Culture.

B. Practicals

Preparation and management of nursery, rearing and grow-out ponds. Study on effect of liming, manuring and fertilization on hydrobiology of ponds and growth of fish and shellfishes. Collection, identification and control of aquatic weeds, insects, predatory fishes, weed fishes and eggs and larval forms of fishes. Algal blooms and their control. Estimation of plankton and benthic biomass. Study of contribution of natural and supplementary feed to growth. Workout of economics of different culture practices. Estimation of livestock requirement / Unit in integrated aquaculture Design of paddy plot for paddy-cum-fish culture. Design of Fish and Shrimp Culture, livestock shed on pond embankment, Economics of different integrated farming systems.

36.1.3 Course Title: AQC 212-Ornamental Fish Production and Management

Credit Hours 2(1+1)

A Theory

Unit 1: World trade of ornamental fish and export potential. Different varieties of exotic and indigenous fishes. Principles of a balanced aquarium. Fabrication, setting up and maintenance of freshwater and marine aquarium.

Unit 2: Water quality management. Water filtration system-biological, mechanical and chemical. Types of filters. Aquarium plants and their propagation methods. Lighting and aeration. Aquarium accessories and decorative. Aquarium fish feeds. Dry, wet and live feeds.

Unit 3: Breeding and rearing of ornamental fishes. Broodstock management. Application of genetics and biotechnology for producing quality strains. Management practices of Aquaculture fish farms.

Unit 4: Common diseases and their control. Conditioning, packing, transport and quarantine methods. Trade regulation and wildlife act in relation to ornamental fishes.

Practicals

Identification of common ornamental fishes and plants. Fabrication of all-glass aquarium. Setting up and maintenance of Aquarium accessories and equipment. Conditioning and packing of ornamental fishes. Preparation of feed. Setting up of breeding tank for live bearers, barbs, goldfish, tetras, chichlids, gouramis, fighters and catfishes. Identification of ornamental fish diseases and prophylactic measures.

36.1.4 Course Title: AQC 221-Coastal Aquaculture and Mariculture

Credit Hours: 3(2+1)

A.Theory

Unit 1: An overview of sea farming and shore-based aquaculture in different parts of the world. Resources for shore-based aquaculture and sea farming in India.

Unit 2: Traits of important cultivable fish and shellfish (seabass, mullet, milkfish, grouper, cobia, snappers, ayu, pearlspot, tiger shrimp, white shrimp, mud crab, mussel, clam, oysters (edible and pearl oyster), lobster, seaweeds, Seed resources.

Unit 3: Shore based aquaculture system: traditional (pokkali, bheries, gazanis, khazans), semi- intensive, intensive aquaculture practice of commercially important species of fish and shellfish.

Unit 4: Methods of Shellfish Culture rafts, racks, cages, poles and ropes., Water and soil quality management. Estimation of growth, survival and pond productivity. Seaweed culture, Pearl culture, Sea ranching.

B. Practical

Identification of important cultivable species. Collection and identification of commercially important seed of fish and shellfishes. Types of fertilizers - Pond preparation. Seed selection, quality and acclimatization. Water quality parameters. Estimation of seed survival. Pond biomass estimation. Material, apparatus and machinery for shore-based aquaculture and sea farming. Estimation of feed intake. Growth and health monitoring. Fouling organisms in cages and pens.

36.1.5 Course Title: AQC 311-Finfish Hatchery Management

Credit Hours: 3(2+1)

A. Theory

Unit 1: Freshwater and marine fish seed resources. Natural breeding of finfishes. Selection of riverine spawn collection sites, gears used and methods of collection. Spawn quality and quantity indices. Advantages and disadvantages of riverine seed collection. Sexual maturity and breeding season of various cultivable species. Development of gametes in male and female. Fish egg and embryonic development.

Unit 2: Methods of breeding; bundh breeding - wet and dry bundhs, collection and hatching of eggs, factors involved in bundh breeding, advantages and disadvantages of bundh breeding. Induced breeding of warmwater finfishes, environmental factors affecting spawning, sympathetic breeding.

Unit 3: Hypophysation of fishes. Fish pituitary gland – its structure, collection, preservation and preparation of extract for injection, dosages and methods of injection. Brood-stock management and transportation of brood fish. Synthetic hormones used for induced breeding of carps.

Unit 4: Different types of fish hatcheries-traditional, Chinese, glass jar and modern controlled hatcheries. Causes of mortalities of eggs and spawn and remedies. Spawn rearing techniques. Use of anesthetics in fish breeding and transport.

Unit 5: Breeding techniques for Indian major carps, exotic carps, mahaseers, trouts, tilapias, catfishes, grey-mullets, milk fish, pearl spot, sea bass, sea horse, groupers, pacu, cobia, pompanos and indigenous fishes, etc. Off-season and multiple breeding of carps.

B. Practicals

Study of maturity stages in fishes. Collection and preservation of fish pituitary gland, preparation of PG extract, Hypophysation. Calculation of fecundity. Brood-stock maintenance and selection of breeders for injection. Histological studies of ovary and testes. Different fish hatchery systems, study of fish eggs and embryonic developmental stages. Identification of eggs, spawn, fry and fingerlings of different species. Preparation and management of fish nursery. Fish seed and brood-stock transportation, use of anesthetics, disinfectants and antibiotics in fish breeding. Water quality monitoring in fish hatcheries and nurseries. Breeding and larval rearing of common finfishes

36.1.6 Course Title: AQC 223-Shellfish Hatchery Management

Credit Hours: 2(1+1)

A. Theory

Natural seed resources, site selection and collection methods. Life cycle of important shellfish (*Penaeus monodon*, *P. indicus*, *Macrobrachium rosenbergii*, *P. Vannamei*, *Scylla serrata*, lobster, edible, oyster, pearl oyster, freshwater mussel, holothurians, horse-shoe crab, Sepia, Loligo, cray fish etc.). Sexual maturity and breeding seasons of different species. Maturation stages of *Macrobrachium rosenbergii* and *Penaeus monodon* and *P. Vannamei*. Induced maturation in *Penaeus monodon* and *P. Vannamei* *P. Indicus* by eye stalk ablation. Reproductive physiology. Reproductive hormones in crustaceans. Brood stock management of *Penaeus monodon* and *Macrobrachium rosenbergii*. Breeding and hatchery management of *Penaeus monodon* and *Macrobrachium rosenbergii*. Breeding and hatchery management of crabs lobster, mussel, edible and pearl oyster. Food and feeding of larval stages of important shellfishes. Health management in hatcheries.

B. Practicals

Identification of brood stock and maturity stages of important crustaceans and mollusks. Observations on gonadal maturation of *Penaeus monodon* and *Macrobrachium rosenbergii*. Breeding and larval rearing of *Macrobrachium rosenbergii*, *Penaeus monodon* and *P. Vannamei*. Identification of larval stages of important crustaceans and mollusks. Demonstration of eyestalk ablation in *Penaeus monodon*. Collection, packing and transportation of shrimp/prawn seed and brood stock. Practice in the operation of shrimp and prawn hatcheries. Water treatment and management in shrimp and prawn hatcheries. Different chemicals and drugs used in shrimp/ prawn hatchery.

36.1.7 Course Title: AQC 122-Aquaculture in Reservoir

Credit Hours: 2(1+1)

A. Theory

Unit 1: Definition of reservoirs in India; nature and extent of reservoirs, topography and species diversity; importance of morpho-edaphic index in reservoir productivity and classification; factors influencing fish production; trophic phases in reservoir; pre-impoundment and post- impoundment stages and their significance in establishment of reservoir fisheries. Salient features of reservoir limnology and their significance to fisheries development; management of

small, medium and large reservoirs; present status and future prospects in reservoirs fish production.

Unit 2: Fisheries of some important reservoirs; recent advances in reservoirs fisheries management; conservation measures in reservoir fisheries. Fish stocking in Reservoirs Role of cage and pen culture in enhancement of fish production from reservoirs; history of cage culture, advantages of cage culture; selection of suitable site of cage culture; cage materials, designs, shape, size and fabrication; cage frames and supporting system. Integration of cage culture with other farming systems.

Unit 3: History of pen culture, pen materials, fabrication; breeding of fish in pen; rearing of spawn in pen; grow-out from pens. Suitable species for culture in cages and pens; constraints in cage and pen culture; economics of cage and pen culture.

B. Practicals

Preparation of charts on the present situation of reservoirs fisheries productivity; detailed case studies of selected reservoirs on the changing trends in capture fisheries profile; drawing inferences from the analysis of data; suggestions for the sustainable development of reservoirs fisheries. Case studies on cage and pen culture; field visit to cage and pen culture site to acquaint with construction details and operation.

36.1.8 Course Title: AQC 312-Fish Nutrition and Feed Technology

Credit Hours: 3(2+1)

A. Theory

Unit 1: Fundamentals of fish nutrition and growth in fish. Principal nutrients and nutritional requirements of cultivable fish and shellfish. Nutritional energetics: definition and forms of energy partitioning.

Unit 2: Methods of feed formulation and manufacturing. Forms of feeds: wet feeds, moist feeds, dry feeds, mashes, pelleted feeds, floating and sinking pellets. Feed additives: binders, antioxidants, enzymes, pigments, growth promoters, feed stimulants. Feed storage: use of preservatives and antioxidants.

Unit 3: Feed evaluation: feed conversion ratio, feed efficiency ratio, protein efficiency ratio, net protein utilization and biological value. Feeding devices and methods. Non-conventional feed ingredients and antinutritional factors. Digestive enzymes, feed digestibility. Factors affecting digestibility. Nutritional deficiency diseases.

B. Practicals

Proximate composition analysis of feed ingredients and feeds. Preparation of artificial feeds using locally available feed ingredients. Determination of sinking rate and stability of feeds. Effect of storage on feed quality.

36.1.9 Course Title: AQC 211-Fish Food Organisms

Credit Hours: 2(1+1)

A. Theory

Candidate species of phytoplankton and zoo-plankton as live food organisms of freshwater and marine species. Tropic potentials - proximate composition of live feed. Biology, culture requirements and methodology of important live food organisms; Green algae, blue-green algae, spirulina, diatoms, infusoria, rotifers, cladocerons, tubifex, brine shrimp, chironomids. Culture of earthworms, bait fish and forage fish.

B. Practicals

Methods of collection and identification of different live food organisms. Laboratory scale culture of selected live food organisms (green algae, spirulina, chetoceros, rotifer, Moina, copepod). Evaluation of live food organisms. Decapsulation and hatching method of brine shrimp cyst.

36.1.10 Course Title: AQC321-Introduction to Biotechnology & Bioinformatics

Credit Hours: 2(1+1)

A. Theory

Unit 1: Biotechnology: Introduction to Biotechnology –scope and importance in fisheries/ aquaculture; Structural organization of prokaryotic and eukaryotic cell. Nucleic acids -structure, function and types, Concepts of gene and genetic code, transcription and translation, mutations and their implications.

Unit 2: Post transcriptional modification and RNA processing. Gene regulation and expression in prokaryotes and eukaryotes; DNA sequencing, Operons. Genetic engineering- Restriction enzymes; Gene isolation; Cloning vectors; Probes; Recombinant DNA technology, vaccines. Transgenic fish and Gene transfer technology, Animal Cell Culture, Hybridoma technology.

Unit 3: Molecular and immunological techniques – PCR; immunoblotting; ELISA; Principle of hybridization; Northern blotting; Western blotting; Southern blotting; DNA fingerprinting; Restriction fragment length

polymorphism., Biosensors. Concept of bioremediation of water, bioprocess engineering and bioprospecting.

