ALAGAPPA UNIVERSITY

(A State University Established in 1985)

Karaikudi - 630003. Tamil Nadu, India

2017 Accredited with A+ Grade by NAAC (CGPA : 3.64)

2018 MHRD Govt. of India UGC Granted as Category - 1 & Granted Autonomy

2018 MHRD Swachh Campus Rank : 4

2021 nirf National Institutional Ranking Framework Rank : 33

2021 QS University Rankings Asia Rank : 199

FACULTY OF SCIENCE

DEPARTMENT OF FISHERIES SCIENCE

M.Sc., FISHERIES SCIENCE

REGULATIONS AND SYLLABUS

(For the candidates admitted from the Academic Year 2022 - 2023)

DEPARTMENT OF FISHERIES SCIENCE
M.Sc., Fisheries Science

REGULATIONS AND SYLLABUS

[For the candidates admitted from the Academic Year 2022 – 2023 onwards]

ALAGAPPA UNIVERSITY
(A State University Accredited with "A+" grade by NAAC (CGPA: 3.64) in the Third Cycle andGraded as Category-I University by MHRD-UGC)
Karaikudi -630003, Tamil Nadu.

The panel of Members-Broad Based Board of Studies

Chairperson: Dr. E. Kannapiran, Professor and Head i/c, Department of Fisheries Science, Alagappa University, Karaikudi. Teaching Experience: 24 years, Research Experience: 23 years, Area of Research: Aquatic Microbiology, Coral reef ecosystem, Marine Fouling.	
Foreign Expert: Dr. Siti Azizah Mohd.Nor, Principal Research Fellow (Professor), Universiti Malaysia, Terengganu. Area of Research: Population genetics and phylogeography research for conservation of wild and captive populations of aquaticorganisms.	
Indian Expert: Dr. T.T. Ajith Kumar, Principal Scientist - Scientists in charge, National Bureau of Fish Genetic Resources, Regional Centre, Cochin. Professional experience: 22 years. Area of Research: Development of hatchery technologies for marine Ornamentals, Aquaculture for conservation and livelihood.	
Indian Expert: Dr. A. Gopalakrishnan, Assistant Professor, Centre of Advanced Study in Marine Biology, Annamalai University, Parangipettai. Teaching Experience: 15 years, Research Experience: 14 years. Area of Research: Aquatic Animal Health and Livelihood Security.	
Indian Expert: Dr. N. Rajendran, Assistant Professor of Zoology, Govt. Arts College, C. Mutlur, Chidambaram. Teaching Experience: 18 years, Research Experience: 26 years, Area of Research: Coastal Ecology, Fisheries and Mangrove Biodiversity Conservation.	
Member: Dr. N.M. Prabhu, Assistant Professor, Department of Animal Health and Management, Alagappa University, Karaikudi. Teaching and Research Experience: 14 years, Industrial Experience: 9 years. Area of Research: Disease Control and Prevention, Alternative medicine: Sulfated polysaccharides, probiotics, and nanoparticles.	
Expert from Industry: Mr. P.K. Senthil Kumar, Project-Chief and integral part of Poseidon Biotech, Supporting production and marketing team, No. 2,3, PKM cross street, Padasalai road, Mel Ayanampakkam, Chennai. Co-ordinator: Society of Aquaculture Professionals. Professional Experience: 28 years.	
Alumnus/Alumna: Mr. M. Arun Kumar, Quality Control Analyst, Maria Aquacon Pvt. Ltd., 1, Maria Tower, Main Road, Kootapuli, Tirunelveli, Tamil Nadu, 627127,India	

ALAGAPPA UNIVERSITY
DEPARTMENT OF FISHERIES SCIENCE
Science Campus, Karaikudi -630003, Tamil Nadu.

REGULATIONS AND SYLLABUS - (CBCS-University Department)
[For the candidates admitted from the Academic Year 2022 – 2023 onwards]

Name of the Department : Fisheries Science

Name of the Programme : M.Sc., Fisheries Science

Duration of the Programme : Full Time (Two Years)

Master of Science in Fisheries Science (M. Sc.,)

M.Sc., Fisheries Science is a postgraduate programme and duration of the programme is two years that spread over four semesters. The course deals with the study of administration and culture, catching, processing and marketing and conservation of fish and related products. The M.Sc., programme can be considered as the interdisciplinary field to the areas of Fisheries Science, Aquaculture, and Industrial Fisheries, Agriculture, Marine Biology, Zoology, Biology, Microbiology, Biotechnology, Management, Economics and Marketing.

Semesters

An Academic year is divided into two **Semesters**. In each semester, courses are offered in 15 teaching weeks and the remaining 5 weeks are to be utilized for conduct of examination and valuation purposes. Each week has 30 working hours spread over 5 days a week.

Medium of Instruction

The medium of instruction is English.

Departmental committee

The Departmental Committee consists of the faculty of the Department. The Departmental Committee shall be responsible for admission to all the programmes offered by the Department including the conduct of entrance tests, verification of records, admission, and evaluation. The Departmental Committee determines the deliberation of courses and specifies the allocation of credits semester-wise and course-wise. For each course, it will also identify the number of credits for lectures, tutorials, practicals, seminars etc. The courses (Core/Discipline Specific Elective/Non-Major Elective) are designed by teachers and approved by the Departmental Committees. Courses approved by the Departmental Committees shall be approved by the Board of Studies/Broad Based Board of Studies. A teacher offering a course will also be responsible for maintaining attendance and performance

sheets (CIA -I, CIA-II, assignments and seminar) of all the students registered for the course. The Non-Major Elective and MOOCs coordinator and Internship Mentor are responsible for submitting the performancesheet to the Head of the department. The Head of the Department consolidates all such performance sheets of courses pertaining to the programmes offered by the department. Then forward the same to beController of Examinations.

Programme Educational Objectives (PEO)

PEO-1	To develop strong-minded graduates with high-quality skills in the field of FisheriesScience
PEO-2	To prepare the students in understanding the vital concept of fishery resources
PEO-3	To prepare the students to understand the vital concept of fishery resources, fishtaxonomy, identification of fish using molecular tools
PEO-4	To prepare the students in understanding the vital concept of modern craft and gears incapture fishery
PEO-5	To prepare the students in understanding the vital concept of diversity, biology, genetics,breeding, freshwater, coastal and marine aquaculture
PEO-6	To prepare the students in understanding the vital concept of fishery conservation &management
PEO-7	To prepare the students with thoughtful concepts and practical knowledge in freshwater capture fishery and aquaculture management
PEO-8	To prepare the students with thoughtful concepts and applied knowledge in coastal aquaculture management and knowledge in value addition.
POE-9	To prepare the students in understanding concept of mariculture and post harvesting methodology.
PEO-10	To prepare the students with thoughtful concepts and applied knowledge in automation in fishery field, instruments used in the fishery sectors.

Programme Specific Objectives (PSO)

PSO-1	To prepare the student with fishery talent and practitioners to develop the nation
PSO-2	To teach the student with a broad understanding of fish and their interactions with differentecosystem
PSO-3	To make the students spirit of modernism and practices in the field of fishery science
PSO-4	To provide in-depth knowledge and recent to the students in the field of aquaculture thatwill give confidence to the student for self-employment.
PSO-5	To make the students capable of independently engaging in fishery techniques, that helps the students to support for improving the socio-economic status of fishermen community

Programme Outcome (PO)

PO-1	Acquire fundamental knowledge and skills on the taxonomy of finfish and shellfish, as well as their economic importance
PO-2	Understand the various fisheries resources, challenges and effective managementapproaches
PO-3	Comprehend the latest technological advancement in capture fisheries and aquaculture
PO-4	Understand the collection and preservation techniques of aquatic animals and apply appropriate statistical methods to research
PO-5	Gain knowledge on the principles of biodiversity, sustainability, pollution control and conservation of fishery resources
PO-6	Acquire knowledge on the construction and management of finfish and shellfishhatchery and farming
PO-7	Become acquainted with the modern technology applied in aquaculture, capturefisheries and fish processing
PO-8	Expertise in the field of fish and fishery products to enhance employment prospects
PO-9	Proficiency in aquaculture and seafood processing techniques
PO-10	Become acquainted with good laboratory practices and the basic skills in instrumentation and biological techniques which will provide valuable preparation for future research careers

Programme Specific Outcomes (PSO)

On successful completion of the programme, the students

PSO-1	Possess global status of fishery resources, modern tools in capture fisheries,conservation and management
PSO-2	Expertise in fishery biology, economics, application of remote sensing and GIS infisheries
PSO-3	Skills in finfish and shellfish hatchery, farming and health management practices
PSO-4	Critically analyse the finfish and shellfish production and processing techniquesfor employability
PSO-5	Acquired extensive knowledge in fishery economics and extension activities

Eligibility for admission

The students who have passed the UG degree in B.F.Sc./ B.Voc./ B.Sc./ B.Tech. in Fisheries Science/ Aquaculture/ Commercial Aquaculture/ Industrial Aquaculture/ Industrial Fish and Fisheries/ Marine Biology/ Marine Science/ Zoology/ Zoology and Animal Biotechnology/ Biotechnology/ Industrial Fish Processing Technology/ Industrial Fishing Technology/ Fisheries Engineering/ Fisheries Nautical Technology/ Food Technology/ Aquatic Animal Health Management/ Animal Sciences / Biological Sciences can apply for the M.Sc., Fisheries Science programme.

Minimum Duration of Programme

The programme is for a period of two years. Each year shall consist of two semesters viz. Odd and Even semesters. Odd semesters shall be from June / July to October / November and even semesters shall be from November / December to April / May. Each semester there shall be 90 working days consisting of 6 teaching hours per working day (5 days/week).

Components

A PG programme consists of a number of courses. The term "course" is applied to indicate a logical part of the subject matter of the programme and is invariably equivalent to the subject matter of a "paper" in the conventional sense. The following are the various categories of the courses suggested for the PG programmes:

A. Core courses (CC)- "Core Papers" means "the core courses" related to the programme concerned including practicals and project work offered under the programme and shall cover core competency, critical thinking, analytical reasoning, and research skill.

B. Discipline-Specific Electives (DSE) means the courses offered under the programme related to the major but are to be selected by the students, shall cover additional academic knowledge, critical thinking, and analytical reasoning.

C. Non-Major Electives (NME)- Exposure beyond the discipline

- Students have to undergo a total of two Non-Major Elective courses with 2 credits offered by other departments (one in II Semester another in III Semester).
- A uniform time frame of 3 hours on a common day (Tuesday) shall be allocated for the Non-Major Electives.
- Non Major Elective courses offered by the departments pertaining to a semester should be announced before the end of previous semester.
- Registration process: Students have to register for the Non-Major Elective course within 15 days from the commencement of the semester either in the department or NME portal (University website).

D. Self-Learning Courses from MOOCs platforms.

- MOOCs shall be on voluntary for the students.
- Students have to undergo a total of 2 Self Learning Courses (MOOCs) one in II semester and another in III semester.

- The actual credits earned through MOOCs shall be transferred to the credit plan of programmes as extra credits. Otherwise 2 credits/course be given if the Self Learning Course(MOOCs) is without credit.
- While selecting the MOOCs, preference shall be given to the course related to employabilityskills.

E. Dissertation (Maximum Marks: 200)

The students shall undertake the dissertation work during the fourth semester.

- Plan of work

Dissertation

The candidate shall undergo Dissertation Work during the fourth semester. The candidate should prepare a scheme of work for the dissertation and should get approval from the guide. The candidate, after completing the dissertation, shall be allowed to submit it to the university departments at the end of the final semester. If the candidate is desirous of availing the facility from other departments/universities/national laboratories (ICAR, CSIR, ICMR, RGCA, NIOT, NGOs / INGOs and other reputed organizations), they will be permitted only after getting approval from the guide and HOD. In such a case, the candidate shall acknowledgethe same in their dissertation.

- **Format to be followed for dissertation report**

The format /certificate for thesis to be followed by the student are given below

- Title page
- Certificate
- Acknowledgment
- Content as follows:

Chapter No.	Title	Page No.
1	Introduction	
2	Aim and objectives	
3	Review of Literature	
4	Materials and Methods	
5	Results	
6	Discussion	
7	Summary and Conclusion	
8	References	

- **Format of the title page**

Title of Dissertation work

Dissertation /Project submitted in partial fulfillment of the requirement for the degree of Masterof Science in Fisheries Science to the Alagappa University, Karaikudi -630003.

By

(Student Name)

(Register Number)

University Logo

Department of Fisheries Science

Alagappa University

(A State University Accredited with "A+" grade by NAAC (CGPA: 3.64) in the Third Cycle and Graded as Category-I University by MHRD-UGC, 2019: QS ASIA Rank-216, QS BRICS Rank-104, QS India Rank-20)

Karaikudi - 630003

(Year)

- **Format of certificates**

Certificate (Guide)

This is to certify that the Dissertation entitled " ---------- " submitted to Alagappa University, Karaikudi-630 003 in partial fulfilment for the degree of Master of Science in ---------- by Mr./Miss ---------- (Reg. No.) under my supervision.

This is based on the results of studies carried out by him/her in the Department of ----------, Alagappa University, Karaikudi-630 003. This dissertation or any part of this work has not been submitted elsewhere for any other degree, diploma, fellowship, or any other similar titles or record of any University or Institution.

Place: Karaikudi Research Supervisor

Date:_____.

Certificate (HOD)

This is to certify that the thesis entitled " ---------- " submitted by Mr/Miss ---------- (Reg No----------) to the Alagappa University, in partial fulfilment for the award of the degree of Master of Science in Fisheries Science is a bonafide record of research work done under the supervision of Dr.----------, Assistant Professor, Department of----------, Alagappa University. This is to further certify that the thesis or any part thereof has not formed the basis of the award to the student of any degree, diploma, fellowship, or any other similar title of any University or Institution.

Place: Karaikudi Head of the Department
Date:_____

Declaration (student)

I hereby declare that the dissertation entitled "----------" submitted to the Alagappa University for the award of the degree of Master of Science in Fisheries Science has been carried out by me under the guidance of Dr. ----------, Assistant Professor, Department of----------, Alagappa University, Karaikudi – 630 003. This is my original and independent work and has not previously formed the basis of the award of any degree, diploma, associateship, fellowship, or any other similar title of any University or Institution.

Place: Karaikudi (----------)
Date:_____

Internship

The students shall undergo Internship / industrial training in the reputed organizations for minimum of two weeks to acquire industrial knowledge during the summer vacation of second semester. The students have to find industry related to their discipline (Public limited/Private Limited/owner/NGOs etc.,) in consultation with the faculty in charge/Mentor and get approval from the Head of the Department and Departmental Committee before going for an internship / industrial training.

Format to be followed for Internship report

The format for internship report to be followed by the student are given below

- **Format of the title page**

Title of internship report

Internship report submitted in partial fulfilment of the requirement for the Master of Science inFisheries Science to the Alagappa University, Karaikudi -630003.

By
(Student Name)
(Register Number)

University Logo

Department of Fisheries Science

Alagappa University
(A State University Accredited with "A+" grade by NAAC (CGPA: 3.64) in the ThirdCycle and Graded as Category-I University by MHRD-UGC, 2019: QS ASIA Rank- 216, QS BRICS Rank-104, QS India Rank-20)
Karaikudi – 630003
(Year)

- **Format of certificate**

(Faculty in-charge)

This is to certify that the internship report entitled " ---------- " submitted to Alagappa University, Karaikudi-630 003 in partial fulfilment for the Master of Science in Fisheries Science by Mr/Miss ---------- (Reg. No.:----------) under my supervision. This is based on the work carried out by him/her in the organization M/S ----------
-------. This Internship report or any part of this work has not been submitted elsewhere for any other degree, diploma, fellowship, or any other similar record of any University or Institution.

Place: Research Supervisor
Date:_____

(HOD)

This is to certify that the Internship report entitled "----------" submitted by Mr./Miss.---------- (Reg No ---------) to the Alagappa University, in partial fulfilment for the award of the Master of Science in Fisheries Science is a bonafide record of Internship report done under the supervision of, Assistant Professor, Department of----------, Alagappa University and the work carried out by him/her in the organization M/S ----------. This is to further certify that the thesis or any part thereof has not formed the basis of the award to the student of any degree, diploma, fellowship, or any other similar title of any University or Institution.

Place: Karaikudi Head of the Department
Date:_____

(Company supervisor or Head of the Organization)

This is to certify that the Internship report entitled " ---------- " submitted to Alagappa University, Karaikudi-630 003 in partial fulfilment for the Master of Science inFisheries Science by Mr./Miss ---------- (Reg No) under my supervision. This is based on the work carried out by him/her in our organization M/S for the period of ----------. This Internship report or any part of this work has not been submitted elsewhere for any other degree, diploma, fellowship, or any other similar record of any University or Institution.

Place: Supervisor or In charge
Date:_____

Declaration (student)

I hereby declare that the Internship Report entitled " ---------- " submitted to the Alagappa University for the award of the Master of Science in Fisheries Science has been carried outby me under the supervision of----------, Assistant Professor, Department of -, Alagappa University, Karaikudi – 630 003. This is my original and independent work carried out byme in the organization M/S ---------- for the period of and has not previously formed the basis of the award of any degree, diploma, associateship, fellowship, or any other similar title ofany University or Institution.

Place: Karaikudi (----------)
Date:_____

- Acknowledgment
- Content as follows:

Chapter No.	Title	Page No.
1	Introduction	
2	Aim and objectives	
3	Organisation profile / details	
4	Methods / Work	
5	Observation and knowledge gained	
6	Summary and outcome of the Internship study	
7	References	

Field Visit

The students shall undergo Field Visits to various aquaculture farms, fish landing centers, sea food processing industries, Research Institutes, ship building industries etc. to acquire industrial and practical knowledge during the first semester.

Format to be followed for Field Visit report

The format for Field Visit report to be followed by the student are given below

- **Format of the title page**

Field Visit Report

submitted in partial fulfilment of the requirement for the Master of Science in Fisheries Scienceto the Alagappa University, Karaikudi -630003.

By

(Student Name)

(Register Number)

University Logo

Department of Fisheries Science

Alagappa University

(A State University Accredited with "A+" grade by NAAC (CGPA: 3.64) in the ThirdCycle and Graded as Category-I University by MHRD-UGC, 2019: QS ASIA Rank- 216, QS BRICS Rank-104, QS India Rank-20)

Karaikudi – 630003

(Year)

- **Format of certificate**

(HOD)

This is to certify that the Field Visit report submitted by Mr./Miss ---------- (Reg No----------) to the Alagappa University, in partial fulfilment for the award of the Master of Science in Fisheries Science is a bonafide record of Field Visit reports carried out by him/her during ----------. This is to further certify that the report or any part thereof has not formed the basis of the award to the student of any degree, diploma, fellowship, or any other similar title of any University or Institution.

Place: Karaikudi Head of the Department
Date:_____

Declaration (student)

I hereby declare that the Field Visit Report submitted to the Alagappa University for the award of the Master of Science in Fisheries Science has been carried out by me. This is my original and independent work carried out by me during and has not previously formed the basis of the award of any degree, diploma, associateship, fellowship, or any other similar title of any University or Institution.

Place: Karaikudi (----------)
Date:_____

- Acknowledgment
- Content as follows:

S. No.	Date	Field Visit	Page No.	Signature
1				
2				
3				
4				
5				
6				
7				

No. of copies of the dissertation/field visit/internship report

The candidate should prepare three copies of the dissertation/ field visit/internship report and submit the same for the evaluation of examiners. After evaluation, one copy will be retained in the department library, one copy will be retained by the guide and the student shall hold one copy.

Teaching Methods

The classroom teaching would be through conventional lectures, use of OHP, Power Point presentation, novel innovative teaching ideas like television, smart board, and computer-aided instructions. Periodic field visit to fish landing centers and pre-processing centers to enable the student for gaining the practical experience in fish identification and update industrial scenario. Student seminars would be arranged to improve their communicative skills. The Fishery lab experiments shall be conducted with special efforts to teach scientific knowledge among students. The students shall be trained to handle advanced instrumental facilities and shall be allowed to do experiments independently. The periodic test will be conducted to assess their knowledge. Slow learners would be identified and will be given special attention by remedial coaching. Major and discipline specific electives would be handled by the Department, and the students shall undertake Non-major electives in the second and third semesters offered by other departments.

Attendance

Students must have earned 75% of attendance in each course for appearing for the examination. Students who have earned 74% to 70% of attendance need to apply for condonation in the prescribed form with the prescribed fee. Students who have earned 69% to 60% of attendance need to apply for condonation in the prescribed form with the prescribed fee along with the Medical Certificate. Students who have below 60% of attendance are not eligible to appear for the End Semester Examination (ESE). They shall re-do the semester(s) after completion of the programme

Examination

The examinations shall be conducted separately for theory and practical's to assess (remembering, understanding, applying, analysing, evaluating, and creating) the knowledge required during the study. There shall be two systems of examinations viz., internal and external examinations. The internal examinations shall be conducted as Continuous Internal Assessment tests I and II (CIA Test I & II).

F. Internal Assessment

The internal assessment shall comprise a maximum of 25 marks for each subject. The following procedure shall be followed for awarding internal marks.

Theory -25 marks

Sr. No.	Content	Marks
1	Average marks of two CIA test	15
2	Seminar/group discussion/quiz	5
3	Assignment/field trip report/case study reports	5
	Total	25

Practical -25 marks

Sr. No.	Content	Marks
1	Average marks of two CIA test	15
2	Observation notebook	10
	Total	25

Internship -25 Marks (assessed by Guide/incharge/HOD/supervisor)

1	Presentation	15 Marks
2	Progress report	10 Marks
	Total	25 Marks

Project/Dissertation -50 Marks (assess by Guide/incharge/HOD/supervisor)

1	Two presentations (mid-term)	30 Marks
2	Progress report	20 Marks
	Total	50 Marks

G. External Examination

- There shall be examinations at the end of each semester, for odd semesters in the month of October / November; for even semesters in April / May.
- A candidate who does not pass the examination in any course(s) may be permitted to appear in such failed course(s) in the subsequent examinations to be held in October / November or April / May. However candidates who have arrears in

Practical shall be permitted to take their arrear Practical examination only along with Regular Practical examination in the respective semester.

- A candidate should get registered for the first semester examination. If registration is not possible owing to shortage of attendance beyond condonation limit / regulation prescribed OR belated joining OR on medical grounds, the candidates are permitted to move to the next semester. Such candidates shall re-do the missed semester after completion of the programme.
- For the Project Report/ Dissertation Work the maximum marks will be 100 marks forproject report evaluation and for the Viva-Voce it is 50 marks.
- For the internship the maximum marks will be 50 marks for project report evaluationand for the Viva-Voce it is 25 marks
- Viva-Voce: Each candidate shall be required to appear for Viva-Voce Examination (indefense of the Dissertation Work / internship).

H. Scheme of External examination (Question paper pattern)

Theory - Maximum 75 Marks

Section A	10 questions. All questions carry equalmarks. (Objective type questions)	10 × 1 = 10 Marks	10 questions – 2 each from everyunit
Section B	5 questions Either / or type like 1.a (or) b. All questions carry equal marks	5 × 5 = 25	5 questions – 1 eachfrom every unit
Section C	5 questions Either / or type like 1.a (or) b. All questions carry equal marks	5 × 8 = 40	5 questions – 1 eachfrom every unit

Practical - Maximum 75 marks

Section A	Major experiment	15 Marks
Section B	Minor experiment	10 Marks
Section C	Experimental setup	5 Marks
Section D	Spotters- (5 spotters x 5 marks)	25 Marks
Section E	Record Note	10 Marks
Section F	Viva-voce	10 Marks

Dissertation –Maximum 150

Dissertation /Project Thesis	100 Marks
Viva voce	50 Marks

Internship –Maximum 75

Internship Report	50 Marks
Viva voce	25 Marks

Results

The results of all the examinations will be published through the Department where the studentunderwent the course as well as through University Website

Passing minimum

- A candidate shall be declared to have passed in each course if he/she secures not less than 40%marks in the End Semester Examinations and 40% marks in the Internal Assessment and not less than 50% in the aggregate, taking Continuous assessment and End Semester Examinations marks together.
- The candidates not obtained 50% in the Internal Assessment are permitted to improve their Internal Assessment marks in the subsequent semesters (2 chances will be given) by writing theCIA tests and by submitting assignments.
- Candidates, who have secured the pass marks in the End-Semester Examination and in the CIA but failed to secure the aggregate minimum pass mark (E.S.E + C I.A), are permitted to improve their Internal Assessment mark in the following semester and/or in University examinations.
- A candidate shall be declared to have passed in the Project / Dissertation / Internship if he /she gets not less than 40% in each of the Project / Dissertation / Internship Report and Viva- Voce and not less than 50% in the aggregate of both the marks for Project Report and Viva- Voce.
- A candidate who gets less than 50% in the Project / Dissertation / Internship Report must resubmit the thesis. Such candidates need to take again the Viva-Voce on the resubmitted Project report.

