Semester	Code	Course	Title of the Course	Hours	Credits	Max. marks	Internal marks	External marks
I	20DAQ1CC1	General	Principles of Aquaculture and Biology of Fishes	4	4	100	25	75

Course Outcomes:

At the end of the course, students will be able to:

1. Define, comprehend, scope and significance of aquaculture
2. Acquire knowledge on taxonomy and morphology of fishes
3. Examine the types and practices of Aquaculture
4. Describe the food, feeding, growth, digestion and respiration in fishes
5. Estimate and evaluate the functions of reproduction and endocrine glands

UNIT 1. History and Scope **12 Hrs.**

History, definition, scope and significance of aquaculture, Concept of blue revolution, Aquaculture - Global and Indian Scenario. Important site selection for pond, pen and cage culture. Criteria for species selection. #Biosecurity#.

UNIT 2. General Characteristics and Taxonomy of Fishes **12 Hrs.**

General characters and Classification of fishes. Morphology and taxonomy of major fish groups. #Bioluminescence in fishes#.

UNIT 3. Types and Practices of Aquaculture **12 Hrs.**

Inland, brackishwater and mariculture. Types of ponds- nursery, rearing and stocking. Cultivable freshwater fishes- Carps, air-breathing fishes, Tilapia and #Freshwater Prawn#. Organic farming and bio flock farming of finfish and shellfish.

UNIT 4. Food, Feeding, Growth, Digestion and Respiration **12 Hrs.**

Classification based on Food and feeding habits. Scales in fishes-Placoid, Ganoid. Cycloid and Ctenoid. Digestive system. Types of gills, Structure of gill, #mechanism of gill respiration#.

UNIT 5. Reproduction and Endocrine glands **12 Hrs.**

Reproduction – ovary and testes, structure, development of primary and secondary sexual & #Sexual dimorphism in fishes#. Endocrine organs in fishes - Pituitary gland, thyroid gland, adrenal gland, Urohypophysis, pancreatic islets and pineal organs.

#..... # Self study

Text Book:

1. Jingaran, V.G.1991. Fish and Fisheries of India. Hindustan Publ.Corporation (India).

Book for References:

1. Pillay, T.V.R., 1990. Aquaculture, Principles and practices. Fishing News books Ltd. Mpeda publication.
2. Santhanam, et.al. A Manual of Freshwater Aquaculture.
3. Sustainable Aquaculture- Bardach.
4. Aquaculture- The farming and husbandary of freshwater & Marine organisms-John E. Bardach John H. Ryther, William O. McLarney.

Relationship Matrix for Course Outcomes, Programme Outcomes and Programme Specific Outcomes:

Semester	**Code**			**Title of the Paper**				**Hours**		**Credits**
I	**20DAQ1CC1**			**Principles of Aquaculture and Biology of Fishes**				**4**		**4**
Course Outcomes (COs)	Programme Outcomes (POs)					Programme Specific Outcomes (PSOs)				
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	✓	✓	✓	✓	✓		✓	✓		✓
CO2	✓	✓		✓	✓	✓		✓	✓	✓
CO3	✓	✓	✓	✓		✓		✓	✓	
CO4		✓		✓	✓		✓	✓		✓
CO5			✓			✓			✓	✓
Number of Matches= 33, Relationship : Moderate										

Prepared by: **Checked by:**

Dr. Prabakar K. *Dr. I. Joseph Antony Jerald*

Note:

Mapping	1-29%	30-59%	60-69%	70-89%	90-100%
Matches	1-14	15-29	30-34	35-44	45-50
Relationship	Very poor	Poor	Moderate	High	Very high

Semester	Code	Course	Title of the Course	Hours	Credits	Max. marks	Internal marks	External marks
I	20DAQ1CC2	General	Freshwater Aquaculture	4	4	100	25	75

Course Outcomes:

At the end of the course, students will be able to:

1. Acquire the knowledge on culture of Freshwater Fishes
2. Describe the culturable characteristics of Prawns and Molluscs; explain the economic importance of Peal oyster
3. Report the reservoir fisheries; apply integrated farming
4. Estimate water quality; evaluate nutrition in Aqua farming
5. Apply the knowledge on microbial infection, disease diagnosis and control measures

UNIT 1. Culture of Freshwater Fishes 12Hrs.