Unit 4: Bioinformatics: Introduction to Bioinformatics; Biological Databases and tools : Introduction; Types of biological databases; Primary and secondary databases; PDB, NCBI, formats and contents; Sequence retrieval, manipulation; Primer design; Restriction mapping; ORF finding; EMBOSS, Molecular visualization Sequence analysis.

B. Practicals

Study of structure of prokaryot and Eukaoryt Cells. Study on Model of protein Synthesis, Study of models rDNA Technology, Cell Culture, Isolation of Nucleic Acids, Restriction enzymes, Gel Electrophorus, ELISA, DNA sequence analysis and comparison.

36.1.11 Course Title: AQC123-Genetics and Breeding

Credit Hours: 2(1+1)

A. Theory

Unit 1: Principles of genetics and breeding, Gene and chromosome as basis of inheritance, Mendel's law of inheritance – complete and incomplete dominance, monohybrid and dihybrid ratios. Gene interactions – dominant and recessive epistasis. Pleiotropism. Lethal genes. Mutation. Sex-linked genes, sex-influenced and sex-limited traits. Linkage and crossing over.

Unit 2: Introduction to population genetics. Hardy- Weinberg law and its significance. Chromosomal structure and aberrations. Chromosome manipulation techniques - androgenesis, gynogenesis and polyploidy and identification of ploidy.

Unit 3: Sex determination. Cross breeding (hybridization) – types of cross breeding, heterosis and design of cross breeding programmes, hybridization in different fishes. Quantitative genetics – quantitative traits, polygenic traits, heritability.

Unit 4: History and present status of selective breeding programs in aquaculture. Selection methods and mating designs. Design for selective breeding. Inbreeding and its consequences. Domestication methods. Seed certification and quarantine procedures. Cryopreservation of gametes.

B. Practicals

Problems on Mendelian inheritance (qualitative genetics) - monohybrid and dihybrid ratios and epistasis. Problems on quantitative traits, response to selection and heritability. Estimation of rate of inbreeding and heterosis. Mitotic and meiotic chromosome preparation. Demonstration

of protocol of androgenesis, gynogenesis and polyploidy. Problems on gene and genotypic frequency. Gamete cryopreservation protocols and quality evaluation of fish milt.

36.1.12 Course Title: AQC112-Fundamentals of Biochemistry

Credit Hours: 3(2+1)

A. Theory

Unit 1: A brief introduction to developments in biochemistry and its transformation to molecular biology. Cell structure, water and major molecules of life. Carbohydrate chemistry: Structure, classification, functions (mono, di and polysaccharides) isomerism and mutarotation.

Unit 2: Metabolism of carbohydrates: glycolysis, gluconeogenesis, glycogenolysis, glycogenesis, TCA cycle.

Unit 3: Protein chemistry: classifications and functions. Classification, structure, function and properties of amino acids. Essential and non-essential amino acids. Primary, secondary, tertiary and quaternary structure of proteins. Amphoteric property. Biuret reaction and xanthoproteic reaction.

Unit 4: Classification, structure, functions and properties of lipids. Essential fatty acids and phospholipids. Lipid autooxidation. Significance of Omega-3 and Omega-6 fatty acids.

Unit 5: Enzymes: nomenclature; classification; specificity; mechanism of enzyme action; Steroid and peptide hormones- chemistry and function. Structure and functions of fat and water-soluble vitamins. Vitamins – classification- functions. Minerals. classification – functions. Nucleic acids: Structure function and importance genetic code. Transcription and translation.

B. Practicals

Preparation of normal solution of acid and base, buffers and reagents. Qualitative determination of carbohydrates, proteins and lipids. Estimation of total nitrogen and crude protein of fish tissue. Estimation of carbohydrates in foods. Determination of specific gravity of oil. Extraction and estimation of total lipids in fish tissue. Determination of saponification value, iodine value and free fatty acid value.

36.2 Department of Fisheries Resource Management

36.2.1 Course Title: FRM 111-Taxonomy of Finfish

Credit Hours: 3(1+2)

A. Theory

Unit 1: Principles of taxonomy. Nomenclature, types. Classification and interrelationships. Criteria for generic and specific identification. Morphological, morphometric and meristic characteristics of taxonomic significance.

Unit 2: Major taxa of inland and marine fishes up to family level. Commercially important freshwater and marine fishes of India and their morphological characteristics.

Unit 3: Introduction to modern taxonomic tools: karyotaxonomy, DNA barcoding, protein analysis and DNA polymorphism.

B. Practicals

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 barcoding, DNA polymorphism; Visit to fish landing centres to study commercially important fishes and catch composition.

36.2.2 Course Title: FRM 112-Taxonomy of Shellfish

Credit Hours: 2(1+1)

A. Theory

Study of external morphology and meristic characteristics of crustacea and mollusca. Classification of crustacea and mollusca up to the level of species with examples of commercially important species.

B. Practicals

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 study of commercially important shellfishes.

36.2.3 Course Title: FRM 121-Anatomy and Biology of Finfish

Credit Hours: 3(2+1)

A. Theory

Unit 1: Study of external and internal anatomy of important groups of finfish. Study of oral region and associated structures. Digestive system and associated digestive glands. Food and feeding habits of commercially important fishes.

Unit 2: Qualitative and quantitative methods of analysis of gut contents. Circulatory system, respiratory system, nervous system, urino-genital system, endocrine system, skeletal systems and sensory organs.

Unit 3: Reproductive biology – maturity stages, gonado-somatic index, ponderal index, fecundity, sex ratio and spawning. Eggs and larval stages and developmental biology. Age and growth determination by direct and indirect methods. Fish migration - type and significance. Tagging and marking.

B. Practicals

Study of internal organs – digestive, respiratory, circulatory, urino-genital system, nervous, skeletal systems and endocrine system. Study of food and feeding habits. Analysis of gut contents. Estimation of age and growth by direct and indirect methods. Classification of maturity stages. Estimation of fecundity. Study of developmental stages. Tagging and marking

36.2.4 Course Title: FRM 311-Anatomy and Biology of Shellfish

Credit Hours: 2(1+1)

A. Theory

Study of external and internal organization of commercially important crustaceans and molluscs. Digestive, respiratory, circulatory, nervous and reproductive systems. Food and feeding habits, growth, moulting, length – weight relationship. Reproductive biology, larval stages. Age and growth determination by direct and indirect methods.

B. Practicals

Study of Internal Organs commercially important crustaceans and mollusks. Study of Digestive, respiratory, circulatory, nervous and reproductive systems. Study of food and feeding habits - analysis of gut contents, age and growth, length - weight relationship and condition. Reproductive biology: maturity stages, spawning periodicity, fecundity and larval stages.

36.2.5 Course Title: FRM 211-Physiology of Finfish and Shellfish

Credit Hours:3(2+1)

A. Theory

Water as a biological medium. Gas exchange; Circulation; Excretion; Osmoregulation; Reproductive physiology; Muscle physiology; Sense organs; Energy and nutrient status of food; Nitrogen balance; Standard

and active metabolism; Energy utilization; Effect of environmental factors on physiology of fin and shellfishes. Stress related physiological changes. Structure and functions of important endocrine glands.

B. Practicals

Estimation of oxygen consumption, Osmoregulation, ammonia excretion and carbon-dioxide output. Influence of temperature and salinity on metabolism. Haematology of fin and shellfishes. Histological techniques.

36.2.6 Course Title: FRM 122-Inland Fisheries

Credit Hours: 3(2+1)

A. Theory

Freshwater fishery regions of the world and their major fish species composition. Global inland fish production data. Capture fishery resources of India. Potential of inland water bodies with reference to respective state. Problems in the estimation of inland fish catch data. Fishing crafts and gears. Major riverine and estuarine systems of India. Major brackish water lakes and their fisheries. Fisheries of major reservoirs / natural lakes of India. Flood-plain capture fishery- present status of their exploitation and future prospects. Cold water fisheries of India.

B. Practicals

Analysis of species composition of commercial catches at landing and assembling centers, sampling and familiarization of commercially important groups. Observations and experimental operations of selected fishing crafts and gears in inland / estuarine waters. Maintenance of records on catch data. Visit to Dept. of fisheries, lakes and reservoirs, net making yards.

36.2.7 Course Title: FRM 221-Marine Fisheries

Credit Hours: 3(2+1)

A. Theory

Unit 1: Classification and definition of fishery zones and fishery resources of world. Overview of marine fisheries resources of the world and India. Major exploited marine fisheries of India, their developmental history and present status.

Unit 2: Important pelagic - demersal fish, shellfish and seaweed resources of India. Traditional, motorized and mechanized fisheries according to major gears. Potential marine fishery resources of the India's EEZ. GIS and Remote sensing in marine capture fishery.

B. Practicals

Visit to fish landing centres, Observation and analysis of catches by major crafts and gears. Field collection of fishes, crustaceans, molluscs and seaweeds and record keeping of relevant data. Participation in fishing cruises. GIS and remote sensing in marine capture fishery.

36.2.8 Course Title: FRM 321-Fish Population Dynamics and Stock Assessment

Credit Hours: 3(2+1)

A. Theory

Unit 1: The concept of population and unit stock. Biological structure of fisheries resource in space and time. Indicators of dynamics in a fishery resource. Characteristics of unit and mixed stock. Data requirements for stock assessment. Segregation of stocks. Principles of stock assessment. Population age structure.

Unit 2: Theory of life tables. Von Bertalanffy growth parameters. Graphical models. Monte Carlo simulation model and ECOPATH model. Estimation of total fishing and natural mortality. 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.

Unit 3: Biological symptoms of under-fishing and over-fishing. Growth over-fishing and recruitment over-fishing. Eumetric fishing. Open access fisheries. Fisheries regulations. CPUE. Trawl selection and gillnet selection. Analytical models of fish stocks.

B. Practicals

Study of length – weight relationship, segregation of stock using direct methods. Study of analytical models: Beverton and Holt model. VBGF, Pauly's integrated methods, graphical models. Estimation of Z, F and M. estimation of net selectivity coefficient. Fitting of surplus production model: Schaeffer model, Fox model. Study of yield isopleth diagrams. Micro-computer packages ELEFAN, FISAT.

36.2.9 Course Title: FRM 212-Aquatic Mammals, reptiles and amphibians

Credit Hours: 1(1+0)

A. Theory

Selected aquatic mammal, reptile, amphibian and birds species of India relevant to fisheries: taxonomic status, identification characters, distribution, abundance, habitat, exploitation, threats and conservation. Biology of aquatic animals: Cetaceans (whales, dolphins, porpoises and narwal), Sirenia (manates and dugongs), Carnivora (seals, sea lions walruses, polar bear and otter), Sea turtles, tortoise, crocodiles, sea/freshwater snakes and amphibians. IUCN criteria – Red list, Wild Life (Protection) Act.

36.3 AQUATIC ANIMAL HEALTH MANAGEMENT

36.3.1 Course Title: AAH 221-Fish and Shellfish Pathology

Credit Hours: 3(2+1)

A. Theory

Unit 1: Significance of Finfish and Shellfish diseases in aquaculture. Host, Pathogen and Environment Interaction. Disease development process. Stress in aquaculture and its role in disease development.

Unit 2: Pathological processes: Cellular response to injury, Inflammatory response to diseases, Pathogenicity mechanism of parasite, bacteria, virus and fungus. Case history and clinical sign in disease diagnosis.

Unit 3: Role of physical (injuries, health, cold) chemical (pH, salinity, toxins, ammonia, nitrogenous waste, endogenous chemicals and metabolites, free radicals, oxidants) soil and water parameters in fish health. Nutritional diseases. Non-infectious diseases.

B. Practicals

Live and postmortem examination of fish and shellfish. Pathology of organ systems. Histopathology of normal and diseases fish and shellfish, Diagnosis of abiotic fish diseases.