Grading of the Courses

The following table gives the marks, Grade points, Letter Grades and classifications meant toindicate the overall academic performance of the candidate.

Conversion of Marks to Grade Points and Letter Grade (Performance in Paper / Course)

RANGE OF MARKS	GRADE POINTS	LETTER GRADE	DESCRIPTION
90 - 100	**9.0 – 10.0**	**O**	**Outstanding**
80 - 89	**8.0 – 8.9**	**D+**	**Excellent**
75 - 79	**7.5 – 7.9**	**D**	**Distinction**
70 - 74	**7.0 – 7.4**	**A+**	**Very Good**
60 - 69	**6.0 – 6.9**	**A**	**Good**
50 - 59	**5.0 – 5.9**	**B**	**Average**
00 - 49	**0.0**	**U**	**Re-appear**
ABSENT	**0.0**	**AAA**	**ABSENT**

a) Successful candidates passing the examinations and earning GPA between 9.0 and 10.0 andmarks from 90 – 100 shall be declared to have Outstanding (O).
b) Successful candidates passing the examinations and earning GPA between 8.0 and 8.9 and marksfrom 80 - 89 shall be declared to have Excellent (D+).
c) Successful candidates passing the examinations and earning GPA between 7.5 – 7.9 and marksfrom 75 - 79 shall be declared to have Distinction (D).
d) Successful candidates passing the examinations and earning GPA between 7.0 – 7.4 and marksfrom 70 - 74 shall be declared to have Very Good (A+).
e) Successful candidates passing the examinations and earning GPA between 6.0 – 6.9 and marksfrom 60 - 69 shall be declared to have Good (A).
f) Successful candidates passing the examinations and earning GPA between 5.0 – 5.9 and marksfrom 50 - 59 shall be declared to have Average (B).
g) Candidates earning GPA between 0.0 and marks from 00 - 49 shall be declared to have Re-appear(U).
h) Absence from an examination shall not be taken as an attempt.

From the second semester onwards the total performance within a semester and continuous performance starting from the first semester are indicated respectively **by Grade Point Average (GPA) and Cumulative Grade Point Average (CGPA).** These two are calculated by the following formulate

GRADE POINT AVERAGE (GPA) = $\sum_i C_i G_i / \sum_i C_i$

$$GPA = \frac{\text{Sum of the multiplication of Grade Points by the credits of the courses}}{\text{Sum of the credits of the courses in a Semester}}$$

Classification of the final result

CGPA	Grade	Classification of Final Result
9.5 – 10.0 9.0 and above but below 9.5	**O+** **O**	First Class – Exemplary*
8.5 and above but below 9.0 8.0 and above but below 8.5 7.5 and above but below 8.0	**D+** **+D+** **D**	First Class with Distinction*
7.0 and above but below 7.5 6.5 and above but below 7.0 6.0 and above but below 6.5	**A+** **+A+** **A**	First Class
5.5 and above but below 6.0 5.0 and above but below 5.5	**B** **+B**	Second Class
0.0 and above but below 5.0	**U**	Re-appear

The final result of the candidate shall be based only on the CGPA earned by the candidate.

a) Successful candidates passing the examinations and earning CGPA between 9.5 and 10.0 shall be given Letter Grade (O+), those who earned CGPA between 9.0 and 9.4 shall be given Letter Grade (O) and declared to have First Class –Exemplary*.

b) Successful candidates passing the examinations and earning CGPA between 7.5 and 7.9 shall be given Letter Grade (D), those who earned CGPA between 8.0 and 8.4 shall be given Letter Grade (D+), those who earned CGPA between 8.5 and 8.9 shall be given Letter Grade (D++) and declared to have First Class with Distinction*.

c) Successful candidates passing the examinations and earning CGPA between 6.0 and 6.4 shall be given Letter Grade (A), those who earned CGPA between 6.5 and 6.9 shall be given Letter Grade (A+), those who earned CGPA between 7.0 and 7.4 shall be given Letter Grade (A++) and declared to have First Class.

d) Successful candidates passing the examinations and earning CGPA between 5.0 and 5.4 shall be given Letter Grade (B), those who earned CGPA between 5.5 and 5.9 shall be given Letter Grade(B+) and declared to have passed in Second Class.

i) Candidates those who earned CGPA between 0.0 and 4.9 shall be given Letter Grade (U) and declared to have Re-appear.

e) Absence from an examination shall not be taken as an attempt.

CUMULATIVE GRADE POINT AVERAGE (CGPA) = $\sum_{n} \sum_{i} C_{ni} G_{ni} / \sum_{n} \sum_{i} C_{ni}$

$$\text{CGPA} = \frac{\text{Sum of the multiplication of Grade Points by the credits of the entire Programme}}{\text{Sum of the credits of the courses for the entire Programme}}$$

Where '**Ci**' is the Credit earned for Course i in any semester; '**Gi**' is the Grade Point obtainedby the student for Course i and 'n' refers to the semester in which such courses were credited.

CGPA (Cumulative Grade Point Average) = Average Grade Point of all the Courses passedstarting from the first semester to the current semester.

Note: * The candidates who have passed in the first appearance and within the prescribed Semesters ofthe PG Programme are alone eligible for this classification.

Maximum duration of the completion of the programme

The maximum period for completion of M.Sc., in Fisheries Science shall not exceed eightsemesters continuing from the first semester.

Conferment of the Master's Degree

A candidate shall be eligible for the conferment of the Degree only after he/ she has earned theminimum required credits for the Programme prescribed therefor (i.e. 90 credits).Village Extension Programme

The Sivaganga and Ramnad districts are very backward districts where a majority of people live in poverty. The rural mass is economically and educationally backward. Thus the aim of the introduction of this Village Extension Programme is to extend out to reach environmental awareness, social activities, hygiene, and health to the rural people of this region. The students in their third semester have to visit any one of the adopted villages within the jurisdiction of Alagappa University and can arrange various programs to educate the rural mass in the following areas for three days basedon the theme.

1. Environmental awareness
2. Hygiene and Health

A minimum of two faculty members can accompany the students and guide them.

What to do after M.Sc.?

After the post-graduation, the candidates can go for the research field for further studies. Theycan take up Ph. D. in Fisheries Science, Fisheries Administration, employment in fisheries and allied sectors etc. Opting for the management degree is also another option for the PG holder. A management degree helps them to join business organizations engaged in Fishery associated product development/ marketing. The interested candidates can also start their career soon after the PG program. There are many opportunities for the M.Sc. candidates. The public sector as well as the private firms provides job openings for the right candidates. The candidates can work with the banks, educational institutes, fish farms, manufacturing units etc. after their post-graduation.

Job and Career options for M.Sc.

The increased demand for sea foods and the growth shown by the Fishing industry opens wider employment opportunities for the qualified candidates in the Fishery Sciences. The export of Freshwater and Marine products and the utilization of related products in the domestic markets have given tremendous boost to the employment opportunities in this field. The competition across the sectorhas increased drastically and it offers a higher pay pack for the professionals in the sector. Some of thejob opportunities for the M.Sc. candidates are:

Employment Areas

1. All State Fisheries Departments in India
2. All Fisheries Universities and Educational Institutes in India
3. Fish Disease Diagnostic Centre and Aquariums
4. Consultancies in fish and prawn farming
5. Fish Farmers Development Agencies and Feed Manufacturing Units
6. Research Institutes (ICAR, ICMR, ZSI, BSI, MoEFs MOEn, CMLRI, NIOT, FSI, NIO etc.)
7. Ornamental Fish Culture and Breeding Centers
8. Aquaculture areas (Fish and Prawn Farms)
9. Fish Processing and Marketing Firms
10. Fish/shrimp Feed Marketing
11. Fish/shrimp Health product Marketing
12. Hatchery and Seed Production Companies
13. Net Making Units
14. Commercial Pearl Production Industry
15. International Organizations like FAO, NACA, INFOFISH, SEAFDEC
16. Nationalized Banks

Job Types

1. Aquaculture Entrepreneur
2. Fisheries Extension Officer / Technical Officer
3. Fisheries Extension Officer
4. Assistant Fisheries Development Officer
5. Consultant and Fish Breeders
6. R&D Professional
7. District Fisheries Development Officer
8. Export Manager
9. Feed Mill Manager
10. Hatchery/ Farm Operator
11. Fish Export Inspector, Aqua Culturist and Fishermen
12. Fisheries Inspector and Assistant Director of Fisheries
13. Fish Exporters and Hatchery Manager and Fish Traders
14. Processing and Production Manager

M.Sc., FISHERIES SCIENCE – PROGRAMME STRUCTURE

S. No.	Paper Code	Title of the Paper		T/P	Credits	Hours/ Week	Max. Marks		
							I	E	Total
I Semester									
1	547101	Core 1	Integrated Taxonomy of Finfish and Shellfishes	T	4	4	25	75	100
2	547102	Core 2	Inland Fisheries	T	4	4	25	75	100
3	547103	Core 3	Coastal and Marine Fisheries	T	4	4	25	75	100
4	547104	Core 4	Freshwater Aquaculture	T	4	4	25	75	100
5	547105	Core 5	Lab- I Integrated Taxonomy of Finfish and Shellfishes, Inland Fisheries, Coastal and Marine Fisheries, Freshwater Aquaculture	P	4	8	25	75	100
6	547106	Core 6	Field Trip	#F	2	2	25	75	100
7	547501/ 547502/ 547503	DSE *1	Aquatic Ecology and Biodiversity/ Fish Genetics and Biotechnology/ Statistics in Fisheries	T	3	3	25	75	100
		Library/ Yoga/counselling/				1			
					25	**30**	**175**	**525**	**700**
II Semester									
8	547201	Core 7	Finfish and Shellfish Biology	T	4	4	25	75	100
9	547202	Core 8	Fishing Crafts and Gears	T	4	4	25	75	100
10	547203	Core 9	Fisheries Management, Regulations and Conservation	T	4	4	25	75	100
11	547204	Core 10	Shellfish and Finfish Hatchery Management	T	4	4	25	75	100
12	547205	Core 11	Lab- II- Finfish and Shellfish Biology, Fishing Crafts and Gears, Fisheries Management, Regulations and Conservation, Shellfish and Finfish Hatchery Management	P	4	8	25	75	100
13	547206	Core 12	Internship*****	-	3	Summer month	25	75	100
14	547504/ 547505/ 547506	DSE*2	Remote Sensing and GIS in Fisheries Management/ Fishery Economics and Extension/ Aquatic Pollution	T	3	3	25	75	100
15		Non-Major Elective - 1**		T	2	3	25	75	100
16		Self-Learning Course (SLC) – MOOCs***		T	Extra Credit				
					28	**30**	**200**	**600**	**800**

S. No.	Paper Code	Title of the Paper		T/P	Credits	Hours/ Week	Max. Marks		
							I	E	Total
III Semester									
17	547301	Core 13	Coastal Aquaculture and Mariculture	T	4	4	25	75	100
18	547302	Core 14	Ornamental Aquaculture	T	4	4	25	75	100
19	547303	Core 15	Fish Processing Technology and Quality Assurance	T	4	4	25	75	100
20	547304	Core 16	Research Methodology in Fisheries	T	4	4	25	75	100
21	547305	Core 17	Lab- III- Coastal Aquaculture and Mariculture, Ornamental Aquaculture, Fish Processing Technology and Quality Assurance, Fish Processing Technology and Quality Assurance	P	4	8	25	75	100
22	547507/ 547508/ 547509	DSE 3	Aquatic Animal Health and Management/ Fish Nutrition and Feed Technology/ Integrated Fish Farming	T	3	3	25	75	100
23		Non-Major Elective – 2**		T	2	3	25	75	100
24		Self-Learning Course (SLC) –MOOCs***		T	Extra Credit				
					25	**30**	**175**	**525**	**700**
IV Semester									
25	547999	Core 18	****Dissertation Work	-	12	30	50	150	200
			Total		**12**	**30**	**50**	**150**	**200**
					90+		**600**	**1800**	**2400**

*DSE – Student Choice and it may be conducted by parallel sections.
** NME –Students have to select courses offered by other (Faculty) departments.
*** SLC- Voluntary basis
**** Dissertation –Marks -Viva-voce (50) + thesis (100) + internal (50) = 200
***** Internship report –Marks -Viva-voce (25) + report (50) + internal (25) = 100

F - Field Trip
T - Theory
P- Practical
I - Internal Assessment
E - External Examination

Non Major Electives offered to other Department

Course code	Semester	Course Name	Credits	Hours/Week
	II	Integrated Fish Farming	2	3
	III	Ornamental Fish Culture	2	3

I – Semester					
Core	**Course Code 547101**	**Integrated Taxonomy of Finfishand Shellfishes**	**T**	**Credits:4**	**Hours:4**
Unit -I					
Objective 1	**To realize the basic principles of taxonomy and classification**				
Principles of Taxonomy: Origin of classification - taxonomic hierarchy - Aim of taxonomist - Theories of taxonomy - Nomenclature - types. Classification and inter relationships. Criteria for generic and specific identification. Preservation, cataloguing, submission in museums (National Digital Repository for Museums of India) and maintenance of specimens.					
Outcome 1	**Students compile the basics in the principles of taxonomy and classification**				**K2**
Unit -II					
Objective 2	**To understand the morphometric and meristic characteristics ofCrustaceans**				
Crustacean: Taxonomic classification of commercially important crustaceans up to genus level - Morphometric and meristic characteristics of Crustaceans. Key characters for identification of commercially important species.					
Outcome 2	**Students analyse and evaluate the morphometric and meristic characteristics of Crustaceans**				**K2/K5**
Unit -III					
Objective 3	**To understand the morphometric and meristic characteristics of Mollusca**				
Mollusca: Taxonomic classification of commercially important molluscs up to genus level - Morphological characteristics of mollusca. Key characters for identification of commercially important molluscan species.					
Outcome3	**Students identify and evaluate the morphometric and meristic characteristics of Mollusca**				**K2/K5**
Unit IV					
Objective 4	**To figure out the taxonomic significance of finfish**				
Finfish Classification: Taxonomic significance - Major taxa of commercially important inland and marine finfishes - Morphometric and meristic characteristic features – Key characters for identification of commercially important finfish species.					
Outcome4	**Students analyse and classify the taxonomic significance of finfish**				**K2**

Unit V		
Objective 5	**To recognise the applications of molecular tools for fish identification**	
Molecular Taxonomy: Karyo-taxonomy - Cytotaxonomy of fishes - protein analysis and DNA polymorphism. Mitochondrial DNA - allozyme analysis - RFLP, RAPD, AFLP, and microsatellite typing - single nucleotide polymorphism (SNP) – expressed sequence tag (EST) - markers - DNA barcoding - NCBI - BLAST- MEGA - Phylogenetic tree		
Outcome 5	**Students critically assess the applications of molecular tools for fish identification**	**K4**

Suggested Readings:

Bal, D.V., Rao, K.V. (1990). *Marine Fisheries of India*. New York: Tata McGraw Hill Publishing Company Limited.

Bore, Q., Richard Moore, H. (2008). *Biology of Fishes* (3rd ed.). New York: Taylor and Francis Groups.

Cooksey, K. (1997). *Molecular Approaches to the Study of the Oceans*. Chapman & Hall.

FAO (2000). *DNA Based Molecular Diagnostic Techniques*.

Jayakumar, N., Durairaja, R., Selvaraj, S., Felix, S. (2018). *Taxonomy of Shellfish*. Daya Publ. House.

Jordan, E.L., Verma, P.S. (2014). *Invertebrate Zoology*. India: S. Chand & Co. Ltd.

Joseph Nelson, S., Terry Grande Mark, C., Wilson, V. H. (2016). *Fishes of the World* (5th ed.).

Wiley Kocher, T.D., Carol, A.S. (1997). *Molecular Systematics of Fishes*. Academic Press.

Kurian, C.V., Sabastian, V.O. (1976). *Prawns and Prawn Fisheries of India*. Hindustan Pub. Co.

Lagler, K.E. et al. (1977). *Ichthyology*. John Wiley and Sons. Rd Eds.

Mayer, E. (1977). *Principle of Systematic Zoology*. Tata McGraw Hill.

Norman, J.R., Greenwood, P.H. (1975). *A History of Fishes*. (3rd ed.). Ernest Benn Ltd.

Ponniah, A.G., George, J. (1998). *Fish Chromosome Atlas*. Lucknow: National Bureau of Fish Genetic Resources (NBFGR).

Whitmore, D.H. (1990). *Electrophoretic and Isoelectric Focusing Techniques in Fisheries Management*. CRC Press.

Online resources

www.abctaxa.be www.aldrin.tripod.com/biochemistry www.catalogueoflife.org/annual-checklist/2017/
www.discoveryeducation.com/teachers/free-lesson-plans/animal-classification.cfm
www.eol.org/
www.fish.cgiar.org/
www.fishbase.org
www.marinespecies.org
www.med.wikidot.com/biochemistry-online-links
www.researcharchive.calacademy.org/research/ichthyology/catalog/fishcatmain.asp
www.sp2000.org/
www.the-aps.org/mm/Education/K-12/EducationProjects/FrontiersinPhys/Teaching-Resources
www.wiley.com/legacy/college/boyer/0470003790/animations/animations.htm
www.worldfishcenter.org/
www.wyzant.com/resources/physiologyhttps://courseware.cutm.ac.in/courses/taxonomy of-finfish/
https://nfdb.gov.in/PDF/Fish%20&%20Fisheries%20of%20India/1.Fish%20and%20Fisheries%20of%20India.pdf
https://med.libretexts.org/Courses/Kansas_State_University/FNDH_413%3A_Science_of_Food/02%3A_Proteins/2.03%3A_Fish_Shellfish/2.3.01%3A_Fish_Classifications_and_Composition

K1-Remember	*K2-Understand*	*K3- Apply*	*K4-Analyse*	*K5-Evaluate*	*K6-Create*

Course designed by: Dr. E. Kannapiran

Course Outcome *vs* Programme Outcome

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	S (3)	M (2)	-	M (2)	L (1)	-	-	L (1)	-	S (3)
CO2	S (3)	M (2)	-	L (1)	L (1)	-	-	L (1)	-	S (3)
CO3	S (3)	M (2)	-	L (1)	L (1)	-	-	L (1)	-	S (3)
CO4	S (3)	M (2)	-	L (1)	L (1)	-	-	L (1)	-	S (3)
CO5	S (3)	-	-	M (2)	-	-	-	L (1)	-	S (3)
W.AV	**3**	**1.6**	**0**	**1.4**	**0.8**	**0**	**0**	**1**	**0**	**3**

S –Strong (3), M-Medium (2), L- Low (1)

Course Outcome *vs* Programme Specific Outcome

CO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	S (3)	L (1)	-	-	-
CO2	S (3)	M (2)	-	-	-
CO3	S (3)	M (2)	-	-	-
CO4	S (3)	M (2)	-	-	-
CO5	S (3)	L (1)	-	-	-
W. AV	**3**	**1.6**	**0**	**0**	**0**

S –Strong (3), M-Medium (2), L- Low (1)

I – Semester					
Core	**Course Code 547102**	**Inland Fisheries**	**T**	**Credits:4**	**Hours:4**
Unit -I					
Objective 1	**To familiarize the students with the basic knowledge on current status ofInland fisheries in India**				
Introduction to inland fisheries: History - Global and Indian scenario of inland capture fisheries and resource potentials - problems and management of the fisheries resources- Role of Government and NGOs in the Inland fishery developments.					
Outcome 1	**Students can comprehend the Inland fishery resourcesand present scenario in India**				**K2**
Unit -II					
Objective 2	**To comprehend the freshwater fisheries with sound knowledge on problems and management**				
Freshwater fisheries: Ponds - Lakes - Natural and Man-made Lakes - present status, productivity levels and management practices - Beels - tanks and derelict water bodies- major fish composition - diversity - Potential inland water bodies with reference to respective state - problems and management. **Reservoir Fisheries**: Classification of reservoirs -present productivity levels and management practices.					
Outcome 2	**Students can realize the need of Freshwater fisheriesresources, problems and management**				**K2**
Unit -III					
Objective 3	**To learn the importance of swamps and other wetlands ecosystem**				
Swamps and other wetlands: Introduction - Jheels /Beels Fishery resources - status - environmentalsustainability and livelihood security - productivity- conditions – capture scenario - prospects of culture-based systems - Degradation - impact of climate change - adaptation and mitigation strategies.					
Outcome 3	**Students can analyse the resources, capture and culture scenario in the Swamp and wetland ecosystem**				**K4**
Unit IV					
Objective 4	**To gain knowledge on the resource potential of riverine ecosystem of India**				
Riverine fisheries: Present status of fisheries resources- direct and indirect effects of human intervention - habitat modification/destruction, improvement, protection and restoration of fish for fish migration and restoration of riverine vegetation – stock enhancement, strategies like introduction of new species, pre- and post- stocking management, potential risk of stocking - Exotic species diversity - merits and demerits of exotic species.					
Outcome 4	**Students can recognize the Riverine fish status in India and their improvement, protection and restoration**				**K2**

Unit V		
Objective 5	**To understand the present status of cold water fisheries and theirresources management**	
Cold water fisheries: Present status - habitat destruction - management - prospects of sports fisheriesin India- Fishing Tackle -Types of angling - Sport fisheries potentials in Himalayan - factors affectingfishing - suggestions to promote sport fisheries. **Assessment**: Carrying capacity of different inland water bodies - water budgeting -community participation in fishery resource management.		
Outcome 5	**Students can comprehend the cold water fisheriesresources management and Sport fisheries**	**K2**

Suggested Readings:

Chandra, P. (2007). *Fishery Conservation, Management and Development*. SBS Publ.

Dipti, N. (2019). *Handbook of Fresh Water Fisheries Biology*. Oxford Book Company.

Iverson, E. S. (2003). *Farming the edge of the Sea*. London: Academic Press.

Khillare, Y. K. (2017). *Freshwater Fishes (A Practical Approach)*. Narendra Publ. House.

Korringa, P. (1999). *Farming marine fishes and shrimps.* New York: Elsevier.

Laxmappa, B. (2019). *A Manual of Murrel Fishes*. Narendra Publ. House.

Mathias, J. S., Charles, A.T., Bootong, H.U. (1998). *Integrated Fish Farming*. CRC Press.

Pingsun, L., Carole, E. (2007). *Shrimp Culture Economics, Market, and Trade*. Wiley-Blackwell.Rath, R. K. (2011). *Fresh Water Aquaculture* (3rd ed.). Scientific Publishers.

Roy, D. (2018). *Fresh Water Fisheries Management*. Oxford Book Company.