Culture of Carps-Nursery rearing and stocking ponds – composite fish culture, Preparation of ponds– different methods for the eradication of weed fishes, predators, aquatic insects and aquatic weeds, stocking and #post stocking management#. Culture of catfishes. Culture of cold water fishes in India.

UNIT 2. Prawns and Molluscs 12Hrs

Prawns - Cultivable species of freshwater prawns and their biology – Culture of *Macrobrachium rosenbergii.*

Molluscs- Important freshwater molluscs of Tamilnadu. #Freshwater pearl oyster culture# – Present status of freshwater pearl oyster culture and production in India.

UNIT 3. Reservoir Fisheries and Integrated Farming 12Hrs

Major reservoirs in India, measures for increasing production from reservoirs in India. Fish culture in ponds, cages and pens, raceways, indoor tanks, canals, silo culture, sewage-fed fish culture, monoculture, polyculture and composite fish culture. #Integrated fish farming with duck#, pig, poultry, livestock and paddy field. Recirculatory aquaculture systems.

UNIT 4. Water quality and Nutrition 12Hrs

Ecosystem-lotic-lentic-brackish water-marine environment-water-physical, chemical and biological characteristics-fish nutrition-nutritional requirements- #feed formulation# and preparation-supplementary feed- live feed- probiotics-prebiotics.

UNIT 5. Microbial infections, disease diagnosis and control measures 12Hrs

Microbial infections of Bacteria, Viruses, fungi and algae- pathogenicity and virulence-source of infection- morphological, physiological and sociological diagnosis-#microbiological water quality management#- application of drugs, chemicals and antibiotics.

#...# Self study

Text Book:

1. Jhingran, V.G. Fish and fisheries of India. Hindustan Publ. Corporation (India), 1982.

Reference Books

1. Jingaran, V.G.1991 Fish and Fisheries of India. Hindustan Publ.Corporation (India).
2. Pillay, T.V.R., 1990: Aquaculture, Principles and practices. Fishing News books Ltd.
   Mpeda publication.
3. ICAR. 2006. Hand Book of Fisheries and Aquaculture. ICAR.
4. Santhanam, R. et. Al. A Manual of Freshwater Aquaculture. Oxford & IBH Publishing Co. Pvt. Ltd., 1987.
5. Pilley, T.V.R. Aquaculture – Principles and Practices. Fishing News (Books) Ltd., London, 1990.
6. Pandey, A.C. Air Breathing Fishes. Reliance Publishing House, New Delhi, 1990.

Relationship Matrix for Course Outcomes, Programme Outcomes and Programme Specific Outcomes:

Semester	**Code**			**Title of the Paper**				**Hours**		**Credits**
I	**20DAQ1CC2**			**Freshwater Aquaculture**				**4**		**4**
Course Outcomes (COs)	Programme Outcomes (POs)					Programme Specific Outcomes (PSOs)				
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	✓	✓	✓	✓	✓		✓	✓	✓	✓
CO2	✓	✓		✓	✓	✓		✓	✓	✓
CO3	✓	✓	✓	✓		✓		✓		✓
CO4		✓		✓	✓		✓	✓		✓
CO5	✓		✓		✓	✓			✓	
Number of Matches= 35, Relationship : Moderate										

Prepared by: **Checked by:**

Dr. Prabakar K. *Dr. I. Joseph Antony Jerald*

Note:

Mapping	1-29%	30-59%	60-69%	70-89%	90-100%
Matches	1-14	15-29	30-34	35-44	45-50
Relationship	Very poor	Poor	Moderate	High	Very high

Semester	Code	Course	Title of the Course	Hours	Credits	Max. marks	Internal marks	External marks
I	20DAQ1CC3	General	Shrimp Farming	4	4	100	25	75

Course Outcomes:

At the end of the course, students will be able to:

1. Acquire knowledge on Shrimp biology and best culture practices
2. Demonstrate the different breeding techniques;explain growth promoters and live feed significance
3. Describe the various culture methods and water quality maintenance in shrimp farming
4. Analyse feeding, disease diagnosis in shrimp culture and methods of treatment
5. Apply the knowledge on harvesting, preservation and export through agencies

UNIT 1. Shrimp Biology **12Hrs**

Habit, Habitat, Life cycle and cultivable species of *Penaeus monodon and Penaeus indicus.* Developmental stages-culture based on types and #best culture practices#.