36.3.2 Course Title: AAH-321-Microbial and Parasitic Diseases of Fish and Shellfish

Credit Hours: 3(2+1)

A. Theory

Unit 1: General characteristics, life cycle, diagnosis, prevention and treatment of parasitic, bacterial, fungal and viral diseases of finfish and shellfish. OIE listed diseases.

Unit 2: Disease surveillance and reporting. Quarantine and health certification in aquaculture. Health management strategies in Aquaculture: Vaccines, Immuno-stimulants, Bioremediation, Probiotics.

Unit 3: Crop rotation, good and best management practices. SPF and SPR stocks –development and application. Bio-security principles, Sanitary and phytosanitary Agreement, Disease control through environmental management.

Unit 4: Importance of Biofilm, Biofloc, Periphyton in aquatic Health Management, Zoonotic diseases. Principles of disease diagnosis, conventional, molecular and antibody based diagnostic methods, Rapid diagnostic methods.

B. Practicals

General procedure for disease diagnosis. Methods of sampling fish and shellfish for disease diagnosis. Taxonomy, lifecycle and identification of fish and shellfish parasites. Sampling, preparation of media and culture of pathogenic bacteria: Techniques for bacterial classification. Techniques in disease diagnosis: Microbiological, haematological, Histopathological, immunological, molecular techniques and Biochemical tests. Agglutination test; Challenge tests; purification of virus; Stress related study of fish and shellfish; Disease treatment.

36.3.3 Course Title:AAH 311-Pharmacology

Credit Hours: 3(2+1)

A. Theory

Unit 1: Introduction to Pharmacology: History, Importance, Terms and Definitions, Drug development, Screening and Nomenclature, Scope of pharmacology in fishes. Route of Administration and Method of application to fish. Source of Drugs. Pharmaco-therapeutic classification of drugs.

Unit 2: Pharmacokinetics: Biological membrane, absorption, distribution, biotransformation and Excretion of drugs. Factors influencing drug metabolism.

Unit 3: Pharmacodynamics: Principles of drug action, concept of drug receptor, nature, chemistry, classification. Functions of receptor. Transducer mechanism, second messenger, non-receptor mediated action. Dose Response Relationship, half-life withdrawal period, potency, efficacy, threshold dose, therapeutic dose, maximal dose, toxic dose, lethal dose. Factors modifying drug action, Adverse drug effects, drug interaction and Bioassay of drugs.

Unit 4: Salient features in drug acting on digestive system, nervous system and cardiovascular system. Drugs used in fish transportation. Recent advances in Pharmacology, biostatistics in experimental Pharmacology, Pharmaceutical industry.

B. Practicals

Introduction to Pharmacy, Metrology, Prescription Writing, Preparation of drug solution, Source and chemical nature of drugs, Incompatibility, Pharmaceutical technology, Bioassay of drugs, Animal models in Pharmacological experiments, Methods of application of drugs in fish.

36.3.4 Course Title: AAH 222-Therapeutics in Aquaculture

Credit Hours: 2(1+1)

A. Theory

Unit 1: Scope and current scenario of therapeutics in aquaculture.

Unit 2: Chemotherapy: History, definition, terms used and classification of AMA. Antibacterial agents, mode of action, general principles, classification, Antibiotics, different classes and their mode of action, properties etc. Antibiotic resistance. Antiseptics and disinfectants. Antiparasiticides: Ectoparasites, Endoparasites and Protozoans. Antibiotics used in aquaculture

Unit 3: Biologics: Immuno-stimulants and Vaccines-Principles in preparation/formulation, mechanism of action. Drug formulation for aquaculture-Principles in preparation/formulation, mechanism of action, drug leaching, stabilizer, binders and dosage.

Unit 4: Therapeutants in aquaculture: Classification, pesticides, fungicides/ algicides, hormones, anaesthetics, flesh color enhancers, Chemicals of therapeutic value, Law priority aquaculture drugs. Drugs used for structural material and substances for maintenance, substances connected with zoo technical practices, list of the drugs used in aquaculture with therapeutics

B. Practicals

Regulations of drug use. Introduction to antimicrobials, preparation of potassium permanganate solution, preparation of weak Tincture Iodine. Minimum inhibitory concentration (MIC). Five-plate screening test for the detection of antibiotic residue. Calculation of different disinfectants dosage in treating fishponds. Generic name, patent name, dosage and indications of various aquaculture drugs used in fish health.

36.3.5 Course Title: AAH 312-Fish Toxicology

Credit Hours: 2(1+1)

A. Theory

Unit 1: *General Toxicology:* Definitions, Branches of Toxicology, Historical developments, Classification of poison. Types of poisoning- Toxicity testing - Chronocity factor, Untoward effects, Common causes, Diagnosis of poisoning, Factors modifying toxicity, Toxicokinetics, Toxicodynamics, General approaches to diagnosis and treatment of poisoning.

Unit 2: *Systemic Toxicology:* Toxicity caused by metal and non-metals, Phytotoxins- Toxic principles of various alkaloids and toxic plants, Drug toxicity and toxicity caused by agrochemicals. Mycotoxins, Bacterial toxins. Collections and dispatch of specimens in Toxicological cases, Toxicity of drugs in Aquaculture: Maximum Residual Limits (MRL) of various drugs and chemicals in fish Metabolism of toxic substances by aquatic organisms.

B. Practicals

Detection of heavy metal poisoning. Spot tests for metals. Group reaction for metals- Arsenic, Antimony, Lead (Pb), Mercury (Hg), Zinc (Zn), Barium (Ba), Iron (Fe +), Copper (Cu), Ammonia (ammonium ions) NH₄⁺ Chloride (Cl⁻), Phosphate (PO₄³⁻) Sulphate (SO₄²⁻) Fluoride (F⁻), Qualitative detection of Nitrite and Nitrate, Detection of hydrocyanic acid, Detection and Estimation of Mycotoxins, Test for detection of alkaloids, Estimation of LD₅₀ and ED₅₀ Demonstration of drug toxicity.

36.3.6 Course Title: AAH 211-Fish Immunology

Credit Hours: 2(1+1)

A. Theory

Unit 1: Introduction, brief history to immunology. Types of immunity: Innate and adaptive immunity, cell mediated and humoral immunity, cells and organs of the immune system. Antigens – structure and types. epitopes, haptens.

Unit 2: Antibody – fine structure, classes with structure and functions, antigenic determinants on immunoglobulins. MHC complex – types, structure, and functions. Antigen-antibody interactions- principle, antigen recognition by B-cells and T cells.

Unit 3: Antigen-antibody reaction - Precipitation reactions, agglutination reactions, Microorganisms associated with fishes in health and disease. Defense mechanism in finfish and shellfish- specific and non-specific immune system. Pathogenicity and virulence. Sources of infection, transmission of disease producing organisms, portals of infection.

Unit 4: Immunity to bacteria, fungi and parasites Role of stress and host defense mechanism in disease development. Vaccines - types of vaccines – whole cell vaccine, purified macromolecules, recombinant –vector, DNA vaccines and multivalent subunit vaccines, modes of vaccine administration.

Unit 5: Serological methods in disease diagnosis. Immunostimulants – types, mechanism of action, modes of administration. Immunoassays, immunodiffusion, ELISA, immunofluorescence, neutralization, radioimmunoassay, serotyping.

B. Practicals

Collection, separation and identification of fish leucocytes. Separation of blood plasma and serum. Differential counting - RBC and WBC by Haemocytometer. Study of different types of leukocytes and isolation of macrophages. Precipitin reactions - Agglutination test, immune-gel diffusion, double immune-diffusion, radial immune-diffusion assay, ELISA. Methods of vaccine preparation and techniques of fish immunization.

36.3.7 Course Title: AAH 111-Fundamentals of Microbiology

Credit Hours: 3(2+1)

A. Theory

Unit 1: Milestones in microbiology. Contributions of Leeuwenhoek, Louis Pasteur, Robert Koch, Alexander Flemming, Joseph Lister, Winogradsky. Microscopy- Principle and construction of brightfield, dark field, phase contrast, stereo, SEM and TEM.

Unit 2: Microbial taxonomy –Bergey's and molecular taxonomy Types of Microorganisms: Prokaryotes– Morphology and ultrastructure of bacterial cell. General features, types and importance of viruses, cyanobacteria, actinomycetes, archae, mycoplasma, rickettsiae. Eukaryotes – Diagnostic features and importance of fungi and protozoa.

Unit 3: Microbial Techniques - Types of media, types of sterilization - physical and chemical agents, cultivation of microorganisms, staining techniques – simple, differential, structural staining; enumeration of micro-organisms, culture preservation methods.

Unit 4: Bacterial metabolism: Nutrient requirements, nutritional types, bacterial photosynthesis and their ecological significance. Microbial growth: Growth phases, measurement of cell growth, factors affecting growth- influence of physico-chemical factors - pH, temperature, moisture, light, osmotic pressure, fermentation-types and significance.

Unit 5: Microbial genetics- general principles, genetic recombination, transformation, transduction and conjugation. Plasmids- types and their importance. Mutation types and significance. Microbial ecology: Introduction and types of interaction.

Unit 6: Aquatic Microbiology: Introduction and scope of aquatic microbiology, aquatic environment as habitat for microorganisms - bacteria, cyanobacteria, fungi, algae, parasites and viruses.

Unit 7: Microbial biofilms. Role of microbes in the production and breakdown of organic matter. Role of microbes in sedimentation and mineralization process. Nutrient cycles-carbon, nitrogen, sulphur, phosphorus, iron, and manganese cycles.

Unit 8: Sewage microbiology, self-purification in natural waters, sewage treatment, drinking water microbiology, bioremediators.

B. Practicals

Handling of microscopes, Wet mount, smear and hanging drop preparations Micrometry- Determination of size of microorganisms (ocular, stage micrometers). Tools and techniques in sterilization methods: Filtration, dry heat, moist heat, chemical agents Cultivation technique: Media preparation, Isolation -pure culture, subculture. Observation of fungi, blue-green algae, and protozoans. Staining techniques for bacteria- simple, differential, structural and Biochemical tests: Indole, methyl red, Voges Proskauer, citrate test, oxidase test, catalase tests. Collection of water and sediment samples for microbiological analysis, Winogradsky cylinder, Isolation, identification and enumeration of various groups of microorganisms from different water bodies including aquaculture systems. Study of bacteria involved in nutrient cycles. Biofilms, water testing for potability, enumeration of coliform. Antibiotic sensitivity of bacteria - antibiotic sensitivity test - disc diffusion method.

36.4 Department of Aquatic Environment Management

36.4.1 Course Title: AEM 111-Meteorology, Climatology and Geography

Credit Hours: 2(1+1)

A. Theory

Nature of Atmosphere: weather and climate; composition of atmosphere; structure of atmosphere. Heat energy of atmosphere: process of heat transmission; heating of atmosphere; disposal of insolation; irregular heating of atmosphere. Temperature: Temperature instruments; periodic, horizontal and vertical temperature variations; effects of vertical air motion on temperature. Humidity and water vapour: relationship between temperature and humidity;

distribution of water vapour in atmosphere; evaporation, humidity instruments and measurements. Condensation and precipitation: process of conditions of condensation, forms of condensation; precipitation; forms of precipitation, measurement of precipitation; rainfall in India. Clouds: amount of cloudiness; classification of clouds; conditions of cloud formation; reporting and identification of clouds; thunderstorms. Atmospheric pressure: meaning of atmospheric pressure; pressure units; pressure instruments; vertical, horizontal and periodic variations; isobars and pressure gradients. Wind: characteristics of wind motion; wind observation and measurement; wind representation; factors affecting wind motion; monsoon winds; land and sea breeze. Tropical cyclones: storm divisions; vertical structure of storm centre; hurricane; hurricane warning. Weather forecasting: forecasting process; forecasting from local indications; role of satellite in weather forecasting; synoptic weather charts. Effects of climate change on fisheries sector. Introduction to Geography: shape, size and structure of the earth; concepts of latitude, longitude and great circles; model globe, maps.