Sarma, D., Shahi, N. (2020). *Coldwater Fisheries and Aquaculture*. Narendra Publ. House

Online resources

https://courseware.cutm.ac.in/courses/inland-fisheries/
https://www.fao.org/3/X2614E/x2614e05a.htm
http://ecoursesonline.iasri.res.in/mod/page/view.php?id=91199
https://dof.gov.in/inland-fisheries
http://ecoursesonline.iasri.res.in/course/view.php?id=431
https://agritech.tnau.ac.in/fishery/fish_species_in_india.html
https://indianwetlands.in/wetlands-overview/wetland-types/
https://wiienvis.nic.in/Database/ramsar_wetland_sites_8224.aspx
https://agritech.tnau.ac.in/fishery/fish_reverinefisheries.html
https://www.cifri.res.in/Riverine%20health%20and%20impact%20on%20fisheries%20in%20India%20--%20Policy%20Paper%201.pdf
https://www.yourarticlelibrary.com/fish/applied-fisheries/cold-water-fisheries-in-india-with- diagram/88555

K1-Remember	*K2-Understand*	*K3- Apply*	*K4-Analyse*	*K5-Evaluate*	*K6-Create*

Course designed by: Dr. N.M. Prabhu

Course Outcome VS Programme Outcomes

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	L (1)	M (2)	L (1)	L (1)	L (1)	-	-	L (1)	L (1)	-
CO2	-	M (2)	L (1)	-	M (2)	M (2)	L (1)	-	L (1)	L (1)
CO3	-	M (2)	L (1)	L (1)	M (2)	M (2)	L (1)	-	L (1)	L (1)
CO4	L (1)	L (1)	L (1)	L (1)	L (1)	-	-	-	-	L (1)
CO5	L (1)	L (1)	L (1)	L (1)	L (1)	-	L (1)	-	-	L (1)
W.AV	**0.6**	**1.6**	**1**	**0.8**	**1.4**	**0.8**	**0.6**	**0.2**	**0.6**	**0.8**

S –Strong (3), M-Medium (2), L- Low (1)

Course Outcome VS Programme Specific Outcomes

CO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	S (3)	L (1)	L (1)	M (2)	S (3)
CO2	S (3)	M (2)	L (1)	M (2)	M (2)
CO3	S (3)	M (2)	L (1)	M (2)	S (3)
CO4	S (3)	L (1)	L (1)	M (2)	M (2)
CO5	S (3)	L (1)	L (1)	M (2)	L (1)
W. AV	**3**	**1.4**	**1**	**2**	**2.2**

S –Strong (3), M-Medium (2), L- Low (1)

I – Semester					
Core	**Course Code 547103**	**Coastal and Marine Fisheries**	**T**	**Credits:4**	**Hours:4**

Unit -I		
Objective 1	**To familiarize the students with the basic concepts of coastal and marine fishery resources**	
Introduction to coastal and marine fisheries: History - National and International status of fisheries- fishery resources in estuaries - mangroves - lagoons – backwaters and brackish water impoundments in India		
Outcome 1	**Students can comprehend the national and international status of coastal and marine fishery**	**K2**
Unit -II		
Objective 2	**To gain knowledge on the fishery resources of different ecosystem**	
Fishery resources: Important finfish and shellfish resources in demersal - pelagic - brackish water systems - conservation strategies. Principles - objectives and management of fisheries resources - issues and challenges of managing multi-gear fisheries.		
Outcome 2	**Students can realize the importance of Conservation and management of coastal and marine fishery resources**	**K2**
Unit -III		
Objective 3	**To understand the present status and sustainability of mangrove fishery**	
Mangrove fishery: Introduction - National and International status of Fishery resources - environmental sustainability and livelihood security - productivity - conditions - capture scenario - prospects of culture-based systems. Habitat degradation - impact of climate change on fishery resources.		
Outcome 3	**Students can analyse the mangrove fishery resources and their sustainability management**	**K3**
Unit IV		
Objective 4	**To analyse the various fishing crafts and gears**	
Fisheries and fishing methods: Introduction to crafts and gears - Inshore fisheries - Offshore fisheries - High sea fisheries up to outer limit of EEZ and in International waters. Sustainability of fisheries: Principles, social, economic, ecological, biological and legal issues - Fisheries co- management - Illegal Unreported and Unregulated (IUU) fishing - National and International status.		
Outcome 4	**Students comprehend sustainability of fisheries in inshore and offshore fisheries with regulations**	**K2**

Unit V		
Objective 5	**To understand the importance of Marine biodiversity conservation**	
Conservation: Marine biodiversity - principles - categorization of species into endangered; Indeterminate and extinct varieties - conservation in selected area – coral reef ecosystem – managing the highly exploited fishery resources - Case studies of fisheries conflicts depending on problems indifferent states - Bioinvasion.		
Outcome 5	**Students can realize the importance of Marine Biodiversity conservation for sustainable fishing**	**K2**

Suggested Readings:

Ayyappan et al., (2006). *Handbook of Fisheries and Aquaculture*. New Delhi: ICAR. Bal, D.V., Rao, K.V. (1990). *Marine Fishes of India* (1st revised ed.). Tata McGraw Hill.

Bykov, V. P. (2017). *Marine Fisheries (Chemical Composition and Processing Properties)*. Amerind Publishing.

Chaudhuri, A.B. (2007). *Biodiversity of Mangroves*. Daya Publ. House.

Jhingran, V.G. (1991). *Fish and Fisheries of India*. New Delhi: Hindustan Publishing Corporation(India).

John H. Steele, Steve A. Thorpe, Karl K. Turekian (2009). *Marine Biology* (2nd ed.). Academic Press.Pandey, D. K., De, H.K. (2014). *Fisheries Governance and Legistation In India*. Narendra Publ. House.

Santhanam, R., Ramanathan, N., Jagadessan, G. (1990). *Coastal Aquaculture in India*. India: CBS Publication.

Sugunan, V.V., Sinha, M. (2001). *Sustainable capture and culture-based fisheries in freshwaters of India*. In Pandian, T.J. (ed.), Proceedings of the National Seminar on Sustainable Fisheries for Nutritional Security. New Delhi: National Academy of Agricultural Sciences, 43 – 70.

Trivedi, P. R., Singh, U. K. (2017). *Biodiversity Conservation and Management*. Jnanada Prakashan

Online resources

https://courseware.cutm.ac.in/courses/marine-fisheries-2/
http://ecoursesonline.iasri.res.in/course/view.php?id=411
https://fisheries.kerala.gov.in/marine-fisheries
https://www.coastalfisheries.com/
https://www.fao.org/in-action/coastal-fisheries-initiative/overview/context/en/
https://www.seaaroundus.org/the-importance-of-coastal-fisheries/
https://dof.gov.in/marine-fisheries
www.fao.org www.cmfri.org.in/
www.ciba.org.in
www.cifa.org.in
www.caa.gov.in
ww.fao.org › FAO Home › Fisheries & Aquaculture

K1-Remember	*K2-Understand*	*K3- Apply*	*K4-Analyse*	*K5-Evaluate*	*K6-Create*

Course designed by: Dr. E. Kannapiran

Course Outcome VS Programme Outcomes

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	-	M (2)	L (1)	-	S (3)	L (1)	M (2)	L (1)	M (2)	L (1)
CO2	-	L (1)	L (1)	-	S (3)	L (1)	M (2)	L (1)	M (2)	L (1)
CO3	-	L (1)	L (1)	-	S (3)	L (1)	M (2)	L (1)	M (2)	L (1)
CO4	-	M (2)	L (1)	-	M (2)	L (1)	M (2)	L (1)	M (2)	L (1)
CO5	-	S (3)	-	-	S (3)	L (1)	L (1)	L (1)	L (1)	L (1)
W.AV	**0**	**1.8**	**0.8**	**0**	**2.8**	**1**	**1.8**	**1**	**1.8**	**1**

S –Strong (3), M-Medium (2), L- Low (1)

Course Outcome VS Programme Specific Outcomes

CO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	M (2)	M (2)	L (1)	L (1)	L (1)
CO2	M (2)	M (2)	L (1)	L (1)	L (1)
CO3	M (2)	M (2)	L (1)	L (1)	L (1)
CO4	M (2)	M (2)	L (1)	L (1)	L (1)
CO5	S (3)	-	L (1)	-	L (1)
W. AV	**2.2**	**1.6**	**1**	**0.8**	**1**

S –Strong (3), M-Medium (2), L- Low (1)

I – Semester					
Core	**Course Code 547104**	**Freshwater Aquaculture**	**T**	**Credits:4**	**Hours:4**
Unit -I					
Objective 1	**To learn the basic concept of freshwater aquaculture for sustainable production**				
Introduction: Present status, problems and scope of fish and prawn farming in global and Indian perspectives. Major cultivable freshwater species (Major, Medium and Minor Carps). Aquaculture systems: Extensive, semi-intensive and intensive culture of fish, Pen and cage culture in lentic and lotic water bodies, polyculture, composite fish culture- species selection, culture practices, harvesting.					
Outcome 1	**Students understand and analyse the status of aquaculture systems**				**K4**
Unit -II					
Objective 2	**To familiarize with freshwater hatchery for finfish and prawn**				
Hatchery Production: Finfish and prawn hatchery site selection - design and equipment for small, medium and large scale production - Present global and Indian status of freshwater hatchery - Commercially important Finfish and prawn hatchery production - Broodstock collection - quarantine - induce breeding - larval rearing - live feed production - feed, water quality and health management. Cost analysis for hatchery.					
Outcome 2	**Students discuss the finfish and prawn hatchery techniques**				**K4**
Unit -III					
Objective 3	**To understand the finfish and prawn nursery practices**				
Nursery production: Finfish and prawn nursery site selection - design and equipment for small, medium and large scale production - Present global and Indian status of nursey. Commercially important Finfish and prawn nursery production - importance of nursey - live feed production - feed, water quality and health management. Nursery cost analysis for important species.					
Outcome 3	**Students discuss the finfish and prawn nursery techniques**				**K4**
Unit IV					
Objective 4	**To analyse the importance of freshwater farming practices for various species**				
Farming: Present global and Indian status of freshwater finfish and prawn farming - Monoculture - polyculture - composite culture. Genetically Improved Farmed Tilapia - Production - monosex - Tilapia - All male Scampi production. Finfish and prawn farm management - pond preparation - water culture - stocking - feed, water and health management - harvesting. Recent management techniques - Biosecurity - Biofloc - HACCP. Freshwater pearl culture.					
Outcome 4	**Students evaluate the freshwater finfish and prawn farming methods**				**K5**

Unit V		
Objective 5	**To gain knowledge on integrated fish farming**	
Integrated fish farming: Farm design, farming practices, constraints and economics of IFS of fish with paddy, cattle, pig, poultry, duck, rabbit, etc. Culture of fishes in the community ponds - Wastewater - fed aquaculture - Water treatment methods, species selection, culture practices, harvesting. Aquaphonics - types and production system.		
Outcome 5	**Students apply the various integrated fish farming techniques**	**K3**

Suggested Readings:

Boyd, Claude E., Tucker, C. S. (1998). *Pond Aquaculture Water Quality Management*. USA:Springer.

CIFE (1993*). Training Manual on Culture of Live Food Organisms for AQUA hatcheries*. Mumbai: Central Institute of Fisheries Education, Versova.

Edward J. Noga (2011). *Fish Disease-Diagnosis and Treatment* (2nd ed.). Wiley-Blackwell.FAO (2003). *Integrated Livestock-fish Farming Systems*.

FAO (2007). *Manual on Freshwater Prawn Farming*.

Ivar, L. O. (2007). *Aquaculture Engineering*. Daya Publ. House.

John E. Bardach (1997). *Sustainable Aquaculture*. New York: John Wiley & Sons Inc. Mathias, J. S., Charles, A.T., Bootong, H. U. (1998). *Integrated Fish Farming*. CRC Press.

Pillay, T. V. R., Kutty, M. N. (2012). *Aquaculture Principles and Practices* (2nd ed.). Wiley -Blackwell.

Rath, R. K. (2000). *Freshwater Aquaculture*. Scientific Publ.

Robert R. Stickney (2016). *Aquaculture an Introductory Text* (3rd ed.). CABI.

Venugopal, S. (2005). *Aquaculture*. Pointer Publ.

Online resources

http://www.fao.org/3/x5625e09.htm
http://ecoursesonline.iasri.res.in/course/view.php?id=297
http://www.fisheries.kerala.gov.in/kavil https://kerala.gov.in/adak
http://www.fao.org/tempref/FI/CDrom/bobp/cd1/Bobp/Publns/MAG/013.pdf
http://cifa.nic.in/
http://www.cifri.res.in/
https://tal.ifas.ufl.edu/extension-and-outreach/extension-publications/
http://www.practicalfishkeeping.co.uk/

K1-Remember	*K2-Understand*	*K3- Apply*	*K4-Analyse*	*K5-Evaluate*	*K6-Create*

Course designed by: Dr. N.M. Prabhu

Course Outcome VS Programme Outcomes

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	-	M (2)	S (3)	-	L (1)	S (3)	S (3)	-	S (3)	S (3)
CO2	-	M (2)	S (3)	-	L (1)	S (3)	S (3)	-	S (3)	S (3)
CO3	-	M (2)	S (3)	-	L (1)	S (3)	S (3)	-	S (3)	S (3)
CO4	-	M (2)	S (3)	-	L (1)	S (3)	S (3)	-	S (3)	S (3)
CO5	-	L (1)	S (3)	-	L (1)	S (3)	S (3)	-	S (3)	S (3)
W. AV	**0**	**1.8**	**3**	**0**	**1**	**3**	**3**	**0**	**3**	**3**

S –Strong (3), M-Medium (2), L- Low (1)

Course Outcome VS Programme Specific Outcomes

CO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	-	M (2)	S (3)	L (1)	-
CO2	L (1)	S (3)	S (3)	M (2)	-
CO3	L (1)	S (3)	S (3)	M (2)	L (1)
CO4	M (2)	M (2)	S (3)	M (2)	L (1)
CO5	S (3)	-	S (3)	S (3)	M (2)
W. AV	**1.4**	**2**	**3**	**2**	**0.8**

S –Strong (3), M-Medium (2), L- Low (1)

I – Semester					
Core	**Course Code 547105**	**Lab-I** - Integrated Taxonomy of Finfish and Shellfishes, Inland Fisheries, Coastal and Marine Fisheries, Freshwater Aquaculture	**P**	**Credits:4**	**Hours:8**

Unit -I		
Objective 1	**To gain knowledge about traditional and taxonomy**	
Taxonomy: Identification of commercially important freshwater, coastal and marine finfish - morphometric and meristic characters. Modern taxonomic tools - DNA bar coding and phylogeneticanalysis. Visit to fish landing centres to identify commercially important fishes and catch composition		
Outcome1	**Students identify the finfishes and evaluate the catch composition**	**K5**

Unit -II		
Objective 2	**To understand the basic knowledge on inland fisheries**	
Taxonomy: Identification of commercially important crustacean, Mollusca - morphometric andmeristic characters		
Outcome 2	**Students identify the shell fishes**	**K4**

Unit -III		
Objective 3	**To gain practical knowledge on Inland, coastal and marine fishery resources**	
Inland fisheries: Different types of tags - case study. Visit to nearest freshwater body. Catchingmethods - catch data analysis on major freshwater resource - Reservoirs - lakes - Biodiversity indices - Gear selectivity.		
Outcome 3	**Students analyse the catch data of Inland fisheries**	**K4**

Unit IV		
Objective 4	**To familiarize the work carried in freshwater aquaculture**	
Coastal and Marine fishery resources: Case study - visit to nearest coastal and marine landing centre - length frequency analysis - catching method - catch data analysis on marine fishery resourcesof India - closed season studies - gear selectivity.		
Outcome 4	**Students analyse the length frequency, catch data of coastal and marine fishery resources**	**K4**

Unit V		
Objective 5	**To perform water quality tests**	
Freshwater aquaculture: Identification of commercially important cultivable fish and prawn - Sampling procedure - growth assessment - feed calculation. Lime, fertilizer and feed additive calculation. Estimation of dissolved oxygen, pH, salinity, ammonia, biological oxygen demand and chemical oxygen demand.		
Outcome 5	**Students estimate the water quality parameters**	**K6**

Suggested Readings:

Anon (2000). *Manual of Chemical Methods* (2nd ed.). Bureau of Indian Standards: IS/ISO14000:1996 on Environmental Management System US-EPA.

Biswas, S P. (1993). *Manual Methods In Fish Biology*. New Delhi: South Asian Publishers.

Castro, P., Huber, M. E. (1997). Marine Biology (2nd ed.). New York: Mc-Graw Hill Company.

David, S., Jeremy, P. (2001). *Inshore Fisheries Management. Methods and Technologies in FishBiology and Fisheries* (Vol. II). Kluwer.

Eva E. Plaganyi (2007). *Models for an Ecosystem approach to Fisheries*. United NationsOrganization.

Nybakken, J. W. (1997). *Marine Biology – An Ecological Approach* (4th ed.). California: AddisonWesley Edu. Pub. Inc.

Parsons, T.R., Maita, Y., Lalli, C. M. (1984). *A Manual of Chemical and Biological Methods forSeawater Analysis*. Pergamon Press.

Pillay, T. V. R., Kutty, M. N. (2012). *Aquaculture Principles and Practices* (2nd ed.). Wiley India.

Srivastava, M. M., Sanghi, R. (2007). *Chemistry of Green Environment*. Narosa Publ. House.

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www.fao.org
https://ciba.icar.gov.in/
https://cifa.nic.in/
https://worldfishcenter.org/
https://www.cmfri.org.in/
https://www.canr.msu.edu/uploads/236/65819/ScienceBlast/Fins-Tails-Scales.pdf
https://seafoodacademy.org/pdfs/fish-id.pdf
https://courseware.cutm.ac.in/wp-content/uploads/2020/06/Shellfish_Identification.pdf
https://aquafind.com/articles/BiodiversityIndices.php#:~:text=A%20diversity%20index%20is%20a, the%20same%20number%20of%20entities.

K1-Remember	*K2-Understand*	*K3- Apply*	*K4-Analyse*	*K5-Evaluate*	*K6-Create*

Course designed by: Dr. E. Kannapiran and Dr. N.M. Prabhu

Course Outcome VS Programme Outcomes

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	S (3)	-	-	S (3)	-	-	-	-	-	S (3)
CO2	S (3)	-	-	S (3)	-	-	-	-	-	S (3)
CO3	L (1)	S (3)	S (3)	S (3)	S (3)	-	S (3)	S (3)	S (3)	S (3)
CO4	L (1)	S (3)	S (3)	S (3)	S (3)	-	S (3)	S (3)	S (3)	S (3)
CO5	L (1)	S (3)	S (3)	S (3)	S (3)	-	S (3)	S (3)	S (3)	S (3)
W. AV	**1.8**	**1.8**	**1.8**	**3**	**1.8**	**0**	**1.8**	**1.8**	**1.8**	**3**

S –Strong (3), M-Medium (2), L- Low (1)

Course Outcome VS Programme Specific Outcomes

CO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	-	-	-	-	-
CO2	-	-	-	-	-
CO3	S (3)	M (2)	S (3)	S (3)	S (3)
CO4	S (3)	M (2)	S (3)	S (3)	S (3)
CO5	S (3)	-	S (3)	S (3)	S (3)
W. AV	**1.8**	**0.8**	**1.8**	**1.8**	**1.8**

S –Strong (3), M-Medium (2), L- Low (1)

I – Semester					
Core	**CourseCode 547106**	**Field Trip**	**F**	**Credits:2**	**Hours:2**

Course Outcomes		
Outcome 1	Students develop a field experience with an opportunity to share theirinsights on the subject	**K4**
Outcome2	Students demonstrate the links between academic preparation and theirfield work	**K5**
Outcome 3	Students integrate academic theory and 'real world' practice, and gainhands-on experience in professional settings	**K4**
Outcome 4	Students recognize knowledge and skills related to the technical aspectsof aquaculture	**K3**
Outcome 5	Students apply appropriate skills in the techniques of aquaculture operations and management and recognise career opportunities	**K4/K5**

K1-Remember	*K2-Understand*	*K3-Apply*	*K4-Analyse*	*K5-Evaluate*	*K6-Create*

Course designed by: Dr. E. Kannapiran

Course Outcome VS Programme Outcomes

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	S (3)	S (3)	S (3)	S (3)	S (3)	S (3)	S (3)	M (2)	M (2)	M (2)
CO2	S (3)	S (3)	S (3)	M (2)	M (2)	S (3)	S (3)	M (2)	S (3)	M (2)
CO3	S (3)	S (3)	S (3)	M (2)	M (2)	S (3)	S (3)	M (2)	S (3)	M (2)
CO4	L (1)	S (3)	S (3)	L (1)	L (1)	S (3)	S (3)	L (1)	M (2)	L (1)
CO5	L (1)	S (3)	S (3)	L (1)	L (1)	S (3)	S (3)	L (1)	M (2)	L (1)
W. AV	**2.2**	**3**	**3**	**1.8**	**1.8**	**3**	**3**	**1.6**	**2.4**	**1.6**

S –Strong (3), M-Medium (2), L- Low (1)

Course Outcome VS Programme Specific Outcomes

CO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	M (2)	L (1)	S (3)	S (3)	M (2)
CO2	S (3)	L (1)	S (3)	S (3)	M (2)
CO3	S (3)	M (2)	S (3)	S (3)	M (2)
CO4	M (2)	L (1)	S (3)	S (3)	L (1)
CO5	L (1)	M (2)	S (3)	S (3)	L (1)
W. AV	**2.2**	**1.4**	**3**	**3**	**1.6**

S –Strong (3), M-Medium (2), L- Low (1)

I – Semester					
DSE	**Course Code 547501**	**Aquatic Ecology and Biodiversity**	**T**	**Credits:3**	**Hours:3**

Unit -I		
Objective 1	**To learn the basic concepts in aquatic environment**	
Concepts in aquatic environment: Aquatic environment/ecosystem - components - structure and functions; Ecological concepts - succession, homeostasis, natality and mortality, r and k selection; Concepts of habitat and ecological niche; carrying capacity.		
Outcome 1	**Students analyse the aquatic ecological components, structure andfunctions**	**K4**

Unit -II		
Objective 2	**To understand the biological features of various aquatic ecosystems**	
Aquatic ecology: Freshwater, estuarine and marine - Biotic features of a freshwater, ecosystem. Estuarine and marine ecosystem - classifications, biological features of Coral Reefs, Seaweeds, Seagrasses and Mangroves. Deep sea ecosystem and Hydrothermal vent community. Natural resources and their conservation - Satellite mapping.		
Outcome 2	**Students discover the biotic features of aquatic ecosystems, naturalresources and their conservation**	**K3**

Unit -III		
Objective 3	**To analyse the role of environmental factors in aquatic environment**	
Biological Ecosystem: Environmental factors influencing life in the oceans: Salinity, temperature, light, currents, waves, tides, oxygen, and carbon dioxide. Phytoplankton and Zooplankton, interrelationship, vertical migration of zooplankton, geographical and seasonal variation in plankton production, plankton and fisheries.		
Outcome 3	**Students analyse the environmental factors influencing the growthof aquatic organisms**	**K4**

Unit IV		
Objective 4	**To understand the Bio-geochemical cycle and Environmental concerns**	
Bio-geochemical cycle: Definition, general concept of complete and incomplete bio-geochemical cycles, sedimentary cycles in tropics. Environmental concerns: population explosion, industrialization, urbanization, and natural calamities; Overexploitation of resources; Environmental stresses; Pollution control and management - Global warming; Ocean acidification, Carbon credit, Ozone Depletion.		
Outcome 4	**Students critically evaluate the environmental concerns including pollution, biogeochemical cycles**	**K5**

Unit V		
Objective 5	**To familiarize the aquatic biodiversity and their conservation**	
Biodiversity: Definition and concept. Factors influencing aquatic biodiversity. Types of biodiversity - Species diversity, Genetic Diversity, and Habitat Diversity; Biodiversity indices and their significance; Concepts of Index of Biotic Integrity (IBI); Economic appraisal of biodiversity; Global diversity patterns and loss of biodiversity.		
Outcome 5	**Students critically evaluate the significance of aquatic biodiversity**	**K5**

Suggested Readings:

Balakrishnan Nair, N., Thampy, D. M. (1980). *A Text Book of Marine Ecology*. The MacMillan Co.

Carter, R.W.G. (1998). *Coastal Environments: An Introduction to the Physical, Ecological and Cultural Systems of Coastlines*. Academic Press.

Dev Raj Khanna (2005). *Aquatic Biodiversity in India: The Present Scenario*. Daya Publ. House.

Gabriella Bianchi, Hein R. Skjoldal (2008). *The Ecosystem Approach to Fisheries*. CABI.

Helfman, G., Collette, B.B., Facey, D.E., Bowen, B.W. (2009). *The Diversity of Fishes Biology, Evolution, and Ecology*. Wiley.

Joseph S. Nelson, Terry C. Grande Mark, Wilson, V. H. (2016). *Fishes of the World*. 5th Eds. Wiley.

Mamta Rawat, Chandrakasan Sivaperuman, Sumit Dookia (2015). *Aquatic Ecosystem: Biodiversity,Ecology and Conservation*. Springer India.

Nikolsky, G. V. (2008). *The Ecology of Fishes*. Academic Press.

Olando Martin (2017). *Aquatic Ecology and Biodiversity*. Callisto Reference.

Sakhare, V. B., Jetithor, S. G., Jadhav, S. S. (2018). *Biodiversity and Fisheries*. Discovery PublishingHouse Pvt. Ltd.