UNIT-2. Breeding and Seed Production **12Hrs**

Wild collection and breeding- hatchery practices- #eye stalk ablation# and hormone induction. Culture and use of live feed in seed production and copepods. Culture and use of polychaetes for brooder micro diets.

UNIT-3. Culture Methods **12Hrs**

Monoculture-Polyculture- Grow out ponds-pond preparation-soil culture-sampling-pre-treatment of inlet water-#water quality maintenance# – water recycling – treatment of farm effluent and sediments. Culture of shrimp-weekly growth and survival measurement.

UNIT-4. Feeding, disease, diagnosis and treatment **12Hrs**

Natural and supplementary feed-feeding ratio-artificial feed and feeding additives-feeding device - factors affecting digestibility -#nutrition deficiency diseases# - infectious diseases and diagnosis-antibiotics, drugs, chemicals and methods of treatment.

UNIT- 5. Harvesting, preservation, Export, Government Agencies **12Hrs**

Harvesting methods-precautions observed during harvesting-preservation techniques-#sorting and grading the catching fishes#-seafood export promotion and Government Agencies – ICAR institutes (CMFRI, CIFRI, CIBA & CIFA), MPEDA. Government schemes and incentives for promotion of

entrepreneurship – Pradhan Mantri Matsya Sampada Yojana, MPEDA Schemes, Tamilnadu Government schemes and subsidies to shrimp farmers.

#...# Self study

Text Book:

1. Kurien, C.V and Sebastian.V.O. 1976 Prawns and prawn Fisheries of India. Hindustan Pub.Co.

Book for References:

1. Chen, T.P. 1976 Aquaculture practices in Taiwan. Fishing News (Books) Ltd., England.
2. Pillay, T.V.R. and Dill.M.A. 1979 Advances in Aquaculture. Fishing News (Books) Ltd., England.
3. Bose, A.N. Gosh.C.T,Yong and A.Mitra, 1991 Coastal Aquaculture Engineering. Oxford & IBH Publishing company Pvt.Ltd.
4. Chakra borty . C & Sadhu A.k. 2000 – Biology hatchers and culture technology of tiger Prawn and giant freshwater Prawn, Daya publication house.

Relationship Matrix for Course Outcomes, Programme Outcomes and Programme Specific Outcomes:

Semester	**Code**			**Title of the Paper**				**Hours**		**Credits**
I	**20DAQ1CC3**			**Shrimp Farming**				**4**		**4**
Course Outcomes (COs)	Programme Outcomes (POs)					Programme Specific Outcomes (PSOs)				
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
CO2	✓	✓		✓	✓	✓		✓	✓	✓
CO3	✓	✓	✓	✓		✓	✓	✓		✓
CO4	✓	✓		✓	✓		✓	✓		✓
CO5	✓		✓		✓	✓	✓		✓	
Number of Matches= 39, Relationship : High										

Prepared by: *Dr. Prabakar K.*

Checked by: *Dr. I. Joseph Antony Jerald*

Note:

Mapping	1-29%	30-59%	60-69%	70-89%	90-100%
Matches	1-14	15-29	30-34	35-44	45-50
Relationship	Very poor	Poor	Moderate	High	Very high

Semester	Code	Course	Title of the Course	Hours	Credits	Max. marks	Internal marks	External marks
I	20DAQ1CC4P	Skill	Principles of Aquaculture and Biology of Fishes- Practical	6	6	100	20	80

Course Outcomes:

At the end of the course, students will be able to:

1. Identify commercially important fish species; acquire knowledge on pond morphometry
2. Analyse the different scales of fishes
3. Identify cultivable fishes and apply aquatic weeds
4. Analyse the alimentary canal and gut of fishes
5. Explain the functioning of different Aqua farms and report healthy practices

1. Morphometric and Meristic Characters of fish.
2. Identification of commercially important fresh water and marine fishes.
3. Types of scales, mounting of placoid, cycloid & ctenoid scales
4. Identification of Cultivable Fishes and Aquatic Weeds

A. Indigenous fishes *Catla catla , Labeo rohita* *Cirrhirus mrigala, Lates calcarifer*		**B. Exotic fishes** *Tilapia mossambica, Hypopthalmicthys molitrix, Ctenopharyngodon idella, Cypinus carpio*		**C. Migratory fishes** *Hilsa ilisha* *Anguilla anguilla*
D. Aquatic weeds				
Floating weeds	**Emergent weeds**	**Submerged weeds**	**Marginal weeds**	**Sea weeds**
Pistia	Typha	Vallisneria	Marsilia	Ulva
Lemna	Nymphaea	Hydrilla	Ipomoea	Sargassum
Eichhornia		Utricularia		Gracilaria

5. Dissections: Dissect and display of alimentary canal of fishes.
   Gut content analysis - demonstration
6. Visiting nearby aquaculture farms and dams, submission of photographs of above mentioned

fishes.