B. Practicals:

Graphic representation of structure of atmosphere: physical layering and compositional layering. Temperature instruments: simple thermometers; Six's Max-Min Thermometer; thermograph. Humidity measurement: hygrometer; psychrometer; Condensation: observation and identification of various types of clouds. Atmospheric pressure measurement: Fortin's mercurial barometer; Aneroid barometer. Wind observation and measurement: wind vane; cup anemometer. Geography: The Earth: diagrammatic representation of shape, size, structure, zones, latitudes, longitudes and great circles.

36.4.2 Course Title: AEM 112-Soil and Water Chemistry

Credit Hours: 3(2+1)

A. Theory

Unit 1: Analytical chemistry: principles, applications and types. Classical methods of analytical chemistry, volumetry and gravimetry. Solutions: Standard solutions, titration, indicators, dilute solutions, units of concentration: standard curve; nomograph.

Unit 2: Chemistry of water: the water molecule, properties of pure water, fresh water and sea water. Composition of waters: surface water, ground water and sea water. Dissolved gasses: Factors affecting natural waters. Acid, base, salts: Hydrogen ions, modern concept of pH and buffer.

Unit 3: Water analysis: collection and preservation of water samples. Measurement of temperature, transparency, turbidity, determination of pH, electrical conductivity, salinity, chlorinity, total solids (TDS, TSS, TVS,

TVDS), dissolved oxygen, free carbon dioxide, total alkalinity, total hardness, Calcium, Magnesium, Inorganic Nitrogen (Ammonium and Nitrate) and phosphorus. Water quality criteria/ requirements for Aquaculture.

Unit 4: Soil Chemistry: origin and nature of soils. Physical properties of soil; soil colour, texture, structure, pore size, bulk density, water holding capacity. Soil types and their distribution. Soil chemistry: soil colloids, cation exchange, organic carbon, Carbon - Nitrogen ratio, soil fertility.

Unit 5: Soil reaction: acidity, alkalinity, conductivity, redox - potential. Submersed soils: wet lands, peat soils, fluxes between mud and water, methane and hydrogen sulphide formation. Saline soils, Alkali soils, acid sulphate soils, iron pyrites, soil reclamation.

Unit 6: Soil analysis: collection and preparation of soil samples. Determination of soil texture, water holding capacity, pH, conductivity, organic carbon, nitrogen, phosphorus, lime requirement. Soil and water amendments: lime manures, fertilizers, micronutrients, zeolites, alum, gypsum. Environmental ameliorative: chlorination, deodorizers, bacterial formulation. Soil quality criteria/ requirements for aquaculture.

B. Practicals

Principles of Titrimetry, Gravimetry, Potentiometry, Conductometry, Refractometry, Colorimetry, Turbidimetry, Spectrophotometry (UV, Visible, Flame, AAS), computerized instrument system. Demonstration: demonstration of laboratory glass wares and equipment used in water and soil analysis. Water analysis: measurement of temperature, turbidity, determination of pH and EC. Determination of salinity, Chlorinity, Total solids, Redox potential, DO, Free CO₂. Determination of total alkalinity, hardness. Determination of inorganic nitrogen, and phosphorus. Soil analysis: Determination of soil texture, soil pH, conductivity, soil available nitrogen, available phosphorus, and organic carbon.

36.4.3 Course Title: AEM 121-Limnology

Credit Hours: 3(2+1)

A. Theory

Unit 1: Introduction to limnology: inland water types, their characteristics and distribution; ponds and lakes; streams and rivers; dynamics of lentic and lotic environments. Lakes - their origin and diversity. Famous lakes of the world and India; nature of lake environment; morphometry, physical and chemical conditions and

related phenomena; biological relations: influence of physical and chemical conditions on living organisms in inland waters.

Unit 2: Plankton: planktonic organisms; classification of plankton; distribution of plankton: geographic, vertical, horizontal and seasonal distribution of phytoplankton and zooplankton; seasonal changes of body form in planktonic organisms; food of planktonic organisms; primary productivity:

Unit 3: Aquatic plants: characteristics, classification, zonation, seasonal variations, quantity produced chemical composition distribution in different waters, limnological role.

Unit 4: Nekton: composition, distribution, movements. Benthos: classification; periphyton; zonation; distribution; movements and migration; seasonal changes in benthos, profundal bottom fauna.

Unit 5: Biological productivity: circulation of food material; classification of lakes based on productivity; laws of minimum; biotic potential and environmental resistance; quantitative relationships in a standing crop; trophic dynamics; successional phenomena; indices of productivity of lakes; artificial enrichment.

Unit 6: Lotic environments: running waters in general; physical conditions; classification of lotic environments, biological conditions; productivity of lotic environments. influence of currents; plant growth; plankton; nekton; benthos; temporary and head waters streams; ecological succession.

B. Practicals

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 freshwater bodies. Collection and identification of freshwater zooplankton. Enumeration and biomass estimation of freshwater zooplankton. Collection and identification of benthos from lakes and ponds, streams and canals. Collection and identification of nekton/aquatic insects from freshwater bodies. Collection and identification of aquatic plants from different freshwater bodies. Field visit to lotic and lentic water bodies.

36.4.4 Course Title: AEM 212-Fishery Oceanography

Credit Hours: 2(1+1)

A. Theory

Unit 1: Introduction to Oceanography: classification; expeditions national and international. Earth and the ocean basin, distribution of water and land; relief of sea floor; Major feature of topography and terminology; major divisions. Relief in Indian oceans.

Unit 2: 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 3: 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 the world. El-Nino.

Unit 4: Physical properties of sea water: Salinity and chlorinity; temperature; thermal properties of sea water; colligative and other properties of sea water; 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 5: Chemistry of sea water: Constancy of composition; elements present in sea water; artificial sea water; dissolves gases in sea water; CO₂ system and alkalinity; inorganic agencies affecting composition of sea water distribution of phosphorus, nitrogen compounds, silicates and manganese in the oceans, factor influencing their distribution.

B. Practicals

Field visits and operation of oceanographic instruments- Nansen reversing water sampler, Bathythermograph, Grabs, Corers, Current meters, Tidal gauges, Echo-sounder. Measurement of temperature, Transparency, pH. Determination of DO, Salinity, Ammonia, Nitrate, Nitrite, Phosphate and Silicate in sea water.

36.4.5 Course Title: AEM 122-Marine Biology

Credit Hours: 3(2+1)

A. Theory

Introduction to Marine Biology: Divisions of marine environment- pelagic, benthic, euphotic, aphotic divisions and their subdivisions. Life in oceans - general account of major groups of phytoplankton, sea weeds, major zooplankton groups. Environmental factors affecting life in the oceans-salinity, temperature, light, currents, waves, tides, oxygen, and carbon dioxide. Vertical migration of zooplankton, Phytoplankton-Zooplankton relationship, geographical and seasonal variation in plankton production, plankton and fisheries. Inter tidal ecology: Rocky shore, sandy shore and mud flats, zonation, communities, and the adaptation. Mud banks: formation, characteristics. Estuaries: Classification, Physico-chemical factors, Biota and productivity, examples of some Indian Estuaries. Boring and fouling organisms. Nekton outline, composition of nekton, habitats of nekton. Bioluminescence and indicator species, Blooms, Red tides: cause and effects.

B. Practicals

Study of common instruments used for collection of phytoplankton, zooplankton and benthos. Collection, preservation and analysis of phytoplankton, zooplankton, sea weeds, Collection preservation and analysis of inter tidal organisms.

36.4.6 Course Title: AEM 211-Aquatic Ecology, Biodiversity and Disaster Management

Credit Hours: 3(2+1)

Theory

Unit 1: Aquatic environment, Flora and fauna: Components of aquatic systems, Aquatic productivity, nutrient cycles, energy flow, food chain. Animal associations: Symbiosis, commensalisms, parasitism, prey-predator relationship, host parasite relationship.

Unit 2: Aquatic biodiversity-its importance, species diversity, genetic diversity, habitat diversity, diversity indices. Ecological and evolutionary processes. Ecological niches – lagoons, estuaries, mangroves, coral reefs, flood plains, coastal wetlands, bheels, oxbow lakes.

Unit 3: Threats to biodiversity- habitat destruction, introduction of exotic species, Conservation of habitats, marine parks and sanctuaries. Conservation programmes for endangered species, *ex situ* and *in situ* conservation, captive breeding and management of endangered species. Various national and international conventions and regulations concerning biodiversity, including use of selective gears and exclusion devices.

Disaster Management in Fisheries:

Unit 4: Basic concepts: Hazard, risk, vulnerability, disaster, capacity building. Multi-hazard and disaster vulnerability of India. Types of natural and manmade hazards in fisheries and aquaculture - cyclones, floods, droughts, tsunami, El-nino, algal blooms, avalanches, pollution, habitat destruction, overfishing, introduction of exotic species, landslides, epidemics, loss of bio-diversity etc. Causes, characteristics and effects of disasters. Management strategies: pre-disaster, during disaster and post-disaster.

Unit 5: 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 6: During disaster: response and recovery systems at national, state and local, coordination between different agencies, international best practices.

Unit 7: Post- disaster: Methods for assessment of initial and long-term damages, reconstruction and rehabilitation. 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. Acquaintance with fire-fighting devices. Life-saving appliances and first-aid. Uses of distress signals and technologies. Relief and rehabilitation measures, trauma counselling.

B. Practicals

Collection of species of fishes and other organisms and studying the assemblages of organisms of rocky, sandy and muddy shores, lentic and lotic habitats. Observation of adaptive characters and interrelationships like commensalisms, symbiosis, parasitism and predation. Field visits to mangroves, marine parks, sanctuaries, coral reefs, rivers, hills, streams, lakes and reservoirs. Working out biodiversity indices.

36.4.7 Course Title: AEM 221-Aquatic Pollution

Credit Hours: 2(1+1)

A. Theory

Unit 1: Introduction to aquatic pollution, the sources of pollutants, toxic organic compounds and their impacts in the aquatic organisms and the abiotic environment, Classification of pollution-physical, chemical and biological classification of water pollution- description of terminologies.

Unit 2: Sewage and domestic wastes- composition and pollution effects- sewage treatment and its reuse. Agricultural wastes- organic detritus, nutrients, Adverse effects of oxygen demanding wastes: importance of dissolved oxygen; Oxygen demand; BOD; COD; Oxygen budget; Biological effects of organic matter.

Unit 3: Excessive plant nutrients: Eutrophication; Red tides and fish kills. Pesticide types and categories; inorganic pesticides, Organochlorine compounds, Organo-phosphorous compounds; Polychlorinated biphenyls (PCBs); Bioaccumulation and impact on aquatic fauna and human health; toxicology.

Unit 4: 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 5: 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.

Unit 6: 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. Solid waste management.

B. Practicals

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 and coliform bacteria. Bacteriological quality of water; Colliform tests, IMVIC test, standard plate count, methods of enumerating bacterial biomass in waters and waste waters. Pollution flora and fauna: indicator species- algae, protozoa and insect larva. Methods of pesticide residue analysis in waters and fish tissue; bioassay and toxicity study.

36.4.8 Course Title: AEM 322-Coastal Zone Management

Credit Hours: 2(1+1)

A Theory

Unit 1: Estuaries, Wet lands and Lagoons, Living resources – Non-living resources. Principles of remote sensing: orbits, electromagnetic radiation, diffraction, electro-optical, and microwave systems. Data Input, Data Management, Data Quality. Remote Sensing for Coastal Management.