Simon, J., Kaiser, M.J., Reynolds, J. D. (2001). *Marine Fisheries Ecology*. Blackwell.

World Conservation Monitoring Centre (1992). *Global Biodiversity: Status of the Earth's LivingResources*. Springer, Dordrecht.

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http://ecoursesonline.iasri.res.in/course/view.php?id=582

http://www.ramp-alberta.org/river/ecology/aquatic+ecology.aspx

https://courseware.cutm.ac.in/courses/aquatic-ecology-biodiversity-and-disaster-management/

https://www.earthreminder.com/types-of-ecosystems/

https://www.nationalgeographic.org/topics/resource-library-biotic-factors/

https://www.biologyonline.com/dictionary/abiotic-factor

https://www.unep.org/news-and-stories/story/marine-environment-essential-component-global-life- support-system

https://www.epa.gov/coral-reefs/basic-information-about-coral-reefs

https://prepp.in/news/e-492-gaseous-cycles-environment-notes https://www.britannica.com/science/sedimentary-cycle https://www.entrepreneur.com/living/types-of-pollution-and-how-to-reduce-them/443113 https://climatekids.nasa.gov/greenhouse-effect/ http://www.bsienvis.nic.in/database/biodiversity-hotspots-in-india_20500.aspx

K1-Remember	***K2-Understand***	***K3- Apply***	***K4-Analyse***	***K5-Evaluate***	***K6-Create***

Course designed by: Dr. E. Kannapiran

Course Outcome VS Programme Outcomes

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	L (1)	S (3)	L (1)	L (1)	M (2)	S (3)	L (1)	L (1)	L (1)	S (3)
CO2	-	S (3)	-	M (2)	S (3)	L (1)	-	L (1)	L (1)	L (1)
CO3	-	S (3)	-	M (2)	S (3)	S (3)	-	M (2)	S (3)	S (3)
CO4	-	L (1)	-	-	S (3)	L (1)	-	-	-	L (1)
CO5	M (2)	S (3)	-	L (1)	S (3)	L (1)	-	M (2)	L (1)	-
W. AV	**0.6**	**2.6**	**0.2**	**1.2**	**2.8**	**1.8**	**0.2**	**1.2**	**1.2**	**1.6**

S –Strong (3), M-Medium (2), L- Low (1)

Course Outcome VS Programme Specific Outcomes

CO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	M (2)	-	-	-	-
CO2	S (3)	L (1)	S (3)	L (1)	-
CO3	M (2)	M (2)	S (3)	S (3)	L (1)
CO4	M (2)	L (1)	M (2)	L (1)	M (2)
CO5	S (3)	S (3)	M (2)	L (1)	M (2)
W. AV	**2.4**	**1.4**	**2**	**1.2**	**1**

S –Strong (3), M-Medium (2), L- Low (1)

I – Semester					
DSE	**Course Code 547502**	**Fish Genetics and Biotechnology**	**T**	**Credits:3**	**Hours:3**

Unit -I		
Objective 1	**To learn the basic concept of genetics**	
Introduction: Definitions, scope of genetics, Mendelian principles and contribution, polygenic inheritance, multiple alleles, sex determination, sex-linked-inheritance and pedigree analysis, simple Mendelian traits. Cell structure and cell division		
Outcome 1	**Students discuss the scope of the genetics in fisheries**	**K5**
Unit -II		
Objective 2	**To familiarize with the principles of molecular genetics**	
Principles of genetics: Interactions and environmental influences - Molecular genetics: Concept of gene - gene expression, gene expression to control eukaryotic, prokaryotes and phages. DNA mutation and recombination. Genetic regulation of development and differentiation. DNA bar- coding. Recombinant DNA technology		
Outcome 2	**Students discuss the principles of biotechnology and genetic study**	**K5**
Unit -III		
Objective 3	**To understand the practical application of genetics**	
Practical application of Genetics: Hybridization in fishes, recent trends and techniques in hybridization, selective -breeding, cross breeding, Marker assisted selection, development of disease resistance and high quality strains - transgenic fishes, GMOs -Cryopreservation techniques. Inbreeding and impacts, Genetic variation		
Outcome 3	**Students critically evaluate the practical application of genetic study**	**K5**
Unit IV		
Objective 4	**To analyse the importance of fish genetic resources conservation**	
Conservation: Androgenesis, gynogenesis, sex reversal and tripoidy, conservation of germplasm. Fish Genetic recourses- collection and preservation of genetic recourses - importance of fish gene banking and live germplasm resource centres. Chromosome manipulation, Sex determination, Application of genetics in conservation		
Outcome 4	**Students analyse the importance of fish genetic resources conservation**	**K4**

Unit V		
Objective 5	**To gain knowledge on fish genetic diversity and influencing factors**	
Diversity: Genetic diversity - importance, estimation and influencing factors; Determination ofsample size. Introduction to population genetics, Hardy - Weinberg law and its significance. Different markers - Allozymes, mitochondrial DNA & microsatellites. Genetic drift- consequences of randomgenetic drift.		
Outcome 5	**Students discuss the importance of genetic diversity and influencingfactors**	**K5**

Suggested Readings:

Crew, F. A., (2006). *Animal Genetics - The Science of Animal Breeding*. 1st Eds. Home Farm Books.

Dunham, R. A. (2004). *Aquaculture and Fisheries Biotechnology- Genetic Approaches*. CABI.

Emmanuel, C. (2006). *Applied genetics: Recent trends and Techniques*. 1st Eds. MJP Publishers.

Gahalain, S. S. (2004). *Fundamentals of Genetics*. India: Anmol Publications.

Ghosh, R. (2007). *Fish Genetics and Endocrinology*. Swastik Publ. & Distr.

Hartwell, L., Hood, L., Goldberg, M., Reynolds, A. E., Silver, L. (2014). *Genetics from genes togenomes*. (5th ed.). McGraw-Hill Education.

Joe Bearden, H., John W. Fuquay., Scott T. Willard (2003). *Applied Animal Reproduction*. 6th Eds. Pearson.

Malvee, S. (2008). *Fish Genetics*. SBS Publ.

Nair, P. R. (2008). *Biotechnology and Genetics in Fisheries and Aquaculture*. Dominant Publ.

Padhi, B. J., Mandal, R. K. (2000). *Applied Fish Genetics*. Fishing Chimes.

Pandian, T. J., Strüssmann, C. A., Marian, M. P. (2005). *Fish Genetics and Aquaculture Biotechnology*. Science Publ.

Reddy, P. V. G. K. (2005). *Genetic Resources of Major Indian Carps*. Daya Publ.

Reddy, P. V. G. K., Ayyappan, S., Thampy, D. M., Gopal Krishna (2005). *Text Book of Fish Geneticsand Biotechnology*. ICAR.

Richard M. Bourdon (1999). *Understanding Animal Breeding*. 2nd Eds. Pearson.

Terence A. Brown (1990). *Genetics: A molecular approach*. Chapman and Hall.

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http://ecoursesonline.iasri.res.in/course/view.php?id=435

https://aquafind.com/articles/Aquaculture_Biotechnology.php

https://www.uou.ac.in/sites/default/files/slm/BSCBO-301.pdf

K1-Remember	*K2-Understand*	*K3- Apply*	*K4-Analyse*	*K5-Evaluate*	*K6-Create*

Course designed by: Dr. E. Kannapiran and Dr. N.M. Prabhu

Course Outcome *vs* Programme Outcome

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	M (2)	L (1)	-	-	-	-	-	-	-	M (2)
CO2	S (3)	-	-	-	-	-	-	-	-	M (2)
CO3	M (2)	L (1)	-	-	-	L (1)	-	-	-	L (1)
CO4	M (2)	-	-	-	-	-	-	-	-	M (2)
CO5	L (1)	-	-	-	-	-	-	-	-	M (2)
W. AV	**2**	**0.4**	**0**	**0**	**0**	**0.2**	**0**	**0**	**0**	**1.8**

S –Strong (3), M-Medium (2), L- Low (1)

Course Outcome *vs* Programme Specific Outcome

CO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	S (3)	-	-	-	S (3)
CO2	-	-	-	-	M (2)
CO3	L (1)	-	-	-	M (2)
CO4	-	-	-	-	M (2)
CO5	-	-	-	-	M (2)
W. AV	**0.8**	**0**	**0**	**0**	**2.2**

S –Strong (3), M-Medium (2), L- Low (1)

I – Semester					
DSE	**Course Code 547503**	**Statistics in Fisheries**	**T**	**Credits:3**	**Hours:3**

Unit -I		
Objective 1	**To analyse the basic concept of sampling survey in fishery resources**	
Definition and Introduction: Sample Survey for estimation of inland and marine fishery resources - Census on Marine Fisheries, Catch Assessment Survey of Inland and Marine Fisheries, Development of Geographical Information System (GIS) based fishery management system, Development of Database of fishery resources in India.		
Outcome1	**Students undertake sampling survey for estimation of fishery resources**	**K6**
Unit -II		
Objective 2	**To familiarize with the National and International status of fish production**	
Production: Fish production - National and International status - National production and disposal - State/union territory wise - inland and marine fish production - Species wise - Inland and Marine Fish Landings - capture fishery - inland and marine - Aquaculture production state wise/UT wise - Fish Seed Production in India - Preservation and processing of fish.		
Outcome 2	**Students evaluate the National and International status of fish production**	**K5**
Unit -III		
Objective 3	**To understand the fishermen population and fishery resources**	
Fishery resources: State and UT wise fishermen population - landing centres - major and minor - number and types of vessels and gears used - National and international EEZ and its potential - government schemes and expenditure - Fishery institutions of India.		
Outcome 3	**Students analyse fishermen population and fishery resources**	**K4**
Unit IV		
Objective 4	**To learn the international market trend in major marine fishes production**	
International scenario: Indian contribution of fishery products to world - fish production - annual growth - major countries in inland production - group wise - Major marine species production countries and their contribution. International market trend and prices - species wise. Per capita fishconsumption, India and international.		
Outcome 4	**Students analyse the major marine fishes production**	**K4/K5**

Unit V		
Objective 5	**To gain knowledge on national fishery welfare and their schemes**	
Fishery welfare: Fishermen welfare - government schemes - State wise details of fund availabilityunder the Central Sponsored Scheme on National Scheme of Welfare of Fishermen, future prospectus - role of NFDB in fishery development and their schemes - PMMSY schemes and implication strategies.		
Outcome 5	**Students discuss the national fishery welfare and their schemes**	**K4/K5**

Suggested Readings:

Amita Saxena (2011). *Fisheries Economics*. Daya Publishing House.

Biradar, R. S. (2002). *Course Manual on Fisheries Statistics*. 2nd Eds. CIFE, Mumbai.

Chitambar, J. B. (1990). *Introductory Rural Sociology*. New Age International Publishers.

Department of Fisheries (2018). *Hand Book on fishery statistics* (Various years).

FAO (2020). *Fishery statistics* (Various years).

Jerry, L. G. (1990). *A Commodity Systems Assessment Methodology for Problem and Project Identification*. Post Harvest Institute for Perishables. College of Agriculture, University of Idaho.

Ministry of Agriculture. *Handbook of Fisheries Statistics*. New Delhi (Various years).

Rajani, M., Balasubramanian, A. (2021). *Statistics for Fisheries Data Analysis*. Narendra Publishing House.

Ramasubramanian, V., Biradar, R. S., Krishnan, M. (2017). *Statistical Methods for Fisheries Students: A Practical Manual*. ICAR-Central Institute of Fisheries Education, Mumbai.

Rao, P. S. (1983). *Fisheries economics and management in India*. Pioneer Publishers And Distributors.

Seijo, J. C., Defeo, D., Salas, S. (1998). *FAO Fisheries technical paper 368. Fisheries Bioeconomics: Theory, modelling and management.* FAO, Rome.

Online resources

https://www.fao.org/statistics/en/

https://ruralindiaonline.org/en/library/resource/handbook-on-fisheries-statistics-2022/#:~:text=In%20the%20case%20of%20marine,of%20marine%20fish%20produce%20respectively.

https://dof.gov.in/statistics

https://dof.gov.in/sites/default/files/2023-01/HandbookFisheriesStatistics19012023.pdf

https://mospi.gov.in/416-fisheries-statistics

https://mospi.gov.in/sites/default/files/publication_reports/Manual_Fishery_Statistics_2dec11_0.pdf

https://ec.europa.eu/eurostat/web/fisheries/data

https://www.agriculture.gov.au/abares/research-topics/fisheries/fisheries-and-aquaculture-statistics

https://www.ab.gov.tr/files/ardb/evt/1_avrupa_birligi/1_6_raporlar/1_3_diger/agriculture_and_fisheries/fishery_statistics.pdfwww.spss.com

www. Fisat.in

www.r.ac.in

K1-Remember	*K2-Understand*	*K3- Apply*	*K4-Analyse*	*K5-Evaluate*	*K6-Create*

Course designed by: Dr. E. Kannapiran

Course Outcome VS Programme Outcomes

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	L (1)	S (3)	L (1)	S (3)	S (3)	-	-	M (2)	M (2)	M (2)
CO2	L (1)	S (3)	M (2)	L (1)	S (3)	-	-	M (2)	M (2)	M (2)
CO3	-	S (3)	L (1)	L (1)	S (3)	-	-	-	-	-
CO4	L (1)	S (3)	M (2)	L (1)	S (3)	L (1)	L (1)	M (2)	M (2)	L (1)
CO5	-	-	-	-	-	M (2)	-	S (3)	-	-
W. AV	**0.6**	**2.4**	**1.2**	**1.2**	**2.4**	**0.6**	**0.2**	**1.8**	**1.2**	**1**

S –Strong (3), M-Medium (2), L- Low (1)

Course Outcome VS Programme Specific Outcomes

CO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	M (2)	-	L (1)	L (1)	-
CO2	S (3)	-	-	-	-
CO3	S (3)	-	-	-	L (1)
CO4	L (1)	S (3)	L (1)	S (3)	L (1)
CO5	-	S (3)	L (1)	0	S (3)
W. AV	**1.8**	**1.2**	**0.6**	**0.8**	**1**

S –Strong (3), M-Medium (2), L- Low (1)

II – Semester					
Core	**CourseCode 547201**	**Finfish and Shellfish Biology**	**T**	**Credits:4**	**Hours:4**

Unit -I		
Objective 1	**To understand the fundamentals of biology of finfishes**	
Finfish: Biology of commercially important freshwater and marine finfishes - Digestive system - Respiratory system - Physiological system - Nervous system -Reproductive system of fishes - food and feeding habits - age & growth - life cycle - role of endocrine system in reproduction – migrationof fishes.		
Outcome 1	**Students analyse the fundamental concepts of biology of finfishes**	**K4**
Unit -II		
Objective 2	**To familiarize with biology of prawn and shrimp**	
Prawn and Shrimp: Commercially important prawn and shrimps - Reproduction - larval stages - food and feeding habits - age & growth - life cycle - role of endocrine system in reproduction - migration.		
Outcome 2	**Students compare and evaluate the fundamentalconcepts of biology of prawn and shrimp**	**K5**
Unit -III		
Objective 3	**To learn the biology of crab and lobsters**	
Crab and lobster: Commercially important crabs and lobsters - life cycle - food and feeding habits - age & growth - role of endocrine system in reproduction - migration.		
Outcome 3	**Students understand the fundamental concepts ofbiology of crab and lobster**	**K2**
Unit IV		
Objective 4	**To impart the biology of bivalves**	
Bivalves: Clam - oyster - green and brown mussel - National and International status - reproductivebiology - life cycle - food and feeding habits - age & growth.		
Outcome 4	**Students evaluate the National and International statusof bivalves and understand the biology of bivalves**	**K5**
Unit V		
Objective 5	**To gain knowledge on gastropods and cephalopods biology**	
Gastropods: Commercially important freshwater snails and Abalone - reproductive biology - lifecycle -food and feeding habits - age & growth. **Cephalopods:** Squid - octopus - cuttlefish - commercially important species - reproductive biology- life cycle - food and feeding habits - age & growth.		
Outcome 5	**Students compare the fundamental concepts of biology of cephalopods and gastropods**	**K4**

Suggested Readings:

Andrea M. Bianchi, Jamie N. Fields (2012). *Gastropods: Diversity, Habitat and Genetics*. NovaScience Pub Inc.

Biswas, S P. (1993). *Manual methods in fish Biology*. South Asian Publishers, New Delhi.

David, S., Jeremy, P. (2001). *Inshore Fisheries Management. Methods and Technologies in FishBiology and Fisheries*. Vol. II. Kluwer.

Gurdarshan Singh, Bhaskar, H. (2003). *An introduction to fishes*. Campus Books, New Delhi.

Johal, M. S., Tandon, K. K. (1996). *Age and growth in Indian freshwater fishes*. Narendra Publ. House, New Delhi.

Khanna, S. S., Singh, H. R. (2003). *A textbook of fish biology and fisheries*. Narendra Publ. House,New Delhi.

Kyle, Harry M. (2008). *Biology of fishes*. Biotech Books.

Reinecke, M., Giacomo Zaccone, Kapoor, B.G. (2006). *Fish Endocrinology* (2 Vols.). CRC Press.

Moyle Peterb (1979). *Fishes: An Introduction to Ichthyology*. Prentice Hall.

Peter Boyle, Paul Rodhouse (2005). *Cephalopods: Ecology and Fisheries*. Blackwell Science Ltd.

Rahul Parihar, P. (2014). *Text book of fish Biology and Indian fisheries*. Central Publ. House.

Santhanam, R., Ramanathan, N., Jegadeesan, G. (1990). *Coastal Aquaculture in India*. CBSPublication, Delhi.

Shanmugam, K. (1990). *Fishery Biology and Aquaculture*. Leo Pathippagam, Madras.

Thomas, P. C. (2003). *Breeding and Seed Production of Fin Fish and Shell Fish*. Daya Publ. House.

Online resources

http://ecoursesonline.iasri.res.in/course/view.php?id=427

https://nfdb.gov.in/PDF/Fish%20&%20Fisheries%20of%20India/1.Fish%20and%20Fisheries%20of%20India.pdf

https://icar.org.in/files/English-Unit/Fisheries/DEVELOPMENTAL%20BIOLOGY%20OF%20FINFISH%20AND%20SHELLFISH.html

https://icar.org.in/files/English-Unit/Fisheries/FEEDING%20AND%20REPRODUCTIVE%20BIOLOGY%20OF%20FINFISH%20AND%20SHELLFISH.html

https://www.tnu.in/wp-content/uploads/2021/09/anatomy-and-biology-of-finfish.pdf

www.fish.cgiar.org/

www.fishbase.org

www.marinespecies.org

www.med.wikidot.com/biochemistry-online-links

www.worldfishcenter.org/

www.wyzant.com/resources/physiology

https://csi-maine.org/

K1-Remember	*K2-Understand*	*K3- Apply*	*K4-Analyse*	*K5-Evaluate*	*K6-Create*

Course designed by: Dr. E. Kannapiran

Course Outcome VS Programme Outcomes

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	M (2)	-	-	L (1)	M (2)	-	-	M (2)	L (1)	S (3)
CO2	M (2)	-	-	L (1)	M (2)	-	-	M (2)	L (1)	S (3)
CO3	M (2)	-	-	L (1)	M (2)	-	-	M (2)	L (1)	S (3)
CO4	M (2)	L (1)	-	L (1)	M (2)	-	-	M (2)	L (1)	S (3)
CO5	M (2)	-	-	L (1)	M (2)	-	-	M (2)	L (1)	S (3)
W. AV	**2**	**0.2**	**0**	**1**	**2**	**0**	**0**	**2**	**1**	**3**

S –Strong (3), M-Medium (2), L- Low (1)

Course Outcome VS Programme Specific Outcomes

CO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	L (1)	S (3)	M (2)	L (1)	-
CO2	L (1)	S (3)	M (2)	L (1)	-
CO3	L (1)	S (3)	M (2)	L (1)	-
CO4	S (3)	S (3)	M (2)	M (2)	S (3)
CO5	L (1)	S (3)	M (2)	L (1)	-
W. AV	**1.4**	**3**	**2**	**1.2**	**0.6**

S –Strong (3), M-Medium (2), L- Low (1)

II – Semester					
Core	**Course Code 547202**	**Fishing Crafts and Gears**	**T**	**Credits:4**	**Hours:4**

Unit -I		
Objective 1	**To understand the conventional and modern fishing crafts in India**	
Introduction to Fishing crafts: Principal method of exploitation of fishes - traditional and modern fishing crafts of India. Basic geometric concepts and important terminologies of fishing vessel - Trapezoidal rule and Simpson's rules - State of equilibrium - various equilibrium of fishing vessel - Tonnage system and types. Maintenance of fishing crafts.		
Outcome 1	**Students can analyse the conventional and modern fishing crafts in India**	**K4**

Unit -II		
Objective 2	**To familiarize with crafts design and construction**	
Crafts design and construction: Construction materials - wood - steel - aluminium - Ferro-cement - FRP (GRP) - advantages and disadvantages. Parts of different crafts - Offset tables - Mould lofting - Backbone assembly of wooden boat. Classification of outboard and inboard engines.		
Outcome 2	**Students can comprehend Modern crafts design and construction**	**K2**

Unit -III		
Objective 3	**To gain knowledge on traditional and modern fishing gears**	
Introduction to fishing gear: Principal method of exploitation of fishes – traditional and modern fishing gears of India. Different fishing gear materials used – Yarn numbering systems - different netting / webbing - mounting of webbing and methods of mounting- types of floats and sinkers. Factors affecting fishing gear - Maintenance and storage of gears.		
Outcome 3	**Students can realize traditional and modern fishing gears of India**	**K2**

Unit IV		
Objective 4	**To learn the design and modification of existing fishing gears**	
Fishing Gears: Passive fishing gears: types, principle and operations. Active fishing gears: types, principle and operations. Grappling and wounding gears - Stupefying gears. Destructive and prohibited fishing gears. **Gear monitoring equipment:** Fish finder - GPS navigator - sonar - net sonde.		
Outcome 4	**Students can analyse the various types of active and passive fishing gear**	**K4**

Unit V		
Objective 5	**To understand the regulations for fishing crafts and gears**	
Regulations for craft and gears: Concept of Responsible Fisheries; Monsoon trawl ban-closed season - mesh size regulations - Exclusive Economic Zone (EEZ) – MSY MEY - Over fishing - Recruitment - ranching - Indian fisheries Act - Coast Guard Act Maritime zones of India Act.		
Outcome 5	**Students can comprehend the regulations for fishingcrafts and gears**	**K2**

Suggested Readings:

Ben-Yami, M. (1994). *Purse Seining Manual.* FAO Fishing Manual. Biswas, K. P. (1996). *Harvesting Aquatic Resources*. Daya Publ. House.

Fridman, A. L., Carrothers, P. J. G. (1986). *Calculations for Fishing Gear Designs (FAO FishingManuals).* Revised Eds. Read Books.

Garner, J. (1991). *Modern Deep Sea Trawling Gear*. 3rd Eds. Wiley.

Hameed, S. M., Boopendranath, M. R. (2000). *Modern Fishing Gear Technology*. Daya Publ.House.

Ponnambalam, A. (2003). *Fishing Craft Technology*. CIFNET, Cochin.

Sanisbury, J. C. (1996). *Commercial Fishing Methods: An Introduction to Vessels and Gear*. 3rdEds. Wiley.