References:

T.V.R.Pillay (1990) Aquaculture: Principles and practices. Fishing news books. Cambridge University press, Cambridge. U.K.

Relationship Matrix for Course Outcomes, Programme Outcomes and Programme Specific Outcomes:

Semester	**Code**			**Title of the Paper**				**Hours**		**Credits**
I	**20DAQ1CC4P**			**Principles of Aquaculture and Biology of Fishes- Practical**				**6**		**6**
Course Outcomes (COs)	Programme Outcomes (POs)					Programme Specific Outcomes (PSOs)				
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
CO2	✓			✓	✓	✓		✓	✓	✓
CO3		✓	✓	✓		✓	✓	✓	✓	✓
CO4	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
CO5	✓			✓	✓	✓	✓		✓	
Number of Matches= 41, Relationship : High										

Prepared by: *Dr. Prabakar K.*

Checked by: *Dr. I. Joseph Antony Jerald*

Note:

Mapping	1-29%	30-59%	60-69%	70-89%	90-100%
Matches	1-14	15-29	30-34	35-44	45-50
Relationship	Very poor	Poor	Moderate	High	Very high

Semester	Code	Course	Title of the Course	Hours	Credits	Max. marks	Internal marks	External marks
I	20DAQ1CC5P	Skill	Freshwater Aquaculture-Practical	6	6	100	20	80

Course Outcomes:

At the end of the course, students will be able to:

1. Analyse water quality parameters and display the appendages of prawns
2. Calculate lime and fertilizer requirement
3. Discuss various method of culture of live feed organisms
4. Examine and estimate primary productivity
5. Apply knowledge to enhance production of breeding ponds and hatcheries

1. Analysis of water quality parameters- Turbidity, pH, Salinity, Hardness and Dissolved oxygen
2. Calculate Lime and fertilizer requirement
3. Identify of fishing accessories (Floats/Sinkers/ Shackles/Swivels/Otterboards).
4. Identification of synthetic and natural fibres.
5. Different types of hooks.
6. Fecundity estimation in Prawn and its relationship with length and weight.
7. Dissect and display of appendages of prawns.
8. Primary productivity, examine and estimate by Light and Dark bottle method.
9. Collection, identification and isolation of live feed organisms.
10. Study of disease causing microbes.
11. Visit to Manimuthar and Bhavani Sagar Dam during breeding season.
12. Visit to Freshwater Prawn farm.

Reference Book

T.V.R.Pillay (1990) Aquaculture: Principles and practices. Fishing news books. Cambridge University press, Cambridge. U.K.

Relationship Matrix for Course Outcomes, Programme Outcomes and Programme Specific Outcomes:

Semester	**Code**			**Title of the Paper**			**Hours**		**Credits**	
I	**20DAQ1CC4P**			**Principles of Aquaculture and Biology of Fishes- Practical**			**6**		**6**	
Course Outcomes (COs)	Programme Outcomes (POs)					Programme Specific Outcomes (PSOs)				
	PO1&2	PO3&4	PO5&6	PO7,8&9	PO10,11&12	PO1&2	PO3&4	PO5&6	PO7,8&9	PO10,11&12
CO1&2	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
CO3&4	✓			✓	✓			✓	✓	✓
CO5&6		✓	✓	✓			✓	✓	✓	✓
CO7, 8&9	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
CO10,11&12	✓			✓	✓	✓	✓		✓	
Number of Matches= 39, Relationship : High										

Prepared by: *Dr. Prabakar K.*

Checked by: *Dr. I. Joseph Antony Jerald*

Note:

Mapping	1-29%	30-59%	60-69%	70-89%	90-100%
Matches	1-14	15-29	30-34	35-44	45-50
Relationship	Very poor	Poor	Moderate	High	Very high