Unit 2: Geographical Information System (GIS): Definition, Concepts, Data Acquisition and Data Management. Applications of GIS in aquatic resource identification. Coastal Regulation Zone (CRZ) Act, Coastal regulation zones for main land and islands – Environmental policies, planning, administrative and regulations. CRZ mapping.

Unit 3: Integrated Coastal Zone Management (ICZM); concept, application and case studies. Communication, research, integration, institutional arrangements, regulations, stakeholder participation, the role of the private sector in ICZM. Impacts of human activities on coastal and ocean areas: Challenges related to climate change, expanding tourism, declining fisheries, intensive shipping and biodiversity protection. Problems related to sectors such as tourism and fisheries in the ICZM context; Analysis of multiple use management problems typical for the coastal areas with the maritime industry.

Unit 4: Environmental Impact Assessment (EIA): Principles and process. EIA of coastal industries. Evaluation and Methodology; Social Impact Assessment and other developmental activities.

B. Practicals

Field visit to different coastal environments to study erosion of beaches, Identification of ecologically sensitive areas and protection, Study of CRZ, ICZM along the coastal belt, Study on implementation and violation of CRZ, Study of application of remote sensing and GIS, Project preparation of EIA.

36.5 FISH PROCESSING TECHNOLOGY

36.5.1 Course Title: FPT 111-Fish in Nutrition

Credit Hours: 1(1+0)

A. Theory

Unit 1: Composition of fish with emphasis on nutritional value. Concept of Biological value, Protein Efficiency ratio, Net protein utilization. Amino acids of fish and shellfishes and importance of essential amino acids.

Unit 2: Fish lipids: fatty acids, nutritional quality. Role of fish lipids in human nutrition. Non-protein nitrogen substances in fishes.

Unit 3: Vitamins in fish: water soluble, fat soluble, significance in human nutrition. Minerals in fish: micro- and macro-elements, trace elements, significance in human nutrition. Other functional biomolecules in fish – peptides, collagen and squalene. Effect of different kinds of cooking fish ie. curry, frying, steaming, smoking, fermentation on nutrition value.

36.5.2 Course Title: FPT 121-Food Chemistry

Credit Hours: 3(2+1)

A. Theory

Unit 1: Composition of food and nutritional value. Moisture in foods. Biological oxidation, electron transport chain, P/O ratio; oxidative phosphorylation.

Unit 2: Carbohydrates: Naturally occurring polysaccharides in foods. Seaweed polysaccharides – sources and uses. Browning reactions – enzymatic and non-enzymatic.

Unit 3: Lipids: metabolism of lipids, oxidation of fatty acids, lipoproteins; VLDL and HDL and their importance.

Unit 4: Proteins: metabolism, deamination, decarboxylation, metabolic fate of amino acids, nitrogen balance. Fish muscle proteins, chemical changes in muscle during contraction. Proteins in foods, role in hydration- native and denatured proteins, gel formation, functional properties of proteins, changes during heat treatment and processing, texturised proteins.

Unit 5: Chemistry of taste, flavour and odour components in foods, flavour intensifiers, synthetic flavouring substances. The taste of fish and shellfish. Food additives - types and their chemical nature, emulsifiers and antimicrobial additives, sequestrants, flavour potentiators surface active agents; non-nutritive sweeteners, colour additives in food.

Unit 6: Assessment of quality of food by instrumental and chemical methods. Nutritive value of foods. Energy value and energy requirements and their estimation. Water, electrolytic and acid-base

balance. Nutritive value of proteins PER, BV digestibility coefficient, NPU values, pepsin digestibility. Role of fibre in human nutrition.

B. Practicals

Estimation of moisture, crude protein, fat, ash (including acid soluble) in fish sample. Determination of energy value of fish. Estimation of glucose and salt content in foods. Colorimetric method of estimation of proteins and carbohydrates. Use of pH meter. Estimation of freshness quality indices such as TVBN, TMA, alpha-amino nitrogen, PV, FFA, TBA value of fish. Estimation of fibre in foods.

36.5.3 Course Title: FPT 122-Freezing Technology

Credit Hours: 2(1+1)

A. Theory

Unit 1: Introduction to freezing technology; characteristics of fish and shellfish; changes in fish after death, spoilage of fish, spoilage and pathogenic microorganism. Handling of fresh fish; sanitation in processing plants. Principles of low temperature preservations.

Unit 2: Chilling of fish – methods and equipment for chilling; icing – quality of ice, ice making; refrigerated or chilled sea water, chilling rate; spoilage of fish during chilled storage; use of antibiotics and chemicals.

Unit 3: Freezing of fish fundamental aspects; heat units; freezing point depression, eutectic point; freezing rate; methods of freezing, freeze drying, physico– chemical changes that occur during freezing, mechanism of ice crystal formation; preparation of fish for freezing.

Unit 4: Changes that occur during frozen storage – microbiological, physical and chemical changes, protein denaturation, fat oxidation, dehydration, drip; protective treatments – polyphosphate, glazing, antioxidants, packaging; thawing of frozen fish – methods of thawing. Transportation of frozen fish, cold chain, quality control, HACCP in freezing industry.

B. Practicals

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 ice plants, cold storages and freezing plants.

36.5.4 Course Title:FPT 221-Fish Canning Technology

Credit Hours: 2(1+1)

A. Theory

Unit 1: Introduction to canning and its historical developments. Advantages of canning in relation to other preservation methods. Raw materials and sub materials, their characteristics and suitability for canning. Classification of foods based on pH, commercial sterility, Absolute sterility, pasteurisation and sterilization.

Unit 2: Canning process, process flow steps involved HTST and aseptic canning. General steps in canning procedure and importance, preparation of raw material, packing, pre-cooking, exhausting, seaming, retorting, cooling labelling and storage.

Unit 3: Principles of thermal processing. Heat resistance of microorganisms, heat penetration studies, mechanism of heat transfer. Cold spot and its importance, convection and conduction type of packs. Process calculation by general/ graphical methods, estimation of Fo value of the process (D-value, Z-Value TDT, F-value, lethal rate). Commercial sterilization, 12-D concept.

Unit 4: Canning of commercially important fin fishes, shell fishes and cephalopods. Spoilage of canned foods, types, causes and preventive measures. Quality standards, plant layout, hygiene and sanitation and waste disposal. Types of packaging materials for canned foods, metal containers (Tin Plate, TFS, Aluminium cans) and retort able pouches.

B. Practicals

Types of cans, canning equipment's and layout of cannery. Canning of different varieties of fish and shellfish. Cutout test of canned products. Examination of can double seam. Heat resistance of bacteria. Heat penetration in canned food, thermal process calculation by general method. Study of spoilage condition in canned products. Familiarization with various packaging materials and container for fish products.

36.5.5 Course Title: FPT 222-Fish Packaging Technology

Credit Hours: 2(1+1)

A. Theory

Unit 1: Introduction to packaging, Importance of packaging in fish processing, functions, objectives and requirements. Packaging materials, basic and laminates, principles of their manufacture and their identification. Properties of packaging materials and their use in protective packaging with special reference to food. Printing for packaging and print identification. Closures of packaging, heat seals bottle closure.

Unit 2: Principles of packaging fresh produce handling and transportation. Packaging for retail sale and storage. Packaging equipment and machinery. Package design, evaluation and testing.

Unit 3: Flexible packaging materials, rigid containers, thermoform containers, glass containers, corrugated fiber boards, duplex cartons, edible packaging materials. Laminations and co-extrusions.

Unit 4: Retort pouch packaging - advantages and disadvantages. Biodegradable films, vacuum packaging, active packaging, MAP, Polymeric Packaging. Packaging requirements of fresh fish, Frozen fish, Canned Fish.

Unit 5: Transport worthiness of packaging materials, accelerated shelf testing. Materials and their safe use in food contact application. Safety and legislation aspects of packing. Labeling and bar coding.

B. Practicals

Determination of grammage of paper and board, bursting strength, burst factor, punctures resistance, water proofness, stiffness of the board, ring stiffness of paper and board, flat crush, tensile strength and elongation at break of plastic films, density of plastic films, breaking length, impact strength of plastic films, tearing strength of paper and plastic films, water vapour transmission rate, oxygen transmission rate, heat seal strength, suitability of plastic films for food contact applications, evaluation of retort pouch, identification of plastic films.

36.5.6 Course Title: FPT 311-Fish Products and Value Addition

Credit Hours: 3(2+1)

A. Theory

Unit 1: Principle of fish preservation and processing. Processing of fish by traditional methods— salting, sun drying, smoking, marinating and fermentation. Theory of salting, methods of salting—wet salting and dry salting.

Unit 2: Drying and dehydration- theory, importance of water activity in relation to microbial growth. Sun drying and artificial drying- solar dryer.

Packaging and storage of salted and dried fish. Different types of spoilage in salt cured fish. Quality standard for salted and dry fish.

Unit 3: 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 method store move them.

Unit 4: Hurdle technology in fish preservation and processing. Marinaded and fermented fish products–role of acid sin marinades, Fish and prawn pickles, fish sauce and Fish paste, traditional Indian fermented products. Fermented fish products of Southeast Asia. Principles and methods of preparation of various fish paste products like fish sausage, fish ham, surimi, fish cake, kamaboko etc.

Unit 5: Fish muscle structure, myofibrillar proteins and their role in elasticity formation. Extruded products – theory of extrusion, equipment used, advantages of extruded products, methods of preparation of extruded products.

Unit 6: Value addition. Diversified fish products: battered and braided products-fishfinger, fish cutlet, fish wafer, and fish soup powder etc. And imitation products. HACCP safe products production.

B. Practicals

Preparation of salted fish, dried fish and smoked fish by different methods. Quality assessment of salted, dried and smoked fish. Preparation of prawn & fish pickles. Preparation of fermented fish sauce and marinaded products. Preparation of surimi and surimi-based products. Preparation of diversified and value-added fish products. Quality assessment of market sample of dried and fermented fish products.

36.5.7 Course Title: FPT 322-Fish By-Products and Waste Utilization

Credit Hours: 2(1+1)

A. Theory

Unit 1: Fish meal. Dry reduction and wet reduction methods – specification – packaging and storage. Fish oil – body oil – liver oil – extraction – purification – preservation – storage – application.

Unit 2: Shrimp wastes – chitin – chitosan-production – uses. Fish protein concentrate. Fish hydrolysate, partially hydrolyzed and deodorized fish meat, functional fish protein concentrate and their incorporation to various products.

Unit 3: Fish silage – acid silage – fermented silage – application. Fish maws, shark leather, fish glue, fish gelatin, isinglass, pearl essence, shark

fin rays, beach-de-mer. Biochemical and pharmaceutical products. Utilization of seaweeds: agar-agar, algin, carrageenan.

B. Practicals

Preparation of fish meal, fish body oil, fish liver oil, fish maws, isinglass, fish silage, ensilage, fish glue, fish gelatin, fattice, pearl essence, chitin, chitosan and fish manure. Preparation of acid and fermented silage. Preparation of fish protein concentrate and fish hydrolysate.

36.5.8 Course Title: FPT 321-Microbiology of Fish and Fishery Products

Credit Hours: 3(2+1)

A. Theory

Unit 1: Introduction and history of microorganisms in foods. Role and significance of microorganisms in nature and in foods. Sources and types of microorganisms in fish and fishery products. Factors (intrinsic and extrinsic) affecting the growth and survival of microorganisms in food.

Unit 2: Enumeration of microorganisms in food by conventional and rapid techniques. Microbial principles of fish preservation and processing by application of low temperature, high temperature, drying, irradiation and chemicals. Microbiology and spoilage of fresh, semi processed and processed fish and fishery products. Indicators of microbiological quality of fish and fishery products.