Sreekrishna, Y., Shenoy, L. (2001). *Fishing Gear and Craft Technology*. ICAR. Yadav, Y. S. (2002). *Traditional Fishing Craft of the Bay of Bengal*. BOBP, Chennai

Online resources

https://mpeda.gov.in/fishers/?page_id=1834

https://www.researchgate.net/profile/Meenakumari-harathiamma/publication/327986569_Fishing_craft_and_gears_of_Asom/links/5c3c8206a6fdccd6b5ab94fa/Fishing-craft-and-gears-of Asom.pdf

https://agritech.tnau.ac.in/fishery/fish_fishingtech.

html www.fao.org

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www.cifa.org.in

www.caa.gov.in

ww.fao.org › FAO Home › Fisheries & Aquaculture

http://ecoursesonline.iasri.res.in/course/view.php?id=439

http://ecoursesonline.iasri.res.in/course/view.php?id=300

https://courseware.cutm.ac.in/courses/fishing-gear-technology/

K1-Remember	*K2-Understand*	*K3- Apply*	*K4-Analyse*	*K5-Evaluate*	*K6-Create*

Course designed by: Dr. E. Kannapiran

Course Outcome VS Programme Outcomes

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	-	M (2)	L (1)	-	S (3)	L (1)	M (2)	L (1)	M (2)	L (1)
CO2	-	L (1)	L (1)	-	S (3)	L (1)	M (2)	L (1)	M (2)	L (1)
CO3	-	L (1)	L (1)	-	S (3)	L (1)	M (2)	L (1)	M (2)	L (1)
CO4	-	M (2)	L (1)	-	M (2)	L (1)	M (2)	L (1)	M (2)	L (1)
CO5	-	S (3)	-	-	S (3)	L (1)	L (1)	L (1)	L (1)	L (1)
W.AV	**0**	**1.8**	**0.8**	**0**	**2.8**	**1**	**1.8**	**1**	**1.8**	**1**

S –Strong (3), M-Medium (2), L- Low (1)

Course Outcome VS Programme Specific Outcomes

CO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	M (2)	M (2)	L (1)	L (1)	L (1)
CO2	M (2)	M (2)	L (1)	L (1)	L (1)
CO3	M (2)	M (2)	L (1)	L (1)	L (1)
CO4	M (2)	M (2)	L (1)	L (1)	L (1)
CO5	S (3)	0	L (1)	0	L (1)
W. AV	**2.2**	**1.6**	**1**	**0.8**	**1**

S –Strong (3), M-Medium (2), L- Low (1)

II – Semester					
Core	**Course Code 547203**	**Fisheries Management, Regulations and Conservation**	**T**	**Credits:4**	**Hours:4**

Unit -I		
Objective 1	**To understand the fishing regulations of Central and States Governments**	
Regulations: Fisheries regulatory and developmental setup in Central and States – their responsibility - need for fisheries management - regulatory - legal and enforcement regimes - Illegal- unreported and unregulated fishing - Indian Ocean Tuna Commission (IOTC) - management of tuna and tuna-like species Fishing ban		
Outcome 1	**Students able to discuss the fisheries regulations and policies of Central and States Governments**	**K2**
Unit -II		
Objective 2	**To familiarize with various regulations for capture fisheries coastal and marine**	
Monitoring, Control and Surveillance: MCS systems for capture fisheries in Inland -coastal - marine environment. Code of Conduct for Responsible Fishing - Mesh size regulations - Best Management Practices in fisheries.		
Outcome 2	**Students can analyse the various regulations for capture fisheries coastal and marine**	**K4**
Unit -III		
Objective 3	**To gain knowledge on deep sea fishing regulations**	
Deep sea fishing regulations: Regulatory and developmental issues concerning deep sea fishing -Guidelines for operation. Maritimes Zones of India Acts (Regulation of fishing by foreign vessels) - Marine Fisheries Policy-International law of the Ocean		
Outcome 3	**Students can analyse the deep sea fishing regulations**	**K2**
Unit IV		
Objective 4	**To learn the marine fishery and aquaculture legislations**	
Marine fisheries and aquaculture legislations: States wise fishery legislations of India - Coastal Aquaculture legislations - Management needs associated with aquaculture development; Coastal Regulation Zone (CRZ) - Sustainability - Integrated Coastal Zone Management - ecosystem management.		
Outcome 4	**Students discuss marine fishery and aquaculture legislations**	**K2**

Unit V		
Objective 5	**To study national water policy and pollution act**	
Water policies: National Water Policy: Agriculture - industry - portability – fisheries - Fishing rights in open waters; role of fisheries cooperatives - aqua/ecotourism. Concepts and implication of Interlinking of rivers for fisheries and biodiversity. Pollution act - Conservation and management ofwater bodies.		
Outcome 5	**Students evaluate national water policy and pollution act**	**K5**

Suggested Readings:

Agarwal, S. C. (2004). *Fishery Management*. APH Publ. Corp.

Ayyappan et al. (2006). *Handbook of Fisheries and Aquaculture*. ICAR, New Delhi. Chandra, P. (2007). *Fishery Conservation, Management and Development*. SBS Publ.

Clark, J. R. (1992). *Integrated Management of Coastal Zones. FAO Fisheries Tech. Paper No. 327*,Rome.

Coastal Area Management and Development (1982). UN Department of International Economic &Social Affairs, New York.

David, S., Jeremy, P. (2001). *Inshore Fisheries Management. Methods and Technologies in FishBiology and Fisheries*. Vol. II Kluwer.

Jhingran, V. G. (1991). *Fish and Fisheries of India*. Hindustan Publishing Corporation (India),Delhi.

Kevern L. Cochrane, Serge M. Garcia (2009). *A Fishery Manager's Guidebook* (2nd ed.). Wiley-Blackwell.

Mahanta, P. C., Tyagi, L. K. (2003). *Participatory Approach for Fish Biodiversity Conservation inNorth East India*. National Bureau of Fish Genetic Resources (NBFGR), Lucknow.

Menon, A. G. K. (2004). *Threatened Fishes of India and their Conservation*. Fisheries Survey ofIndia.

Pandey, D. K., De, H. K. (2014). *Fisheries Governance and Legislation in India*. Narendra Publ.House.

Singh, B. (2007). *Fishery Management: Planning and Objectives*. Vista International Publ. House.

Zacharias, M., Ardon, J. (2019). *Marine Policy: An Introduction to Governance and International Law of the Oceans* (2nd ed.). Earthscans.

Online resources

https://www.fao.org/3/y3427e/y3427e03.htm
https://elearning.fao.org/course/view.php?id=784
http://fisherysolutionscenter.edf.org/virtual-fisheries-academy?ut_sid=6eaad6d1-30f2-46d6-9786-cce448794eea&ut_pid=40c77971-d9db-46f5-b96d-2adcc0f69349
https://www.fao.org/publications/card/en/c/dd722118-290b-489c-9990-6ce3099c02fd/
https://research.csiro.au/iuu/case-studies/monitoring-control-surveillance/
https://mpeda.gov.in/?page_id=633
https://courseware.cutm.ac.in/courses/fisheries-policy-and-law/
https://krishi.icar.gov.in/jspui/bitstream/123456789/78263/1/3_Fishing%20Regulations%20in%20India.pdf
https://andssw1.and.nic.in/sfpermit/pdf/SportFishingGuidlines.pdf
https://niua.in/c-cube/sites/all/themes/zap/pdf/water.pdf

K1-Remember	*K2-Understand*	*K3- Apply*	*K4-Analyse*	*K5-Evaluate*	*K6-Create*

Course designed by: Dr. N.M. Prabhu

Course Outcome vs Programme Outcome

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	-	M (2)	M (2)	-	L (1)	M (2)	M (2)	L (1)	-	-
CO2	-	S (3)	-	-	0	M (2)	L (1)	L (1)	-	-
CO3	-	S (3)	M (2)	S (3)	L (1)	L (1)	L (1)	L (1)	-	-
CO4	-	S (3)	S (3)	M (2)	L (1)	L (1)	L (1)	L (1)	-	-
CO5	-	-	-	-	-	-	S (3)	L (1)	-	-
W.AV	**0**	**2.2**	**1.4**	**1**	**0.6**	**1.2**	**1.6**	**1**	**0**	**0**

S –Strong (3), M-Medium (2), L- Low (1)

Course Outcome vs Programme Specific Outcome

CO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	S (3)	M (2)	-	-	S (3)
CO2	S (3)	S (3)	-	M (2)	S (3)
CO3	S (3)	S (3)	-	-	S (3)
CO4	S (3)	S (3)	S (3)	M (2)	S (3)
CO5	S (3)	-	-	-	-
W. AV	**3**	**2.2**	**0.6**	**0.8**	**2.4**

S –Strong (3), M-Medium (2), L- Low (1)

II – Semester					
Core	**CourseCode 547204**	**Shellfish and Finfish Hatchery Management**	**T**	**Credits:4**	**Hours:4**

Unit -I		
Objective 1	**To learn the status of the hatchery**	
Introduction: History, and current international and national status of finfish, shrimp, crab andmolluscan hatchery - Biology and life cycle of cultivable finfish and Shellfishes.		
Outcome 1	**Students assess the national and international status of Hatchery**	**K5**

Unit -II		
Objective 2	**To acquaint with a crustacean hatchery for finfish and prawn**	
Crustacean hatchery production: Hatchery site selection - design and equipment for small, medium and large-scale hatchery. Shrimp - Crab and lobster seed production - brood stock collection transportation - quarantine and broodstock section - induce breeding - water quality - feed and health management - live feed production. Shrimp captive brood stock development - SPF seed production HACCP. Nursery technology.		
Outcome 2	**Students construct and develop crustacean hatchery production**	**K6**

Unit -III		
Objective 3	**To comprehend the molluscan hatchery practices**	
Molluscan hatchery production: Hatchery site selection - design and equipment for small, medium and large-scale hatchery. Green and brown mussel - oyster - edible and pearl oyster-abalone - scallop - brood stocks collection - induce breeding - water – feed - health management - live feed production.		
Outcome 3	**Students develop and generate the molluscan hatchery production**	**K3**

Unit IV		
Objective 4	**To analyse the importance of finfish hatchery production**	
Finfish hatchery production: Coastal and marine Finfish hatchery production - milkfish - mullets - sea bass - grouper - cobia - pompano - brood stock collection - transportation - quarantine - broodstock development, induced breeding - larval rearing - water - feed and health management. Nursery management for different finfish species.		
Outcome 4	**Students create and modify finfish hatchery**	**K6**

Unit V		
Objective 5	**To gain knowledge on shrimp broodstock banks, trade and disease**	
Economics of hatchery: Shrimp /Crab / Finfish hatchery - cost analysis for small, medium, and large-scale hatchery. Brood banks and international trade and quarantine.		
Outcome 5	**Students identify fish disease and develop shrimp brood stock banks**	**K3**

Suggested Readings:

Biswas, K. P. (1996). *A textbook of fish, fisheries technology*. 2nd Eds. Narendra Publ. House, Delhi.

Das, P., Jhingran, A. G. (1976). *Fish Genetics in India*. Today & Tomorrow Publ.

Douglas, T. (1998). *Genetics for Fish Hatchery Managers*. Kluwer.

FAO (1992). *Manual of Seed Production of Carps*. FAO Publ.

FAO (2007). *Manual for Operating a Small Scale Recirculation Freshwater Prawn Hatchery*.

MPEDA. *Handbook on aqua farming shrimp, lobster, mud crab*. MPEDA Kochi.

ICAR (2006). *Hand Book of Fisheries and Aquaculture*. ICAR.

Khanna, S. S., Singh, H. R. (2003). *A text book of fish biology and fisheries*. Narendra Publ. House,Delhi.

Maria, R. J., Augustine, A., Kapoor, B. G. (2008). *Fish Reproduction*. Science Publ. MPEDA (1995). *Shrimp Hatchery*.

Pillay, T.V. R., Kutty, M. N. (2012). *Aquaculture Principles and Practices*. 2nd Eds. Wiley India.

Rath, R. K. (2000). *Freshwater Aquaculture*. Scientific Publ.

Thomas, P. C., Rath, S. C., Mohapatra, K. D. (2003). *Breeding and Seed Production of Finfish andShellfish*. Daya Publ. House.

Online resources

http://www.fisheriesjournal.com/archives/2019/vol7issue5/PartD/7-4-44-679.pdf

https://krishi.icar.gov.in/jspui/bitstream/123456789/26376/1/Biofloc%20manual%20final%2024-28-9-19.pdf

http://www.fao.org/3/ca6702en/ca6702en.pdf

http://www.fao.org/3/t8598e/t8598e05.htm

K1-Remember	*K2-Understand*	*K3- Apply*	*K4-Analyse*	*K5-Evaluate*	*K6-Create*

Course designed by: Dr. N.M. Prabhu

Course Outcome *vs* Programme Outcome

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	S (3)	-	L (1)	-	-	S (3)	-	L (1)	L (1)	S (3)
CO2	S (3)	S (3)	S (3)	-	-	S (3)	-	-	-	S (3)
CO3	S (3)	S (3)	S (3)	-	-	S (3)	-	-	-	S (3)
CO4	S (3)	S (3)	M (2)	-	-	S (3)	S (3)	-	-	S (3)
CO5	S (3)	M (2)	S (3)	-	-	M (2)	M (2)	-	-	S (3)
W. AV	**3**	**2.2**	**2.4**	**0**	**0**	**2.8**	**1**	**0.2**	**0.2**	**3**

S –Strong (3), M-Medium (2), L- Low (1)

Course Outcome *vs* Programme Specific Outcome

CO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	-	M (2)	S (3)	L (1)	S (3)
CO2	M (2)	-	S (3)	S (3)	S (3)
CO3	-	-	S (3)	S (3)	S (3)
CO4	S (3)	-	S (3)	S (3)	S (3)
CO5	-	M (2)	S (3)	S (3)	S (3)
W. AV	**1**	**0.8**	**3**	**2.8**	**3**

S –Strong (3), M-Medium (2), L- Low (1)

II – Semester					
Core	**Course Code 547205**	**Lab – II-** Finfish and Shellfish Biology, Fishing Crafts and Gears, Fisheries Management, Regulations and Conservation, Shellfish and Finfish Hatchery Management	**P**	**Credits:4**	**Hours:8**

Unit -I		
Objective 1	**To gain practical knowledge on biology of finfish**	
Biology of finfish: Estimation of oxygen consumption and rate of respiration in a fish. Marine andfreshwater fish gut analysis. Display various organs of finfish.		
Outcome 1	**Students estimate the oxygen consumption and rate of respiration infish and examine the internal organs of finfish**	**K6**

Unit -II		
Objective 2	**To familiarize with the biology of shell fish**	
Biology of shellfish: Study of external morphology. Dissection of a prawn to study different internalorgans, their location, structure and function. Visit to shrimp and prawn hatcheries to study developmental stages.		
Outcome 2	**Students examine the external morphology and internal organs ofshellfish**	**K5**

Unit -III		
Objective 3	**To understand the various craft and gears used for inland costal and marinefisheries**	
Craft and Gears: Visit to boat building yards for on–the–spot study - Study of deck lay outs of different types of fishing vessels and preparation of sketches - Report. Gears: draw the different typesof fishing gears used in inland, coastal and marine fishing.		
Outcome 3	**Students analyse the crafts and gears used in fisheries**	**K4**

Unit IV		
Objective 4	**To provide practical knowledge on regulations in fisheries**	
Fishing regulations: Visit to appropriate Government/NGO and preparation of inland, coastal andmarine fishery regulation working report.		
Outcome 4	**Students discuss the fishery regulations**	**K5**

Unit V		
Objective 5	**To learn the technique of induced breeding**	
Finfish fish and shellfish hatchery: Technique of induced breeding- eggs, larval and post-larval stages of shrimp, prawn, crab, fin-fish -stocking size, counting methods of eggs and larvae hatchery.Seed packing.		
Outcome 5	**Students discuss the finfish and shellfish hatchery techniques**	**K5**

Suggested Readings:

Biswas, K. P. (1996). *Harvesting Aquatic Resources*. Daya Publ. House.

Brandt, A. V. (1984). *Fish Catching Methods of the World* (Vol. 2 & 3). Fishing News BooksEnterprises. Israel.

Biswas, S P. (1993). *Manual methods in fish Biology*. South Asian Publishers, New Delhi.

Castro, P., Huber, M. E. (1997). *Marine Biology*, 2nd Eds. Mc-Graw Hill Company, New York.

CIFE (1993). *Training Manual on Culture of Live Food Organisms for AQUA hatcheries*. Central Institute of Fisheries Education, Versova, Mumbai.

Coastal Area Management and Development (1982). UN Department of International Economic &Social Affairs, New York.

Mishra, R. (2019). *Practical Manual on Craft, Gear and Fishing Technology*. Narendra Publ. House.

Parsons, T.R., Maita, Y., Lalli, C. M. (1984). *A Manual of Chemical and Biological Methods for Seawater Analysis*. Pergamon Press.

Pillay, T.V.R., Kutty, M. N. (2012). *Aquaculture Principles and Practices*. 2nd Eds. Wiley India.

Santhanam, R., Sukumaran, N., Nataraj, P. (1999). *A Manual of Freshwater Aquaculture*. Oxford and IBH Publishing Co. Pvt. Ltd., New Delhi.

Gabriel, O., Lange, K., Dahm, E., Wendt, T. (2005). *Von Brandt's Fish Catching Methods of the World*. 4th Eds. Wiley-Blackwell.

Online resources

https://www.instructables.com/Fish-Dissection/

https://www.dec.ny.gov/docs/administration_pdf/ifnyfdlp.pdf

https://cpb-us-e1.wpmucdn.com/share.nanjing-school.com/dist/3/28/files/2013/02/fish-dissection- 2e5c6ra.pdf

https://mpeda.gov.in/fishers/?page_id=1834

http://www.gcwk.ac.in/econtent_portal/ec/admin/contents/159_P18Z1EC1_20201216084521 72.pdf

https://www.yourarticlelibrary.com/fish/applied-fisheries/crafts-and-gears-used-for-fishing-with-diagram/88586

https://www.dakshin.org/wp-content/uploads/2017/08/Marine-fishing-craft-and-gear-of-Odisha.pdf

https://thefisheriesblog.com/2017/09/25/fishery-regulations/

https://mpeda.gov.in/?page_id=607

https://www.yourarticlelibrary.com/fish/applied-fisheries/induced-breeding-of-fish-subject-matter- steps-and-advantages-fishes/88534

K1-Remember	*K2-Understand*	*K3- Apply*	*K4-Analyse*	*K5-Evaluate*	*K6-Create*

Course designed by: Dr. E. Kannapiran and Dr. N.M. Prabhu

Course Outcome VS Programme Outcomes

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	S (3)	-	-	S (3)	-	-	-	-	S (3)	S (3)
CO2	S (3)	-	-	S (3)	-	-	-	-	S (3)	S (3)
CO3	-	S (3)	S (3)	-	S (3)	S (3)	S (3)	-	S (3)	S (3)
CO4	-	S (3)	-	L (1)	S (3)	S (3)	S (3)	S (3)	S (3)	S (3)
CO5	-	S (3)	S (3)	-	L (1)	S (3)	M (2)	M (2)	S (3)	S (3)
W. AV	**1.2**	**1.8**	**1.2**	**1.4**	**1.4**	**1.8**	**1.6**	**1**	**3**	**3**

S –Strong (3), M-Medium (2), L- Low (1)

Course Outcome VS Programme Specific Outcomes

CO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	-	S (3)	S (3)	-	-
CO2	-	S (3)	S (3)	-	-
CO3	S (3)	M (2)	S (3)	S (3)	S (3)
CO4	S (3)	S (3)	S (3)	S (3)	M (2)
CO5	S (3)	M (2)	S (3)	S (3)	M (2)
W. AV	**1.8**	**2.6**	**3**	**1.8**	**1.4**

S –Strong (3), M-Medium (2), L- Low (1)

II - Semester					
Core	**Course Code 547206**	**Internship**		**Credits:3**	**Summer 30 days**
Course Outcomes					
Outcome 1	Students develop an aptitude to carry out and implement an aquaculture project/start-up/self- employment scheme				**K6**
Outcome 2	Students develop a field experience with an opportunity to share their insights on the subject				**K5**
Outcome 3	Students gain hands-on experience in professional settings				**K5**
Outcome 4	Students practice good work habits and interpersonal relationships				**K6**
Outcome 5	Students apply appropriate skills in the techniques of aquaculture operations and management and recognise career opportunities				**K5**
K1-Remember	***K2-Understand***	***K3-Apply***	***K4-Analyse***	***K5-Evaluate***	***K6-Create***
Course designed by: Dr. E. Kannapiran					

Course Outcome VS Programme Outcomes

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	M (2)	S (3)	S (3)	L (1)	S (3)	S (3)	S (3)	S (3)	S (3)	S (3)
CO2	S (3)	S (3)	S (3)	M (2)	M (2)	S (3)	S (3)	M (2)	S (3)	M (2)
CO3	S (3)	S (3)	S (3)	M (2)	S (3)	S (3)	S (3)	M (2)	S (3)	M (2)
CO4	-	S (3)	-	M (2)	-	S (3)	S (3)	M (2)	M (2)	S (3)
CO5	L (1)	S (3)	S (3)	L (1)	L (1)	S (3)	S (3)	M (2)	M (2)	L (1)
W. AV	**1.8**	**3**	**2.4**	**1.6**	**1.8**	**3**	**3**	**2.2**	**2.6**	**2.2**

S –Strong (3), M-Medium (2), L- Low (1)

Course Outcome VS Programme Specific Outcomes

CO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	M (2)	M (2)	S (3)	S (3)	M (2)
CO2	S (3)	L (1)	S (3)	S (3)	M (2)
CO3	S (3)	M (2)	S (3)	S (3)	M (2)
CO4	M (2)	M (2)	S (3)	S (3)	M (2)
CO5	M (2)	M (2)	S (3)	S (3)	M (2)
W. AV	**2.4**	**1.8**	**3**	**3**	**2**

S –Strong (3), M-Medium (2), L- Low (1)

II - Semester					
DSE	**CourseCode 547504**	**Remote Sensing andGIS in Fisheries Management**	**T**	**Credits: 3**	**Hours: 3**
Unit -I					
Objective 1	**To familiarize with remote sensing application in fisheries resources**				
Introduction to remote sensing: History - traditional methods of fishery resource management - overview of pelagic, deep sea fisheries and seaweed - Current problems in fisheries management - Current status of Indian and global remote sensing application in capture, culture fisheries and coastalresource management.					
Outcome1	**Students analyse the application of remote sensing in fisheries**				**K4**
Unit -II					
Objective 2	**To understand the basic terms and concepts of various navigation systems**				
Basic terms and concepts: Electromagnetic radiation and its properties, atmospheric interactions, target interactions. GPS, Acoustics; Safety devices; Vessel Monitoring Systems; Satellite navigation systems; Advanced communication Systems. Warning systems.					
Outcome 2	**Students discuss the basic concepts of various navigation systems**				**K2**
Unit -III					
Objective 3	**To gain knowledge on Sensor platforms**				
Sensor platforms: Boats, buoys, balloons, Doppler, air-crafts and satellites, Sensor systems-rockets- types of orbits - Optical infra-red (OIR), types of scanner - imaging systems, mechanisms – types - Geodesy - global acquisition systems and sequential acquisition systems, IRS series, resources at CARTOSAT					
Outcome 3	**Students gain knowledge on Sensor platforms**				**K2**
Unit IV					
Objective 4	**To learn about the environmental satellites**				
Environmental satellites: The Land sat series, NOAA and IRS; Digital image processing and interpretation. Visual Image Interpretation Technique (VIIT) and Digital Image Processing (DIP) False Colour Composite (FCC)					
Outcome 4	**Students discuss the basics of environmental satellites**				**K3**

Unit V		
Objective 5	**To be acquainted with the GIS and its application in fisheries managementand conservation**	
GIS in Fisheries: Elements of GIS, Application of remote sensing and GIS to fisheries and aquaculture planning and development. Ocean zonation, currents, waves and tides. Challenges of fisheries information systems and future perspectives. Fisheries forecasting system, PFZ, INCOIS		
Outcome5	**Students evaluate the application of GIS in fisheries management and conservation**	**K5**

Suggested Readings:

Bal, D. V., Rao, K. V. (1990). *Marine Fishes of India*. 1st Revised Ed. Tata McGraw Hill.

Chandra, P. (2007). *Fishery Conservation, Management and Development*. SBS Publ.

Dholakia, A. D. (2004). *Fisheries and Aquatic Resources of India*. Daya Publ. House.

Elangovan, K. (2006). *GIS: Fundamentals, Applications and Implementations*. New India Publ. Agency.

Environmental Systems Research Institute (2007). *Understanding GIS, The ARC/INFO Method*. Environmental System Research Org, USA.

ICAR. *Handbook of Fisheries and Aquaculture*. New Delhi: ICAR. James, B. C. (2002). *Introduction to Remote Sensing*. Taylor & Francis.

Joseph, G. (2005). *Fundamentals of Remote Sensing* (2nd ed.). Hyderabad: University Press Pvt.Ltd.

Joseph S. Nelson, Terry C. Grande Mark, Wilson, V. H. (2016). *Fishes of the World*. 5th Eds. Wiley.

Khanna, S. S., Singh, H.R. (2012). *A Text Book of Fish Biology and Fisheries*. Narendra Publ. House.