Unit 3: Food borne pathogens involved in infective and intoxication type of food poisoning – *Vibrio cholerae*, *Vibrio parahaemolyticus*, *E. coli*, *Salmonella*, *Listeria monocytogenes*, *Clostridium botulinum*, *C. perfringens*, *Campylobacter* and *Staphylococcus aureus* – their occurrence, growth, survival, pathogenicity and prevention.

Unit 4: Other biological hazards associated with fish and fishery products- marine toxins-shellfish toxins, scombroid toxins, ciguatera toxins and puffer fish toxins; mycotoxins, parasites and viruses.

B. Practicals

Sampling and processing of samples for microbiological investigation. Enumeration of microorganisms associated with finfish, shellfish, water and ice. Testing of water for potability. Isolation and identification of pathogenic bacteria associated with fish and fishery products-*Vibrio cholerae*, *Vibrio parahaemolyticus*, *E. coli*, *Salmonella*, *Listeria monocytogenes* and Faecal *streptococci*. Biochemical tests for characterization of bacteria. Molecular methods for the detection of pathogenic microorganisms. Determination of MIC and MCC of chemical preservatives.

36.5.9 Course Title: FPT 421-Quality Assurance of Fish and Fishery Products

Credit Hours: 3(2+1)

A. Theory

Unit 1: Quality dimensions of seafood – sensory, intrinsic, quantitative and affective parameters. Pre-harvest and post-harvest factors affecting quality. Assessment of quality changes in fresh and iced fish. Quality changes during processing. Importance of quality, definitions and terminologies.

Unit 2: Application of HACCP concept in surveillance and quality assurance programs for raw, frozen, canned, cured, irradiated, cooked and chilled, modified atmosphere packaged and freeze-dried products. Risk assessment, principles of plant hygiene and sanitation, pest control, personnel hygiene, planning and layout, equipment construction and design.

Unit 3: Food laws and standards, national and international legislation, mandatory and non-mandatory standards. Role of export inspection council & export inspection agency and MPEDA in fish and fishery products. Executive instructions on fish and fishery products, Legislation for export quality assurance in India.

Unit 4: Certification system for fish & fishery products. Legal basis for monitoring products related EU requirements. Scheme for approval and monitoring of establishments/factory vessels/ freezer vessels processing/storing fish & fishery products for export. Complaint handling procedure on fish and fishery products. Interpretation of test reports and limits on chemical residues. GOI notifications on fish and fishery products. General requirements for export of fish and fishery products to the EU.

Unit 5: International regulatory framework for fish safety and quality. Prerequisites to HACCP, labelling for product traceability and Labelling requirements- National and international, legislation on labelling, components of traceability code-nutrition facts and nutrition labelling, specific requirements of nutrition labelling, food meant for specific age group and convalescing people. EU legislation on traceability of fish and fish products,

Unit 6: Assessment of food safety programs, The HACCP for seafood industries and protection of food from adulterants. Standards for sea foods. FSSAI, FDA, ISO. Use of additives in seafood processing as quality enhancers. Seafood safety, authenticity, traceability. Waste management in seafood processing.

B. Practicals

Assessment of quality of fresh fish by sensory, biochemical, and instrumental methods. Chlorination and Hardness estimations. Quality analysis of canned, frozen, cured and pickled fish products. Quality tests for tin and corrugated containers. Assessment of plant, equipment sanitation and personnel hygiene. Detection of filth and extraneous matter in traditional processed products.

36.6 Department of Fisheries Engineering

36.6.1 Course Title: FEG 322-Aquaculture Engineering

Credit Hours: 3(2+1)

A. Theory

Unit 1: Fish Farm- Definition, objectives, types of farms; fresh water, brackish water and marine farms. Selection of site for aqua farm- site selection criteria, pre-investment survey viz., accessibility, physical features of the ground, detailed survey viz., site condition, topography, soil characteristics.

Unit 2: Land Surveying- definition, principles of surveying, classification of surveying, instruments used for chaining, chaining on uneven or sloping ground and error due the incorrect chain length. Chain surveying- definitions, instruments used for setting out right angles, basic problems in chaining, cross staff survey. Compass surveying - definitions, bearing, meridians, whole circle bearing system, reduced bearing system, theory of magnetic compass, prismatic compass.

Unit 3: Leveling definitions, methods of leveling, leveling instruments, terms and abbreviations, types of spirit leveling. Plane table surveying- instruments required, working operation, methods. Contour surveying- definition, contour interval, characteristics of contour, contouring methods and uses of contour.

Unit 4: Calculation of area of regular and irregular plane surfaces, Trapezoidal and Simpson's rule, volume of regular and irregular shape as applied to stacks and heaps, calculation of volume of pond. Earth work calculations- excavation, embankment, longitudinal slope and cross slope, calculation of volume of earth work as applied to roads and channels.

Unit 5: Soil and its properties- classification of soil; soil sampling methods; three phase system of soil, definitions of soil properties and permeability of soil.

Unit 6: Ponds - classification of ponds; excavated ponds, embankment ponds, barrage and diversion ponds; rosary system and parallel system.

Planning of fishponds, layout planning, materials planning, manual planning, comparison of square and rectangular ponds, large and small ponds; Types of ponds; nursing ponds, rearing ponds and stocking ponds. Design of ponds, pond geometry; shape, size, bottom slope of pond *etc.*, construction ponds viz., marking, excavation *etc.*, Dykes, types of dykes viz., peripheral dykes, secondary dyke, design of dykes, construction of dykes.

Unit 7: Water distribution system- canal, types of canals; feeder canal, diversion canal *etc.*, Pipeline system, Water control structures- types of inlets and out let and their construction. Water budget equation, Pond drainage system; seepage and the methods used for seepage control, evaporation; factors affecting evaporation, erosion of soil in dykes and its control. Site selection, planning and construction of coastal aqua farms. Brackish water fish farms- tide fed, pump fed farms, site selection - topography, tidal amplitude, soil and water sources *etc.*,

Unit 8: Hatcheries- site selection, infrastructural facilities; water supply system, main hatchery complex viz., Layout plan and design of hatcheries- brood stock ponds, artemia hatching tanks, sheds *etc.*, Raceway culture system- site selection, layout plan, types of raceway culture system viz., parallel system, series system *etc.*,

Unit 9: Aerators- principles, classification of aerators and placement aerators. Pumps- purpose of pumping, types, selection of pump, total head, horsepower calculation. Filters- types and constructions.

B. Practicals

Evaluation of potential site for aquaculture. Land survey – chain surveying, compass surveying, leveling, plane table surveying and contouring; soil analysis for farm construction. Design and layout plan of fresh water and brackish water farms and hatcheries. Design of farm structure: ponds, dykes and channels. Earth work calculations and water requirement calculation. Visit to different types of farms.

36.6.2 Course Title: FEG 211-Refrigeration and Equipment Engineering

Credit Hours: 3(2+1)

A. Theory

Unit 1: Fundamentals: Force, work, power, energy, volume, pressure, temperature. Heat, specific heat, sensible heat, latent heat, comparison between heat and work-A path function.

Unit 2: Thermodynamics: Laws of Thermodynamics, Laws of perfect gases, Thermodynamic processes, Application of First and Second law of Thermodynamics in refrigeration, Thermodynamics cycle, entropy, enthalpy.

Unit 3: Refrigeration: History of refrigeration, Definition, principle, classification, Types of refrigeration systems i.e., Air refrigeration, vapour absorption refrigeration system. Vapour compression refrigeration system.

Unit 4: Refrigeration plant: Layout of refrigeration plant, Construction. Insulating materials used for the cold storage construction, Frozen product storage capacity of cold storage, usage of Ante-room.

Unit 5: Refrigeration systems: Vapour compression refrigeration system advantages and disadvantages as compared to other refrigeration systems, Types of Vapour compression refrigeration cycles i.e., Theoretical Vapour compression refrigeration cycle, Actual refrigeration cycle.

Unit 6: Compressors: Definition, Types of compressors, construction, working principle advantages and disadvantages. Evaporator: Definition, Types of Evaporator, construction, working principle advantages and disadvantages. Condenser: Definition, Types of Condenser, Cooling Towers, construction, working principle, advantages and disadvantages. Expansion valve: Definition, Types of Expansion valve, construction, working principles advantages and disadvantages. Refrigerant: Primary refrigerant, secondary refrigerant, properties, ideal refrigerant, leakage detection.

Unit 7: Study of auxiliary equipment: Receiver, oil charging, refrigerant charging, gas purging, oil draining, types of defrosting. Ice-plant: Ice plant planning Brine tank construction, preparation of brine, Types of ice, Storage of ice, Equipment used in ice plants.

Unit 8: Freezers: Definition, Design and construction of freezers i.e. Plate freezer, Blast freezer, Tunnel freezer, spray or immersion freezers, refrigerated fish rooms and fish hold. Alternative refrigeration technique arrangements used onboard the fishing vessel i.e., Refrigerated-sea water (RSW), Chilled-sea water (CSW). Refrigerated transport.

Unit 9: Cooling load: Unit of refrigeration, coefficient of performance (C.O.P), Refrigeration effect, study and use of Psychometric chart. Cooling load estimation, introduction, components of cooling load, heat gain through walls, roofs, products, occupants, lighting equipment.

Unit 10: Theory of machines: Transmission of power, friction wheels, shaft, gears, belt and Chain drive. Study of equipment used in fish processing with particular reference to canning, sausage, freeze drying and irradiation.

Unit 11: Maintenance: Definition, Types of maintenance, general maintenance of freezing plant, cold storage and ice plant.

B. Practicals

Drawing of Refrigeration and Fish processing machineries plant layout, graphically represented symbols used in refrigeration, Handling and operation of compressors, condensers, evaporators expansion valves, low and high pressure switches. Study of auxiliary equipments: Receiver, oil charging, refrigerant charging, gas purging, oil draining, types of defrosting. Power transmission line diagram of different fish processing machineries. Visit to processing plant refrigeration plant, Visit to ice plant, Visit to fishing harbor to study the fish hold, refrigerated fishrooms. Calculation on refrigeration effect and cooling load.

36.6.3 Course Title: FEG 221-Fishing Craft Technology

Credit Hours: 2(1+1)

A. Theory

Unit 1: Introduction: History & development of fishing crafts. Traditional fishing crafts of India. Classification of fishing crafts based on fabrication dimension, nature of fishing, depth of operation. History & development of mechanization of fishing crafts.

Unit 2: Basic geometric concepts and important terminologies of fishing vessel. Form coefficients, properties of irregular shapes Calculation of longitudinal and transverse sectional area of fishing craft by using Trapezoidal rule and Simpson's rules. State of equilibrium; Volume of displacement; centre of gravity (CG); centre of buoyancy (CB); vertical centre of gravity (VCB); longitudinal centre of gravity (LCB).

Unit 3: Stability of fishing vessels- longitudinal and transverse. Various equilibrium of ships-stable, unstable and neutral; Light weight, Dead weight, Tonnage system; Gross Registered Tonnage (GRT), Net Registered Tonnage (NRT).

Unit 4: Boat building materials: Choice of construction materials: Wood, properties, advantages and disadvantages. Deck fitting. Maintenance of fishing vessels, fouling and boring organisms; seasoning and preservation of wood.

Unit 5: Constructional details of boat: Offset tables; Mould lofting; Backbone assembly of wooden boat. Constructional details of Steel, FRP, Ferro Cement and Aluminum boats. Introduction of Outboard and inboard engines.

B. Practicals

Studies on traditional fishing crafts; Introduction to drawing and drawing instruments; Lettering, Geometrical construction, Curves. Projections; Projection of points, planes and Projection of solids; lines plan drawing; Drawing of back bone assembly; U & V bottom hull of wooden boat; General view of boat; Drawing of sheer plan, body plan

and half breadth plan; Types of marine engines and their installation of engines. Visit to boat building yard and dry dock.