Kumar, S. (2016). *Basics of Remote Sensing and GIS* (1st ed.). Laxmi Publications.

Lillesand, T. M., Kiefer, R. W., Chipman, J. W. (2004). *Remote Sensing and Image Interpretation*. John Wiley & Sons.

Meaden, G. J., Do Chi, T. (1996). *Geographical Information System: Applications to Marine Fisheries*. FAO Tech. Paper No. 356.

Meaden, G. J., Kapetsky, J. M. (1991). *Geographical Information System and Remote Sensing in Inland Fisheries and Aquaculture*. FAO Tech. Paper No. 318.

Michael, N. D. (2005). *Fundamentals of Geographic Information Systems*. John Wiley & Sons.

Peter, M. A., Nicholas, J. T. (2005). *Advances in Remote Sensing and GIS Analysis*. Wiley.

Shanbhogue, S. L. (2000). *Marine Fisheries of India*. ICAR.

Thomas, M. L., Ralph, K. (1987). *Remote Sensing and Image Interpretation*. John Wiley & Sons.

Yadav, B. N. (1997). *Fish and Fisheries*. 2nd Eds. Daya Publ. House.

Online resources

https://www.fao.org/fishery/en/topic/14860/enhttps://www.fao.org/3/i3102e/i3102e.pdf
https://krishi.icar.gov.in/jspui/bitstream/123456789/47245/1/Remote%20sensing%20and%20fisheries.pdf
https://aquafind.com/articles/GPS_in_Fisheries.php
https://krishi.icar.gov.in/jspui/bitstream/123456789/8728/1/Application%20of%20geographic%20information%20system%20in%20fisheries%20management.pdf
https://grindgis.com/remote-sensing/applications-of-remote-sensing-in-fisheries
https://fisharticle.com/applications-of-gis-in-fisheries-and-aquaculture/
https://www.jircas.go.jp/sites/default/files/publication/intlsymp/intlsymp-8_39-58.pdf

K1-Remember	*K2-Understand*	*K3- Apply*	*K4-Analyse*	*K5-Evaluate*	*K6-Create*

Course designed by: Dr. E. Kannapiran

Course Outcome *vs* Programme Outcome

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	-	M (2)	M (2)	-	L (1)	-	M (2)	-	-	-
CO2	-	M (2)	S (3)	-	L (1)	-	S (3)	-	-	-
CO3	-	L (1)	M (2)	-	L (1)	-	M (2)	-	-	-
CO4	-	L (1)	M (2)	-	L (1)	-	M (2)	-	-	-
CO5	-	L (1)	S (3)	-	M (2)	-	S (3)	-	-	-
W. AV	**0**	**1.4**	**2.4**	**0**	**1.2**	**0**	**2.4**	**0**	**0**	**0**

S –Strong (3), M-Medium (2), L- Low (1)

Course Outcome *vs* Programme Specific Outcome

CO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	M (2)	S (3)	-	-	-
CO2	S (3)	S (3)	-	-	-
CO3	M (2)	S (3)	-	-	-
CO4	M (2)	M (2)	-	-	-
CO5	S (3)	S (3)	-	-	-
W. AV	**2.4**	**2.8**	**0**	**0**	**0**

S –Strong (3), M-Medium (2), L- Low (1)

II – Semester					
DSE	**CourseCode 547505**	**Fishery Economics and Extension**	**T**	**Credits:3**	**Hours:3**

Unit -I		
Objective 1	**To understand the scope of economics in fisheries**	
Scope of Economics: Bio-economic analysis of fisheries. Growth, development and natural resource interrelationships. Pricing and optimal resource use over time under different market situations - role of market structure, interest rate and property rights in fisheries exploitation.		
Outcome 1	**Students discuss the scope of economics in fisheries**	**K2**

Unit -II		
Objective 2	**To understand the basic concepts of economics in fisheries**	
Concept of Economics: Positive and negative externalities. Physical, legal and economic incentives to internalize the externalities. Fishery resource management policies markets, taxes, subsidies, permits, direct controls, distributional effects of fisheries development. Fisheries marketing and Organizations.		
Outcome 2	**Students explain the fishery resource management policies markets**	**K5**

Unit -III		
Objective 3	**To familiarize about the principles of fishery economics**	
Economics Principles: Factor-Product, cost principles, Factor-factor, Product-product and law of comparative advantage, law of equimarginal returns, returns to scale and farm size, Homogeneous production functions; Cobb-Douglas and quadratic production functions. Fisheries and Socio- economic Analysis, meaning and measurement of socio-economic variables. Globalization, GATT, WTO, IPR, GDP, Factors determining development. Role of sociology in the process of fisheries development. PRA and RRA for studying socio-economic problems, stake holder analysis.		
Outcome 3	**Students evaluate the fishery economics principles**	**K5**

Unit IV		
Objective 4	**To impart knowledge on role of extension in fisheries development**	
Fisheries extension: History - role of extension in fisheries development. Extension methods individual, group and mass contact methods and their effectiveness, factors influencing heir selection and use. Characteristics of technology, transfer of technology process; important TOT programs in fisheries; role of NGOs, INGOs, GOs, grass root institutions, PRI, Traditional Panchayat and SHGsin fisheries; Fisheries co- management.		
Outcome 4	**Students develop the transfer of technology in fisheries extension**	**K5**

Unit V		
Objective 5	**To study the extension planning and evaluation in fisheries**	
Extension planning and evaluation: Various steps and importance; participatory, planning process. Basic concepts in rural sociology and psychology and their relevance in fisheries extension; social change, social control, social problems and conflicts in fisheries; gender issues in fisheries. Case studies on extension programs and Success stories. Practical exercises on conducting fish farmers meet.		
Outcome 5	**Students discuss the extension planning in fisheries**	**K5**

Suggested Readings:

Amita Saxena (2011). *Fisheries Economics*. Daya Publishing House. Chitambar, J. B. (1990). *Introductory Rural Sociology*. Wiley Eastern.

Grafton, Q. R., Kirkley, J., Kompas, T., Squire, D. (2006). *Economics for Fisheries Management*. Ashgate Publ. Co.

ICAR. *Handbook of Fisheries and Aquaculture*. New Delhi: ICAR.

Jerry, L. G. (1990). *A Commodity Systems Assessment Methodology for Problem and Project Identification.* Post-Harvest Institute for Perishables. College of Agriculture, University of Idaho.

Kumar, D. (1996). *Aquaculture Extension Services Review: India*. FAO Fisheries Circular No. 906.

Rao, P.S. (1983). *Fisheries economics and management in India*. Pioneer Publishers And Distributors.

Seijo, J. C., Defeo, D., Salas, S. (1998). *FAO Fisheries technical paper 368. Fisheries bioeconomics:Theory, modelling and management*. FAO, Rome.

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http://eprints.cmfri.org.in/10407/1/02_Shyam_S_Salim3.pdf
http://eprints.cmfri.org.in/4334/
http://www.fao.org/3/T0403E01.htm
http://www.fao.org/docrep/004/Y2876E/y2876e0i.htm
www.mpeda.gov.in/
www.fao.org/docrep/003/T0506E/T0506E00.HTM
www.fao.org/docrep/X5625E/x5625e0f.htm
www.seafish.org/

K1-Remember	*K2-Understand*	*K3- Apply*	*K4-Analyse*	*K5-Evaluate*	*K6-Create*

Course designed by: Dr. N.M. Prabhu

Course Outcome *vs* Programme Outcome

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	L (1)	S (3)	L (1)	-	-	-	L (1)	L (1)	L (1)	M (2)
CO2	-	S (3)	L (1)	-	M (2)	L (1)	L (1)	L (1)	L (1)	M (2)
CO3	L (1)	S (3)	L (1)	-	L (1)	-	-	-	L (1)	M (2)
CO4	-	L (1)	S (3)	-	S (3)	M (2)	M (2)	L (1)	L (1)	L (1)
CO5	L (1)	L (1)	M (2)	-	L (1)	L (1)	S (3)	L (1)	L (1)	L (1)
W. AV	**0.6**	**2.2**	**1.6**	**0**	**1.4**	**0.8**	**1.4**	**0.8**	**1**	**1.6**

S –Strong (3), M-Medium (2), L- Low (1)

Course Outcome *vs* Programme Specific Outcome

CO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	S (3)	L (1)	-	L (1)	S (3)
CO2	S (3)	L (1)	L (1)	-	L (1)
CO3	M (2)	L (1)	L (1)	S (3)	S (3)
CO4	L (1)	-	L (1)	S (3)	S (3)
CO5	L (1)	-	M (2)	M (2)	M (2)
W. AV	**2**	**0.6**	**1**	**1.8**	**2.4**

S –Strong (3), M-Medium (2), L- Low (1)

II – Semester					
DSE	**Course Code 547506**	**Aquatic Pollution**	**T**	**Credits:3**	**Hours:3**
Unit -I					
Objective 1	**To understand the current national and international status of aquatic pollution**				
Aquatic pollution: Current national and international status of aquatic pollution. Pollution sources, types and their impacts; Pollution problems of groundwater resources - Sources of contamination, management issues - Methods of aquatic pollution surveys.					
Outcome 1	**Students discuss the current status of aquatic pollution**				**K4**
Unit -II					
Objective 2	**To analyse the pollutants, their transportation and toxic effects**				
Pollutants: Sewage, pesticides, oils, metals, radioactive wastes, biomedical wastes, etc. Common transport processes of pollutants in the aquatic environment; dispersal of pollutants; eutrophication and their management- bioaccumulation - Minamita, itai itai, etc. and their toxic effect.					
Outcome 2	**Students identify aquatic pollution and solve the water borne diseases**				**K3**
Unit -III					
Objective 3	**To analyse the pollutants, their transportation and toxic effects**				
Wastewater management: Wastewaters - classification and characteristics of sewage and industrial effluents; treatment methods for water and waste water; Principles of aeration, chlorination, ozonation and U.V. irradiation. Waste disposal and water quality criteria used in different parts of world - national and international standards; ISO- 14000 (EMS), EIA, Management strategies**.**					
Outcome 3	**Students explain wastewater management**.				**K5**
Unit IV					
Objective 4	**To analyse the water recycling and utilization in aquaculture**				
Waste recycling and utilization in aquaculture: Design and construction of water filtration devices; aerobic and anaerobic treatment of wastewater. Wastes from fish processing units and theirtreatment; solid waste management; removal of nitrogen and phosphorus from waste water; Role ofaquatic macrophytes in treatment of wastewater.					
Outcome 4	**Students develop the waste recycling and utilization in aquaculture**				**K5**

Unit V		
Objective 5	**To gain knowledge on monitoring strategy for pollution control and management**	
Monitoring Strategy: Pollution control and management - Ocean acidifications - current status of global warming - Indicator organisms - Criteria for selection of indicator organism: Red tides phenomena: Monitoring strategies of marine pollution: ballast waters, Bio-invasion (Exotic, Invasive and Alien), Quarantine measures - Global warming and Climate change - Mitigation. Role of international and national organizations and NGOs.		
Outcome 5	**Students evaluate the monitoring strategy for pollution control and management**	**K5**

Suggested Readings:

Andre's Hugo Arias, Jerge Eduardo Marcovecchio (2018). *Marine Pollution and Climate*. CRC Press.

Baird, D. J., Beveridge, M. C. M., Kelly, L. A., Muir, J. F. (1996). *Aquaculture and Water ResourcesManagement*. Blackwell.

Cheremisinoff, N. P. (2002). *Handbook of Water and Waste Water Treatment Technologies*. Butterworth – Heinemann.

Eckenfelder, W. W. (2000). *Industrial Water Pollution Control*. McGraw Hill.Johnston, R. (2007). *Marine Pollution*. 6th Eds. Academic Press, London.

Marcos Von Sperling (2007). *Basic Principles of Wastewater Treatment*. IWA Publishing.

Michael. H. Glantz (2001). *Currents of change*. 2nd Eds. Cambridge University press, UK.

Nybakken, J. W. (1997). *Marine Biology – An Ecological Approach*. 4th Eds. Addison Wesley Edu.Pub. Inc, California, USA.

Phillips, J. D. H. (2011). *Thermal and Radioactive Pollution*. John Wiley & Sons, New York.Ravi Mishra (2002). *Marine environment*. Anmol publications, New Delhi.

Riley, J. P., Chester, R. (2008). *Introduction to Marine Chemistry*. Academic Press, London.

Online resources

http://www.fao.org/3/a-t1623e.pdf http://www.fao.org/3/AC183E/AC183E00.htm

http://www.fao.org/3/t0551e/t0551e09.htm

https://www.nrdc.org/stories/water-pollution-everything-you-need-know#categories

https://www.britannica.com/science/water-pollution

https://www.geo.lu.lv/fileadmin/user_upload/lu_portal/projekti/gzzf/videunilgtspejigaattistiba/Vid Z1000-8.LECTURE-Water_pollution.pdf

http://users.rider.edu/~husch/env100waternotes.htm

https://www.nios.ac.in/media/documents/313courseE/L34.pdf

http://eagri.org/eagri50/ENVS302/pdf/lec09.pdf

K1-Remember	*K2-Understand*	*K3- Apply*	*K4-Analyse*	*K5-Evaluate*	*K6-Create*

Course designed by: Dr. E. Kannapiran

Course Outcome *vs* Programme Outcome

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	-	L (1)	-	-	S (3)	-	-	-	-	S (3)
CO2	-	L (1)	L (1)	-	S (3)	L (1)	L (1)	L (1)	L (1)	S (3)
CO3	-	-	L (1)	-	S (3)	L (1)	M (2)	L (1)	M (2)	S (3)
CO4	-	L (1)	M (2)	-	S (3)	L (1)	M (2)	M (2)	S (3)	S (3)
CO5	-	L (1)	L (1)	-	S (3)	L (1)	L (1)	L (1)	L (1)	S (3)
W. AV	**0**	**0.8**	**1**	**0**	**3**	**0.8**	**1.2**	**1**	**1.75**	**3**

S –Strong (3), M-Medium (2), L- Low (1)

Course Outcome *vs* Programme Specific Outcome

CO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	L (1)	L (1)	M (2)	L (1)	L (1)
CO2	L (1)	L (1)	S (3)	L (1)	M (2)
CO3	L (1)	M (2)	M (2)	L (1)	L (1)
CO4	L (1)	L (1)	S (3)	L (1)	L (1)
CO5	L (1)	L (1)	S (3)	L (1)	L (1)
W. AV	**1**	**1.2**	**2.6**	**1**	**1.2**

S –Strong (3), M-Medium (2), L- Low (1)

III – Semester					
Core	**CourseCode 547301**	**Coastal Aquaculture and Mariculture**	**T**	**Credits:4**	**Hours:4**

Unit -I		
Objective 1	**To learn the history and status of coastal aquaculture**	
Coastal aquaculture: History, global and Indian status of coastal aquaculture - Principles of sustainable aquaculture development - Types of culture - candidate species - farm design - infrastructure facilities for shellfish and finfish grow-out farms.		
Outcome 1	**Students can comprehend national and global status of coastal aquaculture farming system**	**K2**
Unit -II		
Objective 2	**To create awareness of mariculture practices**	
Mariculture: History, present global and Indian status of Mariculture - cultivable species - Cage, Pen and raft - site selection - raw materials for constructions - types - design. Mariculture international and national regulation.		
Outcome 2	**Students can realise the status of mariculture**	**K2**
Unit -III		
Objective 3	**To train the learners for crustacean farming**	
Crustacean Farming: Shrimp - crab - lobster. Pond preparation, soil culture – water culture - acclimatization - stocking - water quality - feed and health management - Biosecurity - HACCP and Biofloc technology in shrimp farming. Recirculation aquaculture system (RAS), other recent technology for shrimp farming.		
Outcome 3	**Students can analyse the shrimp, crab and lobster production**	**K4**
Unit IV		
Objective 4	**To educate the student on mollusc and seaweed farming**	
Mollusc and Seaweed Farming: Mussels - oyster - abalone - scallop - pearl oyster culture - types of culture - stocking - water quality, feed and health management. Major problems in molluscan farming in India. Seaweed farming and its economical importance.		
Outcome 4	**Students can investigate the sustainable mollusc and seaweed farming**	**K4**
Unit V		
Objective 5	**To deliver skills in finfish farming**	
Finfish farming: Cultivable species - types of culture - site selection - pond preparation - soil culture - water culture - stocking - feed - water quality and health management - Recirculating aquaculture system (RAS) - Biofloc technology - Biosecurity procedure for finfish farming		
Outcome 5	**Students can critically examine the Finfish farming**	**K4**

Suggested Readings:

Athithan, S. (2021). *Coastal Aquaculture and Mariculture*. CRC Press.

David, A. Bengtson (2003). *Status of Marine aquaculture in relation to live prey: Past, Present andFuture*. Blackwell publishing.

Gerwick Jr., B. C. (2007). *Construction of Marine and Offshore Structures*. 3rd Eds. CRC press, New York.

Holmer, M., Black, K., Duarte, C. M., Marba, N., Karakassis, I. (2008). *Aquaculture in the Ecosystem*. Daya Publ. House.

ICAR (2006). *Handbook of Fisheries and Aquaculture*. ICAR.

John E. Bardach (1997). *Sustainable Aquaculture*. John Wiley & Sons Inc., New York.

Korringa, P. (2017). *Farming Marine Fishes and Shrimps*. United Book Print.

Mcvey, J. P., (1993). *Handbook of Mariculture*. 2nd Eds. CRC Press.

Pillay, T. V. R. (1972). *Coastal Aquaculture in the Indo – Pacific Region*. Fishing News (Book)Ltd., London.

Pillay, T.V. R., Kutty, M. N. (2012). *Aquaculture Principles and Practices*. 2nd Eds. Wiley India.

Robert R. Stickney (2000). *Encyclopedia of Aquaculture*. John Wiley & Sons, Inc., New York.

US Fish, Wildlife Service (1982). *Fish Hatchery Management*. University Press of the Pacific.

Wedemeyer, G. (2002). *Fish Hatchery Management*. 2nd Eds. CABI Publishing.

Online resources

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http://www.fisheries.kerala.gov.in/kavil
https://kerala.gov.in/adak
http://www.practicalfishkeeping.co.uk/
http://ecoursesonline.iasri.res.in
http://www.cmfri.org.in/
http://www.rgca.org.in/
http://www.seafdec.org
https://enaca.org/
www.ciba.res.in
www.fao.org

K1-Remember	*K2-Understand*	*K3- Apply*	*K4-Analyse*	*K5-Evaluate*	*K6-Create*

Course designed by: Dr. N.M. Prabhu

Course Outcome VS Programme Outcomes

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	-	M (2)	L (1)	L (1)	L (1)	S (3)	S (3)	M (2)	L (1)	L (1)
CO2	-	M (2)	L (1)	L (1)	L (1)	S (3)	S (3)	M (2)	L (1)	L (1)
CO3	L (1)	L (1)	M (2)	L (1)	M (2)	S (3)	S (3)	M (2)	L (1)	L (1)
CO4	L (1)	L (1)	M (2)	L (1)	M (2)	S (3)	S (3)	M (2)	L (1)	L (1)
CO5	L (1)	L (1)	M (2)	L (1)	M (2)	S (3)	S (3)	M (2)	L (1)	L (1)
W.AV	**0.6**	**1.4**	**1.6**	**1**	**1.6**	**3**	**3**	**2**	**1**	**1**

S –Strong (3), M-Medium (2), L- Low (1)

Course Outcome VS Programme Specific Outcomes

CO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	L (1)	-	L (1)	M (2)	S (3)
CO2	L (1)	L (1)	L (1)	M (2)	S (3)
CO3	-	-	S (3)	S (3)	S (3)
CO4	-	-	S (3)	S (3)	S (3)
CO5	-	-	S (3)	S (3)	S (3)
W. AV	**0.4**	**0.2**	**2.2**	**2.6**	**3**

S –Strong (3), M-Medium (2), L- Low (1)

III – Semester					
Core	**Course Code 547302**	**Ornamental Aquaculture**	**T**	**Credits: 4**	**Hours: 4**

Unit -I		
Objective 1	**To impart knowledge on the status of ornamental fish culture and aquarium keeping**	
Ornamental fish introduction: History - international and national status. Capture and cultivable ornamentals. Aquarium plants - Different marine and freshwater fishes - indigenous and exotics.		
Outcome 1	**Students discuss the global status of ornamental fish cultureand aquarium keeping**	**K2**

Unit -II		
Objective 2	**To teach how to design aquariums for various fishes**	
Infrastructure and equipment Site selection - layout - design - construction - equipment's required for freshwater and marine ornamental hatchery and farm production. Aquaponics - Types - infrastructure facilities - layout - model - plant and fish species cultured. Aquarium - freshwater andmarine aquarium design - aquarium accessories.		
Outcome 2	**Students design aquarium for various ornamental fishes**	**K6**

Unit -III		
Objective 3	**To educate skills in ornamental fish production**	
Ornamental fish production: Farming management - Types of marine and freshwater and marine ornamental fish - water quality - feed and health management. Arowana - flower horn - koi carp - gold fish - angel - discuss - breeding and faming. Marine Clown Fish, Damsel Fish and Cardinal fishes. Hatchery and farm management. Cross breeding and selective breeding. Good Management Practices.		
Outcome 3	**Students evaluate ornamental fish production, hatchery andfarm management**	**K5**

Unit IV		
Objective 4	**To learn rear live feeds for aquarium fishes**	
Live feed production for aquarium: Freshwater and marine species - phytoplankton and zooplankton production - different media-water quality parameters - health management - quality control. Live feed production - culture methods and mass scale production international and nationaltrade.		
Outcome 4	**Students develop the Live feed production for Freshwater and ornamental fishes**	**K3**

Unit V		
Objective 5	**To teach the importance of ornamental fish trading**	
Marketing: Present status - national and international trading for marine and freshwater ornamental fishes. High value freshwater and marine ornamental fishes. Market price and demand - MPEDA - regulations for export and import - government subsidies - Green Certification.		
Outcome5	**Generate trading for marine and fresh water ornamental fishes**	**K5**

Suggested Readings:

Ahilan, B., Felix, N., Santhnam, R. (2008). *Textbook of Aquariculture*. Daya Publ. House.

Dick Mills (1987). *The Practical Encyclopedia of the Marine Aquarium*. Salamander Books Limited.

Er Hunnam (1989). *The Living Aquariums*. NORDBOK.

Halver, J. E., Hardy, R. W. (2002). *Fish Nutrition*. Academic Press.

John Dawes (1995). *Live bearing Fishes (A guide to their Aquarium care, Biology and Classification).* Cassell Pvt., London.

Sebastian J. Kuravamveli (2002). *The Aquarium Handbook*. Amity Aquatech Pvt. Ltd., Cochin.

Stephen Spotte (1985). *Marine Aquarium Keeping: The Science, Animals, and Art*. Wiley-Interscience.

Sundararaj, V., Sathish, J. M. (2005). *Tropical marine aquarium*. Yegam Publications, Chennai.

Walter H. Adey, Karen Loveland (1998). *Dynamic Aquaria Building Living Ecosystems*. Academic Press.

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http://www.cmfri.org.in/

http://www.fisheries.kerala.gov.in/index.php?option=com_content&view=article&id=110&Itemid= 73

http://www.ofish.org/

http://www.practicalfishkeeping.co.uk/

https://ornamentalfish.org/

https://tal.ifas.ufl.edu/extension-and-outreach/extension-publications/

K1-Remember	*K2-Understand*	*K3- Apply*	*K4-Analyse*	*K5-Evaluate*	*K6-Create*

Course designed by: Dr. N.M. Prabhu

Course Outcome *vs* Programme Outcome

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	S (3)	S (3)	M (2)	M (2)	L (1)	S (3)	S (3)	S (3)	S (3)	S (3)
CO2	-	M (2)	S (3)	S (3)	L (1)	S (3)	S (3)	S (3)	S (3)	S (3)
CO3	-	L (1)	S (3)	L (1)	L (1)	S (3)	S (3)	S (3)	S (3)	S (3)
CO4	L (1)	L (1)	S (3)	L (1)	-	S (3)	S (3)	S (3)	S (3)	S (3)
CO5	S (3)	S (3)	S (3)	S (3)	L (1)	S (3)	S (3)	S (3)	S (3)	S (3)
W. AV	**1.4**	**2**	**2.8**	**2**	**0.8**	**3**	**3**	**3**	**3**	**3**

S –Strong (3), M-Medium (2), L- Low (1)

Course Outcome *vs* Programme Specific Outcome

CO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	S (3)	M (2)	S (3)	S (3)	L (1)
CO2	S (3)	M (2)	S (3)	S (3)	L (1)
CO3	S (3)	L (1)	S (3)	S (3)	L (1)
CO4	S (3)	L (1)	S (3)	S (3)	L (1)
CO5	S (3)	M (2)	S (3)	S (3)	M (2)
W. AV	**3**	**1.6**	**3**	**3**	**1.2**

S –Strong (3), M-Medium (2), L- Low (1)

III – Semester					
Core	**Course Code 547303**	**Fish Processing Technology and Quality Assurance**	**T**	**Credits:4**	**Hours:4**

Unit -I		
Objective 1	**To learn the status and post-harvest techniques for fish**	
General introduction: History and status of processing technology - Biochemistry of fish - Biochemical changes after fish death. Types of fish spoilage, causative factors -autolytic spoilage, microbial spoilage, oxidative changes. Post-harvest management forfinfish and shellfishes: Grading of fish, fish quality evaluation - Packing, different storage procedure and transportation up to processing plants - Quality assurance in Post-harvest.		
Outcome 1	**Students analyse and remembering the National and global status of fish processing**	**K4**

Unit -II		
Objective 2	**To teach different types of fish processing methods**	
Processing methods: Principles and different methods of chilling, Freezing**:** Air Blast Freezers, Plate freezers- Horizontal, vertical, IQF - Brine freezer, other freezers. Irradiation methods of preservation and Pasteurization for different fishery products. Salt curing - conventional and modern methods of drying (Solar driers) - pickling and smoking. Biochemical changes during processing. Packing: materials sources - types -packing - quality assurance during packing.		
Outcome 2	**Students synthesise and analyse Fish processing methods**	**K4**

Unit -III		
Objective 3	**To provide knowledge on Canning**	
Canning: Introduction, history, status, products, types of canning - processing - seaming - types of canned products - finfish and crustaceans. Problems related to canning. Packing: materials sources -types - packing - quality assurance during packing		
Outcome 3	**Students critically evaluate the canning and pasteurization techniques**	**K4**

Unit IV		
Objective 4	**To educate the learners on the fishery by-products**	
Fishery By-products: Fish silage Fish hydrolysate, Fish meal, bone meal, fish oil, surgical sutures from intestine, chitin, chitosan and etc - Definitions - methods - production and uses. Additives and preservatives. Value added products - processing methods.		
Outcome4	**Students synthesise the Fishery by-products and value addition**	**K4**

Unit V		
Objective 5	**To create knowledge in fish quality assurance**	
Quality Control, Packaging and Marketing: Quality control and quality assurance - HAACP, USFDA, EU, BIS, BRC, Good Management Practices etc. for different fish products and processing techniques. Trading: role of EIA and MPEDA. Inland and export trade. Fast MovingGoods (FMG) - Products - retail marketing - chilled and frozen product market. Logistic management and quality assurance of fishery products.		
Outcome 5	**Students apply the Fish quality control and assurance and national and international trading**	**K4**

Suggested Readings:

Balachandran, K. K. (2016). *Post-Harvest Technology of Fish and Fish Products*. Daya Publ.

Borda, D., Anca I. Nicolau, Raspor, P. (2018). *Trends in Fish Processing Technologies*. CRC Press.

Connell, J. J. (1999). *Control of fish quality*. Wiley-Blackwell.

Geroge M. Hall (2010). *Fish Processing: Sustainability and New Opportunities*. Wiley-Blackwell.

Gopakumar, K. (1997). *Tropical Fishery Products*. Science Publishers.

Gopakumar, K. (2013). *Fish packaging technology.* Concept Publishing Company, Delhi.

Huss, H. H., Jakobsen, M., Liston, J. (1991). *Quality assurance in the fish industry*. Elsevier.

John, D. E. V. (1999). *Food safety and toxicity.* CRC Press, New York, London, Tokyo.

Less Bratt (2010). *Fish Canning Handbook*. Wiley-Blackwell.

Nambudiri, D. D. (2006). *Technology of Fishery Products*. Fishing Chimes.

Venugopal, V. (2006). *Seafood Processing*. Taylor & Francis.

Online resources

https://aquafind.com/articles/Aquaculture_Biotechnology.php

https://www.fao.org/3/X5624E/x5624e08.htm

http://niftem-t.ac.in/olapp/pmfme/upload/mt_handbook_fish.pdf

https://units.fisheries.org/fhs/wp-content/uploads/sites/30/2017/08/S3-QA-QC-Model-For-Fish-Health-Labs-2014-rev-ref.pdf

https://aquadocs.org/bitstream/handle/1834/33633/FT11.1_001.pdf?sequence=1&isAllowed=y

https://courseware.cutm.ac.in/courses/quality-assurance-of-fish-and-fishery-products/

http://ecoursesonline.iasri.res.in/course/view.php?id=286

K1-Remember	*K2-Understand*	*K3- Apply*	*K4-Analyse*	*K5-Evaluate*	*K6-Create*

Course designed by: Dr. E. Kannapiran and Dr. N.M. Prabhu

Course Outcome *vs* Programme Outcome

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	-	M (2)	L (1)	-	L (1)	-	S (3)	S (3)	S (3)	L (1)
CO2	L (1)	-	-	-	M (2)	-	S (3)	M (2)	L (1)	L (1)
CO3	-	-	-	-	L (1)	L (1)	L (1)	-	L (1)	-
CO4	L (1)	L (1)	L (1)	M (2)	-	-	L (1)	-	M (2)	-
CO5	L (1)	S (3)	M (2)	S (3)	S (3)	-	M (2)	M (2)	S (3)	M (2)
W. AV	**0.6**	**1.2**	**0.8**	**1**	**1.4**	**-**	**2**	**1.8**	**2**	**1**

S –Strong (3), M-Medium (2), L- Low (1)

Course Outcome *vs* Programme Specific Outcome

CO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	S (3)	L (1)	-	M (2)	L (1)
CO2	-	-	-	M (2)	L (1)
CO3	-	-	-	M (2)	M (2)
CO4	-	-	-	L (1)	L (1)
CO5	L (1)	-	M (2)	L (1)	S (3)
W. AV	**0.8**	**0.4**	**0.6**	**0.8**	**1.6**

S –Strong (3), M-Medium (2), L- Low (1)

III – Semester					
Core	**CourseCode 547304**	**Research Methodology in Fisheries**	**T**	**Credits:4**	**Hours:4**
Unit -I					
Objective 1	**To recognize the essential components of research methodology**				
Literature survey: Collection of research literatures, design research projects, analysis, compilation and presentation of research data, preparation of transparencies, research papers, dissertations, oral and visual delivering of results. H-index, I-10 index - citation index calculation - research gate - Scopus index - Google scholar citation - Research Ethics.					
Outcome1	**Students develop a research project/ study**				**K6**
Unit -II					
Objective 2	**To create knowledge on Good Laboratory Practices**				
Laboratory practices and spectral analysis: Good laboratory practices. Normality and Molarity calculation. Working principle and applications of pH meter, UV-visible Spectrophotometer, Fourier Transform - Infrared spectrophotometer, Flame photometer, Atomic Absorption Spectrophotometers, Nuclear Magnetic Resonance, and Mass spectrophotometer.					
Outcome 2	**Students discuss the applications and principle involved inspectral analysis**				**K4**
Unit -III					
Objective 3	**To study the separation and molecular techniques**				
Chromatography and Molecular techniques: Principle and use of Centrifuges, Chromatography(Paper, thin-layer, and column chromatography), Electrophoresis, ELISA, PCR, RT-PCR, BlottingTechniques, Microarray techniques.					
Outcome 3	**Students analyse the principle and use of chromatography and molecular techniques**				**K4**
Unit IV					
Objective 4	**To impart knowledge in Microscopy and Histology**				
Microscopy and Histology: Principle and application of Light Microscopy: Bright field, Dark field, Phase contrast, Differential Interface Contrast Microscopy, Fluorescence Microscopy, Confocal Microscopy. Electron microscopy: Scanning and Transmission. Principles and application of Histology and Histochemistry.					
Outcome 4	**Students explain the principle and application of various microscopes**				**K4**

Unit V		
Objective 5	**To analyse the biostatistics in fisheries sector**	
Biostatistics: Sampling or census methods - random and non-random technique. Data collection. Descriptive statistics of central tendency and dispersion - mean, median, mode, standard deviation, standard error. Probability distribution, data - binominal, Poisson and normal distribution. Relational statistics of correlation and regression - Student's' test, ANOVA - one way and two-wayanalysis. Diagrammatic and graphical representation of data. Different software's in fisheries.		
Outcome 5	**Students critically evaluate the appropriate statistical methods required for a particular research design**	**K5**

Suggested Readings:

Bernard, A. R. (2006). *Fundamentals of Biostatistics*. Thomson-Brooks/Cole: Science.

Chandler, D.E., Roberson, R.W. (2009). *Bioimaging: Current concepts in light and electronmicroscopy*. Sunbury, MA, USA: Jones & Bartlet Publishers.

Donald L. Pavia, Gary M. Lampman, George S. Kriz, James A. Vyvyan (2014). *Introduction to Spectroscopy* (5th ed.). Cengage.

Gurumani, N. (2008). *Research Methodology for Biological Sciences*. Chennai: MJP Publishers.

Gurumani, N. (2010). *An Introduction to Biostatistics*. Chennai: MJP Publishers.

Hoppert, M. (2003). *Microscopic Techniques in Biotechnology*: Wiley-Blackwell Publications.

Mark F. Vitha (2016). *Chromatography: Principles and Instrumentation*. Wiley.

Pare, J. R. J., Belanger, J. M. R. (1997). *Instrumental Methods in Food Analysis*. Elsevier.

Sharma, A.K. (2005). *Textbook of Biostatistics II*. Discovery Publishing Pvt. Ltd.

Triola, M., Triola, M., Roy, J. (2017). *Biostatistics for the Biological and Health Sciences* (2nd ed.). Pearson.

Veerakumari, L. (2006). *Bioinstrumentation*. Chennai: MJP Publishers.

Wilson, R. H. (1994). *Spectroscopic Techniques for Food Analysis*. VCH Publ.

Online resources

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https://onlinecourses.nptel.ac.in/noc23_ge36/preview
https://onlinecourses.swayam2.ac.in/cec20_hs17/preview
https://onlinecourses.nptel.ac.in/noc19_bt19/preview https://ndl.iitkgp.ac.in
https://mrcet.com/downloads/digital_notes/CSE/Mtech/I%20Year/RESEARCH%20METHODLO GY.pdf
https://ccsuniversity.ac.in/bridge-library/pdf/MPhil%20Stats%20Research%20 Methodology-Part1.pdf
https://www.nature.com/scitable/topicpage/effective-writing-13815989
http://study.com/academy/lesson/research-methodology-approaches-techniques-quiz.html
https://www.drnishikantjha.com/papersCollection/Research%20Methodology%20.pdf
https://explorable.com/research-methodology
https://sist.sathyabama.ac.in/sist_coursematerial/uploads/SBAX1023.pdf
https://research-repository.griffith.edu.au/bitstream/handle/10072/34561/62679_1.pdf
https://www.britannica.com/technology/microscope/Stereoscopic-microscopes
https://rajswasthya.nic.in/RHSDP%20Training%20Modules/Lab.%20Tech/Histo/Introduction.pdf
https://histology.siu.edu/intro/tissprep.htm

K1-Remember	*K2-Understand*	*K3- Apply*	*K4-Analyse*	*K5-Evaluate*	*K6-Create*

Course designed by: Dr. E. Kannapiran

Course Outcome VS Programme Outcomes

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	-	-	-	-	-	-	-	-	-	S (3)
CO2	-	-	S (3)	-	-	S (3)	S (3)	L (1)	L (1)	S (3)
CO3	-	-	S (3)	-	-	-	S (3)	-	M (2)	S (3)
CO4	-	-	M (2)	-	-	M (2)	S (3)	L (1)	L (1)	S (3)
CO5	-	L (1)	-	S (3)	M (2)	M (2)	-	L (1)	L (1)	M (2)
W. AV	**0**	**0.2**	**1.6**	**0.6**	**0.4**	**1.4**	**1.8**	**0.6**	**1**	**2.8**

S –Strong (3), M-Medium (2), L- Low (1)

Course Outcome VS Programme Specific Outcomes

CO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	L (1)	L (1)	M (2)	M (2)	M (2)
CO2	-	L (1)	M (2)	M (2)	-
CO3	M (2)	-	L (1)	M (2)	-
CO4	M (2)	M (2)	M (2)	M (2)	L (1)
CO5	S (3)	M (2)	S (3)	S (3)	S (3)
W. AV	**1.6**	**1.2**	**2**	**2.2**	**1.2**

S –Strong (3), M-Medium (2), L- Low (1)

III – Semester					
Core	**Course Code 547305**	**Lab – III-** Coastal Aquaculture and Mariculture, Ornamental Aquaculture, Fish Processing Technologyand Quality Assurance, Fish Processing Technology and Quality Assurance	**P**	**Credits: 4**	**Hours:8**

Unit -I		
Objective 1	**To impart practical skill in coastal aquaculture and mariculture**	
Costal aquaculture and Mariculture: Identification of cultivable marine and brackish water finfish and shellfish. Identification of cultivable seaweeds. Designing of different farming systems - cages,pens, rafts and racks.		
Outcome 1	**Students identify the cultivable finfish, shellfish, sea weeds anddesign different farming systems**	**K6**

Unit -II		
Objective 2	**To provide practical knowledge on aquarium setup**	
Ornamental Aquaculture: 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. Identification phytoplankton and zooplankton.		
Outcome 2	**Students set up and maintain Ornamental aquarium**	**K6**

Unit -III		
Objective 3	**To understand the basic knowledge of fish processing technology**	
Fish Processing Technology: Studies on physical, chemical and sensory changes - Filleting of fish, treatments, glazing, packaging, freezing, Processing of Prawns, Lobster, Squid, Cuttle Fish, Crab etc. in different styles, Packaging and Freezing, Freezing curve, determination of freezing point.		
Outcome 3	**Students explain the techniques in fish processing technology**	**K5**

Unit IV		
Objective 4	**To gain knowledge on the instruments in a research lab**	
Research Methodology: Preparation of solutions - Molarity, Normality, and Percentage. Buffer preparation, Determination of pH. Prepare report on instrumentation. Visit to common instrumentation facility and write the different instruments principles, its applications in fisheries.		
Outcome 4	**Students prepare solutions and demonstrate the use of instrumentsin a research lab**	**K6**

Unit V		
Objective 5	**To perform statistical calculations**	
Biostatistics: Calculation of mean, median, mode, standard deviation, standard error, correlation and regression. Diagrammatic and graphical representation of data.		
Outcome 5	**Students discuss the appropriate statistical methods required for aparticular research design**	**K6**

Suggested Readings:

Burges, G.H.O., Cutting, C.L., Lovern, J.A., Waterman, J.J. (1965). *Fish Handling and Processing*. Chemical Publishing Co Inc., U.S.

Connell, J. J. (1999). *Control of fish quality*. Wiley-Blackwell.

Dick Mills (1987). *The Practical Encyclopedia of the Marine Aquarium*. Salamander Books Limited

Gopakumar, K. (2002). *Text Book of Fish Processing Technology*. ICAR.

Gurumani, N. (2008). *Research Methodology for Biological Sciences*. MJP Publishers, Chennai.

Halver, J. E., Hardy, R. W. (2002). *Fish Nutrition*. Academic Press.

Mcvey, J. P. (1983). *Handbook of Mariculture*. CRC Press.

MPEDA (1993). *Handbook on Aqua Farming - Live Feed. Micro Algal Culture*. MPEDA Publ.

Pillay, T.V.R., Kutty, M. N. (2012). *Aquaculture principles and practices*. 2nd Eds. Wiley-Blackwell.

Pritimishra, Neera Jain (2018). *Practical manual on fish nutrition and feed technology*. Daya Publ. House.

Santhanam, R., Sukumaran, N., Nataraj, P. (1999). *A manual of freshwater aquaculture*. Oxford and IBH Publishing Co. Pvt. Ltd., New Delhi.

Stephen Spotte (1985). *Marine Aquarium Keeping: The Science, Animals, and Art*. Wiley-Interscience.

Veerakumari, L. (2006). *Bioinstrumentation*. MJP Publishers, Chennai.

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https://sist.sathyabama.ac.in/sist_coursembiostaterial/uploads/SMB2103.pdf

https://knowledge.carolina.com/discipline/physical-science/chemistry/molarity-molality-or- normality-a-quick-review/

http://niftem-t.ac.in/olapp/pmfme/upload/mt_handbook_fish.pdf

https://scert.kerala.gov.in/wp-content/uploads/2020/06/15-mfsp.pdf

www.caa.gov.in

www.ciba.org.in www.cifa.org.in www.cmfri.org.in/

www.fao.org

K1-Remember	*K2-Understand*	*K3- Apply*	*K4-Analyse*	*K5-Evaluate*	*K6-Create*

Course designed by: Dr. E. Kannapiran and Dr. N.M. Prabhu

Course Outcome VS Programme Outcomes

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	S (3)	S (3)	L (1)	L (1)	L (1)	S (3)	L (1)	M (2)	S (3)	M (2)
CO2	S (3)	S (3)	-	S (3)	M (2)	S (3)	M (2)	S (3)	M (2)	S (3)
CO3	-	M (2)	S (3)	-	-	-	S (3)	S (3)	S (3)	S (3)
CO4	-	-	-	-	-	-	-	-	M (2)	S (3)
CO5	-	-	-	S (3)	L (1)	-	-	L (1)	-	S (3)
W. AV	**1.2**	**1.6**	**0.8**	**1.4**	**0.8**	**1.2**	**1.2**	**1.8**	**2**	**2.8**

S –Strong (3), M-Medium (2), L- Low (1)

Course Outcome VS Programme Specific Outcomes

CO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	L (1)	-	S (3)	M (2)	-
CO2	M (2)	M (2)	S (3)	L (1)	-
CO3	-	M (2)	M (2)	S (3)	M (2)
CO4	-	-	L (1)	M (2)	-
CO5	M (2)	M (2)	S (3)	M (2)	M (2)
W. AV	**1**	**1.2**	**2.4**	**2**	**0.8**

S –Strong (3), M-Medium (2), L- Low (1)

III – Semester					
DSE	**Course Code 547507**	**Aquatic Animal Health and Management**	**T**	**Credits:3**	**Hours:3**

Unit -I		
Objective 1	**To understand the immune system in fish and shellfish**	
Finfish and shellfish immunology: International and national status of finfish and shell disease. Host-pathogen-environment relationship. Environmental stress. Immune system in fish and shellfish: innate and acquired immunity, inflammation response to diseases. Antibody and cell mediated immunity in finfish and shellfish.		
Outcome1	**Students discuss the immune systems of fin fishes and shell fishes**	**K4**

Unit -II		
Objective 2	**To create knowledge on fish bacterial and viral diseases**	
Bacterial and viral diseases: Bacterial and viral diseases of finfish and shellfish - general characteristics, diagnosis, mode of transmission, prevention and treatment. Environment management, chemotherapeutic agents, host management, prophylaxis - vaccines, adjuvants, immunostimulants, prebiotics and probiotics. Use and abuse of antibiotics and chemicals in health management and alternatives to antibiotics.		
Outcome2	**Students understand and discuss fish bacterial and viral diseases**	**K4**

Unit -III		
Objective 3	**To provide knowledge on fish parasitic and mycotic diseases**	
Parasitic and mycotic diseases: Parasitic and mycotic diseases of finfish and shellfish disease - general characteristics, epizootiology, diagnosis, life cycle, prevention and treatment. Environment management, chemotherapeutic agents, host management, prophylaxis- vaccines, adjuvants, immunostimulants, prebioitcs and probiotics.		
Outcome3	**Students understand and discuss fish parasitic and mycotic diseases**	**K4**

Unit IV		
Objective 4	**To teach the importance of non –infectious fish disease**	
Non-infectious Diseases: Finfish and shellfish nutritional diseases in hatcheries and grow outsystems. Identification, diagnosis, prevention and control. **Techniques in identification of diseases:** Microbiological, haematological, histopathological,immunological and molecular techniques.		
Outcome4	**Students choose appropriate diagnostic tools for identification of the disease-causing agent**	**K5**

Unit V		
Objective 5	**To prove skill on quarantine for disease prevention**	
Quarantine: Fish health and quarantine systems, national and international status-importance. Design of quarantine and equipment's for fish and shellfish brood stock maintenance - Seed certification, SPF and SPR stocks development and management -cost analysis.		
Outcome 5	**Students select preventive strategies for quarantine**	**K5**

Suggested Readings:

Austin, B., Austin, D. A. (1999). *Bacterial Fish Pathogens – Diseases of farmed and wildfish*. Springer Praxis Publishing, NewYork.

Conroy, D.A., Herman, R. L. (1997). *Text Book of fish diseases*. Narendra Publ. House.

John Humphrey, Richard Arthur, J., Rohana Subasinhe, P., Michael Philips, J. (2005). *Aquaticanimal quarantine and health certification in Asia*. FAO, Daya Publ. House.

Jorge, E., Helmut, S., Thomas, W., Kapoor, B. G. (2008). *Fish Diseases*. Science Publ.

Merrifield, G., Ringe, E. (2014). *Aquaculture Nutrition: Gut Health, Probiotics and Prebiotics*. JohnWiley.

Shankar, K. M., Mohan, C. V. (2002). *Fish and Shellfish Health Management*. UNESCO Publ.

Stickney, P.R. (2000). *Encyclopedia of Aquaculture*. John Wiley & Sons, Inc, NewYork.

Wedemeyer, G. A., Meyer, F. P., Smith, L. (1999). *Environmental Stress and fish diseases.* NPH Publishing House, New Delhi.

Willey, J., Sherwood, L., Christopher J. Woolverton (2016). *Presscott's Microbiology*. 10th Eds. McGraw Hill Inc, NewYork.

Woo, P.T.K., Bruno, D. W. (1998). *Fish Diseases and Disorders – Vol. 3. Viral, Bacterial andFungal Infections*. CABI Publishing, New Delhi.