36.6.4 Course Title: FEG 321-Navigation and Seamanship

Credit Hours: 2(1+1)

A. Theory

Unit 1: Principles of navigation –terms and definitions, finding positions and method of position fixing magnetic Compass-parts and functions, cardinal, inter cardinal, three letter and lay points pelorus and azimuth mirror, method of observation.

Unit 2: Sextant -parts and functions, finding adjustable and non adjustable errors and principles and use. Hand lead line –construction and markings and method of taking soundings. Types of speed logs – patent log, impeller log.

Unit 3: Types of marine charts, Mercator and gnomonic projections great circles and rumba lines, chart collections and chart readings, chart observation and fixing positions. The IALA-buoy age systems, cardinal and lateral marks, meaning of shapes, colors and lights top marks and explanation of approaching.

Unit 4: International code of signals, flag signals mars code and storm signals general system, brief system and extended system, storm signals stations Indian coasts, Fog signals, types and methods. Distress- signals, methods, types and communication international regulations for preventing collision at sea and recognition of lights and shapes at sea. Observation of radar and parts and functions of radar, aneroid barometer, parts and functions of echo sounder, and sonar, observation of GPS

Unit 5: Principles of seamanship- Causes fire at sea, fire prevention on board the vessel and method of fire-fighting at sea and recommended fire-fighting appliances, Life-saving appliances –life jackets, life buoys and method of operations and contents, SART and EPIRB. Observations of storms, formation of storms and method of locating the eye of the storms and method of escaping from the center of the storms as per buys ballet law.

Unit 6: Preparing vessel to face heavy weather. Temporary repairs for leaks constructions of steering system and rigging emergency jury rudder. Types of anchors and their applications. selection of suitable anchorage, procedure for anchoring anchor watch and procedure to combating dragging of anchor, method of standing moor and running moor, open moor berthing procedures, axial thrust, transverse thrust

mooring and securing the vessel to the jetty rigging fenders and gangways, and method of leaving vessels from the berth.

Practicals

Anchoring, coming alongside the berth and leaving, practicing the different types of knots and wire splices, use of magnetic compass, GPS, Echo-sounder. CHART WORK-Finding positions by latitudes and longitudes by position lines by cross bearing, horizontal sextant, angles, vertical sextant angle and by running fix, finding position by speed, distance and time findings set and drift of current and findings course made good speed made good and steering course and finding position by counter acting the current observation of RADAR

36.6.5 Course Title: FEG 311-Fishing Gear Technology

Credit Hours: 2(1+1)

A. Theory

Unit 1: Development fishing gears and Fishing Technology: Evolution of Fishing gears; Mechanization of Fishing; Basic classification of fishing gears- Principle, Subsidiary and Auxiliary gears. Classification of fishing gears and methods: FAO classification of fishing gear and methods of the world; International Standard Statistical Classification of Fishing gear (ISSCFG).

Unit 2: Fishing gear materials: Natural materials and Synthetic netting materials and their classification. Types and important synthetic materials used in fishing gears. Raw-materials for synthetic material; Preparation of nylon (PA 6.66) material; Different types of fibres-continuous fibre; monofilament, staple and split fibers and production of single yarns. Identification of synthetic fishing gear materials: Visual observation, water test, solubility test, burning test and melting point test.

Unit 3: Construction of twisted netting materials: Yarn, single yarns, folded yarns, netting twine, cable netting twine and cable netting twine of higher order; Construction of ropes and their higher order; construction of braided netting twines.

Unit 4: Yarn numbering system - direct system: Tex system Denier system and calculation of resultant tex value. Indirect system: British count, metric count, runnage system and their conversion. Methods of Preparation of knotted and knotless webbing, advantage and disadvantages of knotted and knotless webbings. Shape of mesh: diamond; square hexagonal and their measurement.

Unit 5: Properties of netting material: physical properties- Density, twist and amount of twist, Breaking strength-tenacity, & tensile strength, breaking length, abrasion resistance, elasticity, extensibility, water absorption &, shrinkage, sinking velocity, weather resistance, melting point and visibility. Chemical and Biological properties.

Unit 6: Floats – buoys – its materials, types their properties; Classification of floats: based on shape and materials; calculation of buoyancy. Sinkers – types, materials, properties- negative buoyancy. Factors to be considered while designing /selection of fishing gears; Biological, Environmental, oceanographical, Vessel characteristics and mesh size regulation.

Unit 7: Choice of netting materials for trawl, gillnet and purse seine. Classification of trawl gears. 2 seam trawl; 4 seam trawl and wing trawl. Design and construction of wing trawl. Rigging of trawl gear: Arrangements of bridles, sweep lines and attachment of ground gears: tickler chain, bobbins and rock hoppers and attachment of otter board

B. Practicals

Study of net making tools; Knots and hitches used in net making. Methods of net making: Hand braiding- Chain mesh method and loop methods of net making. Shaping of webbing: baiting, creasing and reducing mesh size step by step. Tailoring method: T and N direction of webbing; T-cuts, N-cuts, B-cuts and their combination. Joining of net pieces. Net mounting – hanging coefficient, hung depth and their calculation. Selvedging. Methods of net mounting: reeving, stapling and norselling. Mending and net shooter techniques.

36.6.6 Course Title: FEG 312-Fishing Technology

Credit Hours: 2(1+1)

A. Theory

Unit 1: Structure of various commercial fishing gears. Rigging of fishing gears: Bridles, sweep lines, otter boards, floats and ground gears arrangements.

Unit 2: Otter door: Different types of otter doors. Behavior of otter doors in water: Angle of attack, angle of heel and angle of tilt. Fishing accessories – thimbles, shackles, C-links, rings, G-links, Kelly's eye,

stopper, bottle screw, Deck layout of different fishing vessels. Trawling: Beam trawling; otter trawling; side trawling; twin trawling out rig trawling bull trawling and mid water trawling.

Unit 3: Constructional details of single boat purse seine; two boat purse seine and method of operation. Types of gill net – constructional details of simple gill net, trammel gill net, stick held gillnet, frame gillnet and vertical line gillnet, Operation of gillnet: set gillnetting; drift gillnetting; bottom, mid water and pelagic gillnetting.

Unit 4: Line fishing: Types of hooks; structure and size of hooks. Constructional details of long line, tuna long line, vertical long line, pole & line and trolling line. Operation of long line: set and drift long lining: bottom, mid water and pelagic long lining; jigging. Operation of beach seine, boat seine and traps. Selectivity in fishing gear and by catch reducing devices.

Unit 5: Deck equipment – types of winches, net haulers, line haulers, triple drum, gurdy, power blocks, fish pumps. Fishing equipment: Fish finder, GPS navigator, sonar, net sonde, gear monitoring equipment.

B. Practicals

Survey of fishing gears; Trawl; gillnet; long line and purse seine fishing gears. Rigging of trawl, purse seine, gillnet and hook & line. Commercial fishing techniques: Bottom trawling; purse seining; gillnetting and line fishing. Cast net fishing and trap fishing.

36.7 Department of Fisheries Extension, Economics and Statistics

36.7.1 Course Title: FES 111-Statistical Methods

Credit Hours: 3(2+1)

A. Theory

Unit 1: Definition of statistics, Concepts of population, sample, Census and sample surveys, Classification of data, frequency distribution table. Diagrammatic and graphical representation of data- bar diagrams, pie-diagram, histogram, frequency polygon and frequency curve.

Unit 2: 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. Coefficient of variation.

Unit 3: Normal Curve, Concepts of Skewness and kurtosis. Definitions of probability, mutually exclusive and independent events. Basic concept of sampling distribution, sampling methods, standard error and central limit theorem.

Unit 4: Bivariate data, scatter diagram, simple linear correlation, measure and properties, linear regression, equation and fitting; relation between correlation and regression. Applications of linear regression in fisheries.

Unit 5: Length-weight relationship in fishes; Methodology for estimation of marine fish landings in India, Estimation of inland fish production in India and problems encountered.

B. Practicals:

Frequency distribution table. Diagrams and graphs. Calculation of arithmetic mean, median, mode, range, Mean Deviation, Variance and Standard Deviation, probability, Coefficient of variation, Normal Curve, Concepts of Skewness and kurtosis. Fitting of length-weight relationship in fishes.

36.7.2 Course Title: FES 211-Fisheries Economics

Credit Hours: 3(2+1)

A. Theory

Unit 1: Introduction to fisheries economics, basic economic terminologies – micro and macroeconomics, positive and normative economics, environmental economics, resource, scarcity, farm-firm relationships, production Contribution of fisheries sector to the economic development of the country.

Unit 2: Micro-economics: theories of demand, supply; market – equilibrium price, consumption, utility, Consumer surplus. Elasticity – price, income, cross, application of elasticity in fisheries managerial decision. Farm production economics – production functions in capture and culture fisheries; Costs and returns –breakeven analysis of fish production system; concepts of externalities and social cost; factors of production, marginal cost and return, law of diminishing marginal return, returns to scale, economies of scale and scope, revenue, profit maximization, measurement of technological change, farm planning and budgeting. Significance or importance of marginal cost.

Unit 3: Macro-economics: Introduction to national income, accounting, measurement and determinants of national income, contribution of fisheries to GNP and employment; balance of payments, economic growth and sustainable development. Globalization: dimensions and driving Forces.

Unit 4: Introduction to GATT and WTO. WTO Framework – Key Subjects - Agreement on Sanitary and Phytosanitary Measures (SPS), Seafood Export Regulations; Non-Tariff Barriers (NTBs) and Agreement on Anti-Dumping Procedures. Fisheries Subsidies and WTO. Fisheries Trade and Environment; protests against globalisation and WTO.

Unit 5: Intellectual Property Rights (IPR) and different forms. Patents and patenting process, Agreement on TRIPS. Bio-piracy. GMOs in fisheries. Salient features of Indian Patent (Amendment) Act 2005. Overview of Patents in Indian fisheries sector.

B. Practicals

Demand and supply functions of fish market – determination of equilibrium price for fish and fisheries products, calculation of price, income and cross elasticities. Production function – production with one or two variable inputs. Shifting demand and surplus curve and its importance in fish price. Economic analysis on cost, return and breakeven of any two production units like fish farm / shrimp farm / seed production unit / fish processing plant / export unit.

36.7.3 Course Title: FES 321-Fisheries Policy and Law

Credit Hours: 1(1+0)

A. Theory

Unit 1: Introduction to public administration, principles of organization and management of public enterprise. Central and State responsibilities for fisheries development, organizational set up of fisheries administration at the Centre and state levels.

Unit 2: Present relevance of past fisheries policies and recent policies in fisheries sector. Functions and powers of functionaries of department of fisheries, corporations and cooperatives. Different central and state level fisheries institutions. Role of Central and State Government in the regulatory activities of Aquaculture and fisheries.

Unit 3: Implementation of community-based resource management plans. Historical review of fisheries development and management in India and world. International agencies / organizations for promotion of fisheries worldwide.

Unit 4: Fisheries legislation: Overview of fisheries and aquaculture legislations in India. Indian Fisheries Act, 1897. Environmental legislation; Water Act, Air Act and Environmental (Protection) Act. International environmental legislation and its impact on fisheries. Laws relating to conservation and management of fishery resources in marine and inland sectors. Recent changes in land reforms. Land reforms legislation as applicable to aquaculture.

Unit 5: Judicial judgments relating to Aquaculture. Objectives, functions and authority of fishery regulatory agencies like Coastal Regulatory Zone (CRZ) and Aquaculture Authority of India. Brackish water aquaculture act, Marine fisheries policy, Laws relating to fish products and marketing. International Law of the Seas and international commissions on fisheries and their impact.