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https://www.bobpigo.org/webroot/img/pdf/report/2Aquaculture%20Medicine%20and%20Aquatic%20Animal%20Health%20Management.pdf

https://www.woah.org/app/uploads/2021/05/en-oie-aahs.pdf

https://fisheries.kerala.gov.in/sites/default/files/2020-08/SOP%20AAH.pdf

www.caa.gov.in

www.mpeda.gov.in

www.oie.int

K1-Remember	*K2-Understand*	*K3- Apply*	*K4-Analyse*	*K5-Evaluate*	*K6-Create*

Course designed by: Dr. E. Kannapiran and Dr. N.M. Prabhu

Course Outcome VS Programme Outcomes

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	-	M (2)	L (1)	-	-	-	-	-	L (1)	M (2)
CO2	-	S (3)	L (1)	-	L (1)	L (1)	S (3)	S (3)	S (3)	S (3)
CO3	-	S (3)	L (1)	-	L (1)	L (1)	S (3)	S (3)	S (3)	S (3)
CO4	-	M (2)	M (2)	-	M (2)	-	S (3)	S (3)	S (3)	S (3)
CO5	-	S (3)	M (2)	-	-	S (3)	M (2)	L (1)	M (2)	-
W. AV	**0**	**2.6**	**1.4**	**0**	**0.8**	**1**	**2.2**	**2**	**2.4**	**2.2**

S –Strong (3), M-Medium (2), L- Low (1)

Course Outcome VS Programme Specific Outcomes

CO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	L (1)	M (2)	M (2)	L (1)	L (1)
CO2	M (2)	M (2)	S (3)	M (2)	L (1)
CO3	M (2)	M (2)	S (3)	M (2)	L (1)
CO4	S (3)	L (1)	S (3)	M (2)	L (1)
CO5	S (3)	L (1)	S (3)	L (1)	L (1)
W. AV	**2.2**	**1.6**	**2.8**	**1.6**	**1**

S –Strong (3), M-Medium (2), L- Low (1)

III – Semester					
DSE	**Course Code 547508**	**Fish Nutrition and Feed Technology**	**T**	**Credits:3**	**Hours: 3**

Unit -I		
Objective 1	**To study the principles of fish nutrition**	
Fish nutrition and biochemistry: Principles of fish nutrition and terminologies. Nutritional requirements of cultivable finfish and shellfish: larvae, juveniles and adults. Sources and role of nutrient in physiology of fin and shellfish - Proteins, amino acids, lipids and fatty acids, carbohydrates - carotenoids, vitamins and minerals.		
Outcome 1	**Students explain the nutritional requirements of fish and shell fishat different stages of their life**	**K5**

Unit -II		
Objective 2	**To teach the nutritional bioenergetics**	
Nutritional bioenergetics: Energy requirement of cultivable Finfish and Shellfish - protein to energy ratio, digestible energy, nitrogen balance index, protein sparing effect, high energy feeds, isocaloric diets, Optimal foraging theory, Mathematical modeling of ingestion, Metabolic rate, Energy budgets,Energetic efficiency of fish production.		
Outcome 2	**Students calculate the energy requirements of finfish and shellfish**	**K4**

Unit -III		
Objective 3	**To educate the importance of raw materials in fish feed formulation**	
Raw material: National and international status - purchase of feed ingredients - logistic management - storage - inventory maintenance - good management practices - fish silage production - alternative ingredients to fish proteins and fatty acids - quality assurances. Majorissues during storage and management.		
Outcome 3	**Students explain the significance and alternatives of feed ingredientsand storage**	**K5**

Unit IV		
Objective 4	**To provide knowledge on shrimp feed processing**	
Shrimp feed processing: National and international status - types of processing - feed formulation and production - Formulation - raw material mixing - Grinding and Pulverizing - Pre-Hydration - Pre-Conditioning - Pellet Milling - Post conditioning - Drying - Cooling - Crumbling - packing - store maintenance - transport - logistic management - HACCP - Good Management practices.		
Outcome 4	**Students explain shrimp feed formulation, manufacture and storage**	**K5**

Unit V		
Objective 5	**To provide knowledge on finfish feed processing**	
Finfish feed processing: National and International Status of floating and semi-floating feed - feed formulation and production - Formulation - raw material mixing: Grinding and Pulverizing - Pre-Hydration - Pre-Conditioning - Pelleting and extrusion - Milling - Post conditioning - Drying - Cooling - packing - store maintenance - transport - logistic management, HACCP - Good Management practices.		
Outcome 5	**Students explain finfish feed formulation, manufacture and storage**	**K5**

Suggested Readings:

Athithan, S., Felix, N., Venkatasamy, N. (2016). *Fish nutrition and feed technology*. Daya Publ. House.

Cyrino, E. P., Bureau, D., Kapoor, B. G. (2008). *Feeding and Digestive Functions in Fishes*. SciencePubl.

Guillame, J., Kaushik, S., Bergot, P., Metallier, R. (2001). *Nutrition and Feeding of Fish andCrustaceans*. Springer Praxis Publ.

Joachim W. Hertramft, Felicitas Piedad – Pascal (2000). *Hand Book on Ingredients for AquacultureFeeds*. Kluwer Academic Publishers, London.

National Research Council (1993). *Nutrient Requirements of Fish*. National Academy Press,Washington.

Robert R. Stickney (2000). *Encyclopedia of Aquaculture*. John Wiley & Sons, Inc., New York.

Sena S. De Silva, Trever A. Anderson (1995). *Fish Nutrition in Aquaculture*. Chapman & Hall, London.

Wedemeyer, G. (1996). *Physiology of Fish in Intensive Culture Systems*. Springer US.

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https://www.fao.org/3/x5738e/x5738e00.htm#Contents

http://edis.ifas.ufl.edu/topic_fish_nutrition

http://www.glfc.org/pubs/SpecialPubs/sp83_2/pdf/chap8.pdf

https://nofima.no/en/forskningsomrade/nutrition-and-feed-technology/fish-nutrition/

https://thefishsite.com/articles/principles-of-fish-nutrition

https://www.pashudhanpraharee.com/ingredients-and-manufacturing-process-for-fish-feed-shinking-floating-formulation/

https://fishfeedmachinery.com/Solution/nutritional-fish-feed-formulation.html

K1-Remember	*K2-Understand*	*K3- Apply*	*K4-Analyse*	*K5-Evaluate*	*K6-Create*

Course designed by: Dr. E. Kannapiran and Dr. N.M. Prabhu

Course Outcome VS Programme Outcomes

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	-	S (3)	-	-	-	S (3)	L (1)	-	M (2)	M (2)
CO2	-	S (3)	-	-	-	S (3)	L (1)	-	M (2)	M (2)
CO3	-	M (2)	-	-	-	M (2)	-	-	M (2)	M (2)
CO4	-	S (3)	S (3)	-	-	S (3)	S (3)	L (1)	M (2)	M (2)
CO5	-	S (3)	S (3)	-	-	S (3)	S (3)	L (1)	M (2)	M (2)
W. AV	**0**	**2.8**	**1.2**	**0**	**0**	**2.8**	**2**	**0.4**	**2**	**2**

S –Strong (3), M-Medium (2), L- Low (1)

Course Outcome VS Programme Specific Outcomes

CO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	L (1)	-	S (3)	S (3)	-
CO2	L (1)	-	S (3)	S (3)	-
CO3	-	L (1)	S (3)	S (3)	L (1)
CO4	-	-	S (3)	S (3)	-
CO5	-	-	S (3)	S (3)	-
W. AV	**0.4**	**0.2**	**3**	**3**	**0.2**

S –Strong (3), M-Medium (2), L- Low (1)

III – Semester					
DSE	**Course Code 547509**	**Integrated FishFarming**	**T**	**Credits: 3**	**Hours: 3**

Unit -I		
Objective 1	**To impart theoretical knowledge on types of culture**	
Types of Culture Systems: Operational details of monoculture, composite fish culture polyculture in freshwater and coastal aquaculture - running water systems - Integrated farming.		
Outcome1	**Students develop the different culture system**	**K3**
Unit -II		
Objective 2	**To teach agriculture practices in India**	
Agriculture: Introduction - history - national and international status - different type of economically crops - farming systems. Suitable agriculture crops for integrated fish farming - Mushroom cultivation - Suitable species for integrated production system.		
Outcome2	**Students evaluate suitable agriculture crops for integrated farming**	**K5**
Unit -III		
Objective 3	**To deliver knowledge on animal production**	
Animal husbandry: Introduction - history - national and international status - different type of animals for integrated fish arming systems - cattle - goat - piggery and poultry - farming system - problems. Epiculture - Sericulture and economics.		
Outcome3	**Students operate the different type of animals for integratedfish farming systems**	**K4**
Unit IV		
Objective 4	**To teach the importance of integrated fish farming**	
Integrated fish farming: Introduction - history - national and international status - a different type of integrated farming system - aquaculture and agriculture - aquaculture - horticulture and cattle farming - aquaculture - poultry - agriculture - apiculture and animals - cost analysis.		
Outcome 4	**Students analyse the status and types of integrated fish farming techniques**	**K3**
Unit V		
Objective 5	**To educate the skills on aquaponics**	
Aquaponics: National and international status - types of aquaponics - layout and design of different aquaponics system - production of fish and plants - water, feed and health management - cost analysis.		
Outcome5	**Students evaluate the different types of Aquaponics systems**	**K5**

Suggested Readings:

Agarwal, V. P. (1999). *Recent trends in aquaculture.* Publisher Society of Bios, Muzaffarnagar.

Andy Jacobson (2019). *Aquaponics: The Essential Aquaponics Guide: A Step-By-Step Aquaponics Gardening Guide to Growing Vegetables, Fruit, Herbs, and Raising Fish.* CreateSpaceIndependent Publishing Platform.

Banerjee, G. C. (2019). *A Textbook of Animal Husbandry*. 8th Eds. Oxford.

Chandra, P. (2007). *Fishery Conservation, Management and Development*. SBS Publ.

Mathias, J. S., Charles, A. T., Bootong, H. U. (1998). *Integrated fish farming*. CRC Press.

Pandey, N., Davendra, S. M. (2008). *Integrated Fish Farming*. Daya Publ. House.

Pillay, T.V. R., Kutty, M. N. (2012). *Aquaculture Principles and Practices*. 2nd Eds. Wiley India.

Robert R. Stickney (2000). *Encyclopedia of Aquaculture*. John Wiley & Sons, Inc., New York.

Somerville, C., Cohen, M., Pantanella, E., Stankus, A., Lovatelli, A. (2014). *Small-scale aquaponics food production Integrated fish and plant farming*. FAO Fisheries and Aquaculture Technical Paper 589.

Templeton, R. G. (1995). *Freshwater fisheries management*. 2nd Eds. Wiley-Blackwell.

Tripathi, S. D., Lakra, W.S., Chadha, N. K. (2018). *Aquaculture in India*. Narendra Publ. House.

Online resources

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http://www.cifri.res.in/

https://tal.ifas.ufl.edu/extension-and-outreach/extension-publications/

http://www.practicalfishkeeping.co.uk/

http://www.fisheries.kerala.gov.in/kavil

https://kerala.gov.in/adak

http://www.fao.org/tempref/FI/CDrom/bobp/cd1/Bobp/Publns/MAG/013.pdf

http://www.fao.org/3/x5625e09.htm

http://ecoursesonline.iasri.res.in/course/view.php?id=297

K1-Remember	*K2-Understand*	*K3- Apply*	*K4-Analyse*	*K5-Evaluate*	*K6-Create*

Course designed by: Dr. N.M. Prabhu

Course Outcome *vs* Programme Outcome

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	-	S (3)	M (2)	-	M (2)	S (3)	S (3)	L (1)	S (3)	S (3)
CO2	-	L (1)	L (1)	-	L (1)	L (1)	L (1)	L (1)	M (2)	S (3)
CO3	-	L (1)	-	L (1)	L (1)	M (2)	S (3)	S (3)	S (3)	S (3)
CO4	-	M (2)	S (3)	-	L (1)	M (2)	S (3)	S (3)	S (3)	S (3)
CO5	-	-	S (3)	-	L (1)	-	S (3)	S (3)	S (3)	S (3)
W. AV	**0**	**1.4**	**1.8**	**0.2**	**1.2**	**1.6**	**2.6**	**2.2**	**2.8**	**3**

S –Strong (3), M-Medium (2), L- Low (1)

Course Outcome *vs* Programme Specific Outcome

CO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	S (3)	M (2)	L (1)	M (2)	L (1)
CO2	L (1)	L (1)	M (2)	M (2)	M (2)
CO3	S (3)	L (1)	L (1)	L (1)	S (3)
CO4	M (2)	L (1)	M (2)	S (3)	S (3)
CO5	S (3)	-	L (1)	L (1)	L (1)
W. AV	**2**	**1**	**1.4**	**1.8**	**2**

S –Strong (3), M-Medium (2), L- Low (1)

IV - Semester					
Core	**Course Code 547999**	**Dissertation Work**	**T**	**Credits: 12**	**Hours: 30**

Unit -I		
Objective 1	**To conduct review of literature**	
Outcome1	Students demonstrate the ability to conduct literature reviews and gather the critical scientific information related to the research proposal	**K5**
Unit -II		
Objective 2	**To create a research proposal**	
Outcome 2	Students identify a research hypothesis/problem and create a research proposal	**K6**
Unit -III		
Objective 3	**To undertake a research project following precise research methodology**	
Outcome 3	Students undertake a research project following precise research methodology	**K6**
Unit IV		
Objective 4	**To develop skills in scientific writing**	
Outcome 4	Students develop skills in scientific writing for the preparation and submission of dissertation	**K6**
Unit V		
Objective 5	**To develop skills in presentation of results**	
Outcome 5	Students develop skills in presentation of results and communication	**K6**

K1-Remember	***K2-Understand***	***K3- Apply***	***K4-Analyse***	***K5-Evaluate***	***K6-Create***

Course designed by: Dr. E. Kannapiran and Dr. N.M. Prabhu

Course Outcome VS Programme Outcomes

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	M (2)	S (3)	S (3)	S (3)	S (3)	M (2)	S (3)	S (3)	S (3)	S (3)
CO2	M (2)	S (3)	S (3)	S (3)	S (3)	M (2)	S (3)	S (3)	S (3)	S (3)
CO3	M (2)	S (3)	S (3)	S (3)	S (3)	M (2)	S (3)	S (3)	S (3)	S (3)
CO4	M (2)	S (3)	S (3)	S (3)	S (3)	M (2)	S (3)	S (3)	S (3)	S (3)
CO5	M (2)	S (3)	S (3)	S (3)	L (1)	M (2)	S (3)	S (3)	S (3)	L (1)
W. AV	**2**	**3**	**3**	**3**	**2.6**	**2**	**3**	**3**	**3**	**2.6**

S –Strong (3), M-Medium (2), L- Low (1)

Course Outcome VS Programme Specific Outcomes

CO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	S (3)	S (3)	S (3)	S (3)	M (2)
CO2	M (2)	S (3)	S (3)	S (3)	M (2)
CO3	S (3)	S (3)	S (3)	S (3)	L (1)
CO4	S (3)	S (3)	S (3)	S (3)	M (2)
CO5	S (3)	S (3)	S (3)	S (3)	L (1)
W. AV	**2.8**	**3**	**3**	**3**	**1.6**

S –Strong (3), M-Medium (2), L- Low (1)

II – Semester- Non Major Elective (NME)					
NME	**Course Code 547NM1**	**Integrated Fish Farming**	**T**	**Credits:2**	**Hours:3**

Unit -I		
Objective 1	**To impart theoretical knowledge on types of culture**	
Types of Culture Systems: Operational details of monoculture, composite fish culture polyculture in freshwater and coastal aquaculture - running water systems - Integrated farming.		
Outcome 1	**Students develop the different culture system**	**K3**
Unit -II		
Objective 2	**To teach agriculture practices in India**	
Agriculture: Introduction - history - national and international status - different type of economicallycrops - farming systems. Suitable agriculture crops for integrated fish farming - Mushroom cultivation - Suitable species for integrated production system.		
Outcome 2	**Students evaluate suitable agriculture crops for integrated farming**	**K5**
Unit -III		
Objective 3	**To deliver knowledge on animal production**	
Animal husbandry: Introduction - history - national and international status - different type of animals for integrated fish arming systems - cattle - goat - piggery and poultry - farming system - problems. Apiculture - Sericulture and economics.		
Outcome3	**Students operate the different type of animals for integrated fish farming systems**	**K4**
Unit IV		
Objective 4	**To teach the importance of integrated fish farming**	
Integrated fish farming: Introduction - history - national and international status - a different type of integrated farming system - aquaculture and agriculture - aquaculture - horticulture and cattle farming - aquaculture - poultry - agriculture - apiculture and animals - cost analysis.		
Outcome 4	**Students analyse the status and types of Integrated Fish Farming techniques**	**K3**
Unit V		
Objective 5	**To educate the skills on aquaponics**	
Aquaponics: National and international status - types of aquaponics - layout and design of different aquaponics system - production of fish and plants - water, feed and health management - cost analysis.		
Outcome 5	**Students evaluate the different types of Aquaponics systems**	**K5**

Suggested Readings:

Agarwal, V. P. (1999). *Recent trends in aquaculture.* Publisher Society of Bios, Muzaffarnagar.

Andy Jacobson (2019). *Aquaponics: The Essential Aquaponics Guide: A Step-By-Step Aquaponics Gardening Guide to Growing Vegetables, Fruit, Herbs, and Raising Fish.* Create Space Independent Publishing Platform.

Banerjee, G. C. (2019). *A Textbook of Animal Husbandry*. 8th Eds. Oxford.

Chandra, P. (2007). *Fishery Conservation, Management and Development*. SBS Publ.

Mathias, J. S., Charles, A. T., Bootong, H. U. (1998). *Integrated fish farming*. CRC Press.

Pandey, N., Davendra, S. M. (2008). *Integrated Fish Farming*. Daya Publ. House.

Pillay, T.V. R., Kutty, M. N. (2012). *Aquaculture Principles and Practices*. 2nd Eds. Wiley India.

Robert R. Stickney (2000). *Encyclopedia of Aquaculture*. John Wiley & Sons, Inc., NewYork.

Somerville, C., Cohen, M., Pantanella, E., Stankus, A., Lovatelli, A. (2014). *Small-scale aquaponics food production Integrated fish and plant farming*. FAO Fisheries and Aquaculture Technical Paper 589.

Templeton, R. G. (1995). *Freshwater fisheries management*. 2nd Eds. Wiley-Blackwell.

Tripathi, S. D., Lakra, W.S., Chadha, N. K. (2018). *Aquaculture in India*. Narendra Publ. House.

Online resources

http://cifa.nic.in/

http://www.cifri.res.in/

https://tal.ifas.ufl.edu/extension-and-outreach/extension-publications/

http://www.practicalfishkeeping.co.uk/

http://www.fisheries.kerala.gov.in/kavil

https://kerala.gov.in/adak

http://www.fao.org/tempref/FI/CDrom/bobp/cd1/Bobp/Publns/MAG/013.pdf

http://www.fao.org/3/x5625e09.htm

http://ecoursesonline.iasri.res.in/course/view.php?id=297

K1-Remember	*K2-Understand*	*K3- Apply*	*K4-Analyse*	*K5-Evaluate*	*K6-Create*

Course designed by: Dr. N.M. Prabhu

Course Outcome *vs* Programme Outcome

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	-	S (3)	M (2)	-	M (2)	S (3)	S (3)	L (1)	S (3)	S (3)
CO2	-	L (1)	L (1)	-	L (1)	L (1)	L (1)	L (1)	M (2)	S (3)
CO3	-	L (1)	-	L (1)	L (1)	M (2)	S (3)	S (3)	S (3)	S (3)
CO4	-	M (2)	S (3)	-	L (1)	M (2)	S (3)	S (3)	S (3)	S (3)
CO5	-	-	S (3)	-	L (1)	-	S (3)	S (3)	S (3)	S (3)
W. AV	**0**	**1.4**	**1.8**	**0.2**	**1.2**	**1.6**	**2.6**	**2.2**	**2.8**	**3**

S –Strong (3), M-Medium (2), L- Low (1)

Course Outcome *vs* Programme Specific Outcome

CO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	S (3)	M (2)	L (1)	M (2)	L (1)
CO2	L (1)	L (1)	M (2)	M (2)	M (2)
CO3	S (3)	L (1)	L (1)	L (1)	S (3)
CO4	M (2)	L (1)	M (2)	S (3)	S (3)
CO5	S (3)	-	L (1)	L (1)	L (1)
W. AV	**2**	**1**	**1.4**	**1.8**	**2**

S –Strong (3), M-Medium (2), L- Low (1)

III – Semester-Non Major Elective (NME)					
NME	**Course Code**	**Ornamental Fish Culture**	**T**	**Credits: 2**	**Hours : 3**
Unit -I					
Objective 1	**To impart knowledge on the status of ornamental fish culture and aquarium keeping**				
Ornamental fish introduction: History - international and national status. Capture and cultivable ornamentals. Aquarium plants - Different marine and freshwater fishes - indigenous and exotics. Types of Aquarium. Aquarium - freshwater and marine aquarium design - aquarium accessories.					
Outcome 1	**Students understand global status of ornamental fish culture and aquarium keeping**				**K2**
Unit -II					
Objective 2	**To teach how to design aquariums for various fishes**				
Infrastructure and equipment: Site selection - layout - design - construction - equipment's required for freshwater and marine ornamental hatchery and farm production. Aquaponics - Types - infrastructure facilities - layout - model - plant and fish species cultured.					
Outcome 2	**Students develop and design aquarium plants and various ornamental fishes**				**K3**
Unit -III					
Objective 3	**To educate skills in ornamental fish production**				
Ornamental fish production: Farming management - Types of marine and freshwater and marine ornamental fish - water quality - feed and health management. Arowana - flower horn - koi carp - gold fish - angel - discuss - breeding and faming. Marine Clown Fish, Damsel Fish and Cardinal fishes. Hatchery and farm management. Cross breeding and selective breeding. Good Management Practices.					
Outcome 3	**Students evaluate ornamental fish production, hatchery and farm management**				**K5**
Unit IV					
Objective 4	**To learn rear live feeds for aquarium fishes**				
Live feed production for aquarium: Freshwater and marine species - phytoplankton and zooplankton production - different media-water quality parameters - health management - quality control.					
Outcome 4	**Develop the Live feed production for Freshwater and ornamental fishes**				**K3**

Unit V		
Objective 5	**To teach the importance of ornamental fish trading**	
Marketing: Present status - national and international trading for marine and freshwater ornamental fishes. High value freshwater and marine ornamental fishes. Market price and demand - MPEDA - regulations for export and import - government subsidies - Green Certification.		
Outcome 5	**Generate trading for marine and fresh water ornamental fishes.**	**K5**

Suggested Readings:

Ahilan, B., Felix, N., Santhnam, R. (2008). *Textbook of Aquariculture*. Daya Publ. House.

Dick Mills (1987). *The Practical Encyclopedia of the Marine Aquarium*. Salamander Books Limited.

Er Hunnam (1989). *The Living Aquariums*. NORDBOK.

Halver, J. E., Hardy, R. W. (2002). *Fish Nutrition*. Academic Press.

John Dawes (1995). *Live bearing Fishes (A guide to their Aquarium care, Biology and Classification).* Cassell Pvt., London.

Sebastian J. Kuravamveli (2002). *The Aquarium Handbook*. Amity Aquatech Pvt. Ltd., Cochin.

Stephen Spotte (1985). *Marine Aquarium Keeping: The Science, Animals, and Art*. Wiley-Interscience.

Sundararaj, V., Sathish, J. M. (2005). *Tropical marine aquarium*. Yegam Publications, Chennai.

Walter H. Adey, Karen Loveland (1998). *Dynamic Aquaria Building Living Ecosystems*. AcademicPress.

Online resources

http://ecoursesonline.iasri.res.in/course/view.php?id=297
http://www.cmfri.org.in/
http://www.fisheries.kerala.gov.in/index.php?option=com_content&view=article&id=110&Itemid=73 http://www.ofish.org/
http://www.practicalfishkeeping.co.uk/
https://ornamentalfish.org/
https://tal.ifas.ufl.edu/extension-and-outreach/extension-publications/

K1-Remember	*K2-Understand*	*K3- Apply*	*K4-Analyse*	*K5-Evaluate*	*K6-Create*

Course designed by: Dr. N.M. Prabhu

Course Outcome *vs* Programme Outcome

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	S (3)	S (3)	M (2)	M (2)	L (1)	S (3)	S (3)	S (3)	S (3)	S (3)
CO2	-	M (2)	S (3)	S (3)	L (1)	S (3)	S (3)	S (3)	S (3)	S (3)
CO3	-	L (1)	S (3)	L (1)	L (1)	S (3)	S (3)	S (3)	S (3)	S (3)
CO4	L (1)	L (1)	S (3)	L (1)	-	S (3)	S (3)	S (3)	S (3)	S (3)
CO5	S (3)	S (3)	S (3)	S (3)	L (1)	S (3)	S (3)	S (3)	S (3)	S (3)
W. AV	**1.4**	**2**	**2.8**	**2**	**0.8**	**3**	**3**	**3**	**3**	**3**

S –Strong (3), M-Medium (2), L- Low (1)

Course Outcome *vs* Programme Specific Outcome

CO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	S (3)	M (2)	S (3)	S (3)	L (1)
CO2	S (3)	M (2)	S (3)	S (3)	L (1)
CO3	S (3)	L (1)	S (3)	S (3)	L (1)
CO4	S (3)	L (1)	S (3)	S (3)	L (1)
CO5	S (3)	M (2)	S (3)	S (3)	M (2)
W. AV	**3**	**1.6**	**3**	**3**	**1.2**

S –Strong (3), M-Medium (2), L- Low (1)

Core	Course Code: 547999	DISSERTATION	Credits:12	Hours:30

The Fisheries dissertation work will be conducted by the student, guided by mutual understanding, and interest from both the student and the research supervisor. The student's work will be continuously evaluated to ensure progress. Research supervisor will deliver instructions on how to design the work ,write and compile the dissertation, detailing the components, topics, materials, methods, and issues to address in each section. The dissertation will include the following sections: Introduction, Review, Materials and Methods, Results and Discussion, Summary and Conclusion, and References.. The dissertation should also include well-prepared graphs, diagrams, flow charts and appropriate statistical tools must be used for data analysis. An appendix may be included if necessary.

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