36.7.4 Course Title: FES 311-Fisheries Co-operatives and Marketing

Credit hours: 2(1+1)

A. Theory

Unit 1: Principles and objectives of co-operation, co-operative movement in fisheries in India, structure, functions, status and problems of fisheries co-operatives management in relation to resources, production and marketing. Role of credit for fisheries development, credit requirements of fishers, source and type of credit/finance, micro-credit, indigenous and institutional finance, structure of institutional finance in fisheries; returns, risk bearing ability and recovery in fisheries sector; role of NABARD in fisheries development; role of insurance in fish and shrimp farming and industry. Basic accounting procedures, profit and loss account.

Unit 2: Introduction to marketing management; core marketing concepts: market structure, functions and types, marketing channels and supply chain, marketing margins, marketing environment, marketing strategies, product development and product mix, consumer behavior and marketing research.

Unit 3: Fish markets and marketing in India, demand and supply of fish, market structure and price formation in marine and inland fish markets; cold storage and other marketing infrastructure in India; export markets and marketing of fish and fishery products.

Unit 4: Trade liberalization and fisheries markets. Integrated marketing approach in fisheries. Sea food export case study on product and market diversification- export and import policies (fisheries). New product development and market segmentation. Export and import policies relevant to fisheries sector.

B. Practicals

Developing questionnaire and conducting market surveys, analysis of primary and secondary market data. Exercises on equilibrium price for fish and fishery products; estimation of demand and supply using simple regression. Analysis of credit schemes of banks and the government. Case studies of cooperatives. Visit to co-operative societies, commercial banks and fish markets and organizations dealing with marketing of fish and fishery products. Pattern and Performance of India's Seafood Exports; Case studies on product and market diversification. Case studies on competitiveness of Indian fish and fish products.

36.7.5 Course Title: FES 322-Fisheries Business Management and Entrepreneurship Development

Credit Hours: 1(1+0)

A. Theory

Unit 1: Concept of entrepreneurship; entrepreneurial and managerial characteristics; managing an enterprise; motivation and entrepreneurship development; importance of planning, monitoring, evaluation and follow up; managing competition; entrepreneurship development programs; Generation, incubation and commercialization of ideas and innovations.

Unit 2: Government schemes and incentives for promotion of entrepreneurship. Preparation of enterprise budget for integrated fish farming. Fiscal and monetary policies and its impact on entrepreneurship. Infrastructural and other financial requirement for fishery entrepreneurship Government policy on Small and Medium Enterprises (SMEs) / SSIs. Venture capital. Contract farming and joint ventures, public- private partnerships. Overview of fisheries inputs industry. Characteristics of Indian fisheries processing and export industry.

Unit 3: Introduction to fish business management- Concept of management, management process (planning, organising, staffing, leading and controlling), Organizational behaviour, human resource planning, new dimensions in fish business environment and policies. Accounting procedures of fish business entity.

Unit 4: Emerging trends in fish production, processing, marketing and exports. Assessing overall business environment in the Indian economy. Overview of Indian social, political and economic systems and their decision making by individual entrepreneurs. Globalisation and the emerging business /entrepreneurial environment. Social Responsibility of Business.

36.7.6 Course Title: FES 121-Information and Communication Technology

Credit Hours: 2(1+1)

A. Theory

Unit 1: IT and its importance. IT tools, IT-enabled services and their impact on society; computer fundamentals; hardware and software; input and output devices; word and character representation; features of machine language, assembly language, high-level language and their advantages and disadvantages; principles of programming- algorithms and flowcharts.

Unit 2: Operating systems (OS)-definition, basic concepts, introduction to WINDOWS and LINUX Operating Systems; Local area network (LAN), Wide area network (WAN), Internet and World Wide Web, HTML and IP;

Unit 3: Introduction to MS Office - Word, Excel, Power Point. Audio visual aids - definition, advantages, classification and choice of A.V aids; cone of experience and criteria for selection and evaluation of A.V aids; video conferencing. Communication process, Berlo's model, feedback and barriersto communication

B. Practicals

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; Analysisof fisheries data using MS Excel. Handling of audio-visual equipment. Planning, preparation, presentation of posters, charts, overhead transparencies and slides. Organization of an audio-visual programme.

36.7.7 Course Title: FES 221-Fisheries Extension Education

Credit Hours: 2(1+1)

A. Theory

Unit 1: 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 2: Fisheries extension methods- individual, group and mass contact methods and their effectiveness, factors influencing their selection

and use; characteristics of technology, transfer of technology process; important TOT programs in fisheries; role of NGOs and SHGs in fisheries.

Unit 3: Fisheries co-management; Adoption and diffusion of innovations, adoption and diffusion process, adopter categories and barriers in diffusion of fisheries innovations; Extension program planning and evaluation - steps and importance; participatory planning process.

Unit 4: 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.

B. Practicals

Collection of socio-economic data from fishing villages; study of social issues/problems through participatory and rapid rural appraisal techniques, stake-holders analysis and needs assessment; assessment of development needs of community and role of formal and non – governmental organizations through stakeholder analysis; case studies on social/gender issues and social conflicts in fisheries. Case studies on extension programs and Success stories. Practical exercises on conducting fish farmers meet.

36.7.8 Course Title: FES 222-Communication Skills and Personality Development

Credit Hours: 1(0+1)

A. Practicals

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. Organizing seminars and conferences.

36.8 Compulsory Non-Credit Course (CNC)

36.8.1 Course Title: CNC 111-Swimming

Credit Hours: 1(0+1)

A. Practicals

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.

36.8.2 Course Title: CNC 121-Physical Education, First Aid & Yoga Practices

Credit Hours: 1(0+1)

A. Practicals

Introduction to physical education: definition, objectives, scope, history, development and importance; physical culture; Meaning and importance of Physical Fitness and Wellness; Physical fitness components -speed, strength, endurance, power, flexibility, agility, coordination and balance; Warming up - General & Specific & its Physiological basis; Test and measurement in physical education; Training and Coaching - Meaning & Concept; Methods of Training; aerobic and an aerobic exercises; Calisthenics, weight training, circuit training, interval training, Fartlek training; Effects of Exercise on Muscular, Respiratory, Circulatory & Digestive systems; Balanced Diet and Nutrition: Effects of Diet on Performance; Physiological changes due to ageing and role of regular exercise on ageing process; Personality, its dimensions and types; Role of sports in personality development; Motivation and Achievements in Sports; Learning and Theories of learning; Adolescent Problems & its Management; Posture; Postural Deformities; Exercises for good posture.

Yoga; Introduction to - Asanas, Pranayam, Meditation and Yogic Kriyas; Role of yoga in sports; Governance of sport in India; Important national sporting events; Awards in Sports; History, latest rules, measurements of playfield, specifications of equipments, skill, technique, style and coaching of major games (Cricket, football, table Tennis, Badminton, Volleyball, Basketball, Kabaddi and Kho-Kho) and Athletics

Need and requirement of first aid. First Aid equipments and upkeep. Handling and transport of injured traumatized persons. Emergency procedure for suffocation, demonstration of artificial respiration. Treatment of injuries (wounds and bleeding)–methods of dressing and bandages; first-aid procedure for injured bones. Handling unconsciousness; Treatment of burns and scalds. Emergency procedure for poisoning with special references to snakebite. Injuries I accidents in fishing, fish processing factories, chemical laboratories and their

treatments. Shock injuries to muscles and joints and treatments. Sports injuries and their treatments.



Annexure –I

**U.P. Pt. DEEN DAYAL UPADHYAYA PASHU CHIKITSA VIGYAN VISHWAVIDYALAYA EVAM GO-
ANUSANDHAN (DUVASU), MATHURA**
GRADE SHEET OF-----SEMESTER COLLEGE OF-----SCIENCE, MATHURA

Enrolment No.: XYZ
Name: XYZ
Mother's Name: XYZ

Father's Name: XYZ
Programme: xxxxxxxxxxxx
Session: xxxxxx

S. No.	Course Title	Course No.	Credit Hours	Marks Obtained			Grade Point (10 Point Basis)	Credit Points	
				Theory		Practical			Total
				Internal	External				
1									
2									
3									
4									
5									
6									
7									
8									
9									
10									
Total									
GPA									
CGPA (till this semester)									
Result									

Note:

Calculation of Grade Point (GP), Credit Point (CP), Grade Point Average (GPA) & Cumulative Grade Point Average (CGPA)

- Grading of marks shall be done on 10 point scale. The minimum marks are 50% in theory and practical separately.
- The divisions are determined on the basis of aggregate of marks of all the courses prescribed as under-First Division with distinction: 8.000 and above, First Division: 7.000-7.999, Second Division: 6.000-6.999, Pass: 5.000-5.999.
- In case of any discrepancy the marks entered in the university tabulation chart shall be final.
- The credit points earned will be 0 if the marks obtained in theory or practical are less than 50%.
- The credit point (CP) in a course shall be equal to the total marks obtained in theory and practical multiplied by number of credit hours and divided by 10.
- The Grade Point Average (GPA) is sum of the total credit points earned divided by the sum of credit hours.
- The Cumulative Grade Point Average (CGPA) is equal to the total credit points divided by total number of course credit hours in all the semesters.

Date:

Prepared by:

Checked by:

Controller of Examinations

Serial No.:

Enrollment No.:



U.P. Pt. DEEN DAYAL UPADHYAYA PASHU CHIKITSA VIGYAN
VISHWAVIDYALAYA EVAM GO- ANUSANDHAN (DUVASU), MATHURA 281001
TRANSCRIPT



Name of Student:
Name of The College
Degree Programme:
Admitted in:

Father Name:

Mother Name:

Completed in:

Academic Year and Semester	Course Title	Course Code	Credit Hours	Marks Obtained	Grade Point	Credit points	GPA
20....-.... 1 st Semester							
20....-.... 2 nd Semester							
20....-.... 1 st Semester							
20....-.... 2 nd Semester							
20....-.... 1 st Semester							
20....-.... 2 nd Semester							

20..... 1 st Semester							
20..... 2 nd Semester							

Grand Total of Credit Hours:

Grand Total of Credit Points:

Overall Grade Point Average (OGPA):

Percentage of Marks:

Result:

DIVISION AND HONORS

First division with distinction	8.000 and above
First division	7.000 – 7.999
Second division	6.000 – 6.999
Pass	5.000 – 5.999

Abbreviation Used

- S- Satisfactory
- US – Unsatisfactory
- r- Repeat Courses
- GPA- Grade Point Average
- OGPA- Overall Grade Point Average

QR Code

Calculation of Grade Point (GP), Credit Point (CP), Grade Point Average (GPA) & Overall Grade Point Average (OGPA)

- Grading of marks shall be done on 10 point scale. The minimum marks are 50% in theory and practical separately.
- The divisions are determined on the basis of aggregate of marks of all the courses prescribed as under-First Division with distinction: 8.000 and above, First Division: 7.000-7.999, Second Division: 6.000-6.999, Pass: 5.000-5.999.
- In case of any discrepancy the marks entered in the university tabulation chart shall be final.
- The credit points earned will be 0 if the marks obtained in theory or practical are less than 50%.
- The credit point (CP) in a course shall be equal to the total marks obtained in theory and practical multiplied by number of credit hours and divided by 10.
- The Grade Point Average (GPA) is sum of the total credit points earned divided by the sum of credit hours.
- The Overall Grade Point Average (OGPA) is equal to the total credit points divided by total number of course credit hours in degree programme.

Date:

Prepared by:

Checked by:

Controller of Examinations



**U.P. Pandit Deen Dayal Upadhyaya Pashu Chikitsa Vigyan
Vishwavidyalaya Evam Go-Anusandhan Sansthan (DUVASU),
Mathura – 281 001 (UP)
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