Semester	Code	Course	Title of the Course	Hours	Credits	Max. marks	Internal marks	External marks
I	20DAQ1IN	Skill	Shrimp Farming- Internship	6	6	100	-	100

Course Outcomes:

At the end of the course, students will be able to:

1. Design and construct shrimp seed farms
2. Acquire knowledge on collection and identification of commercially important shrimps
3. Record the types of fertilizers; examine pond preparation for shrimp culture.
4. Investigate pathogenic microbes affecting shrimp farms; estimate feed intake and growth monitoring
5. Formulate shrimp feed

Internship: Field Practical and Hands on Training

#1. Design and construction for shrimp seed farms.

2. Collection and identification of commercially important shrimps.

3. Types of fertilizers; pond preparation for shrimp culture.

4. Analysis of water quality parameters.

5. Estimation of feed intake and growth monitoring-FCR (Feed Conventional Ratio).

6. Study of disease causing microbes.

7. Estimation of bacterial population in water and shrimps.

8. Feed formulation and preparation of feed in the labs.

9. Flow chart study of shrimp feed manufacture.#

Students have to undergo internship in a recognized shrimp hatchery for a period of one month in different aspects of Breeding, Larval Rearing, Feed Management, Seed Management and Equipment Handling. At the end of the internship, each student has to submit a comprehensive project report (not less than 40 pages, A4 size) and present the report with the aid of PPT to the corresponding teachers. The report should be attested by the organization. Student should also produce a certificate of internship from the organization. All the above details (1-9) should be submitted to the Department for evaluation.

#....# Internship

Text Books:

1. Halver, J.E. 1989. Fish Nutrition, Academic Press, San Diego, CA.

2. NRC. Nutritional Requirements of Warm Water Fishes. National Academy of Sciences, Washington.

Book for References:

1. Kurien, C.V and Sebastian.V.O. 1976 Prawns and Prawn Fisheries of India. Hindustan Pub. Co.
2. Boyd, C.E. 1982 Water quality Management for pond fish culture. Elsevier scientific Publishing Company.
3. Srivastava, C.B.L., 1985.Textbook of fishery science and Indian Fisheries. KutubMahal Publications, Allahabad.
4. Lovell, R.T. 1998. Nutrition and feeding of fishes, Chapman & Hall, New York.
5. New, M.B. 1987. Feed and feeding of fish and shrimp. A manual on the preparation and preservation of compound feeds for shrimp and fish in aquaculture. F.A.O. Rome.
6. Sena S.De Silva, Trevor A.Anderson. 1995. Fish nutrition in aquaculture, Chapman & Hall Aquaculture Series, London.
7. Boyd, C.E. Tucker, CS, 2014, Hand Book for Aquaculture water quality.

Relationship Matrix for Course Outcomes, Programme Outcomes and Programme Specific Outcomes:

Semester	**Code**			**Title of the Paper**			**Hours**		**Credits**	
I	**20DAQ1IN**			**Shrimp Farming- Internship**			**6**		**6**	
Course Outcomes (COs)	Programme Outcomes (POs)					Programme Specific Outcomes (PSOs)				
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
CO2	✓			✓	✓			✓	✓	✓
CO3		✓	✓	✓			✓	✓	✓	✓
CO4	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
CO5	✓			✓	✓	✓	✓		✓	✓
Number of Matches= 40, Relationship : High										

Prepared by: *Dr. Prabakar K.*

Checked by: *Dr. I. Joseph Antony Jerald*

Note:

Mapping	1-29%	30-59%	60-69%	70-89%	90-100%

Matches	1-14	15-29	30-34	35-44	45-50
Relationship	Very poor	Poor	Moderate	High	Very high

Semester	Code	Course	Title of the Course	Hours	Credits	Max. marks	Internal marks	External marks
II	**20DAQ2CC6**	**General**	**Brackishwater Aquaculture and Mariculture**	**4**	**4**	**100**	**25**	**75**

Course Outcomes:

At the end of the course, students will be able to:

1. Describe brackishwater farms
2. Examine finfish culture.
3. Acquire knowledge on Crustacean culture.
4. Discuss Mariculture.
5. Investigate and apply hatchery technology for better management practices.

UNIT 1: Brackishwater Farms **12Hrs**

Introduction: History, development and present status of brackishwater farming in India. #Ecological factors – abiotic and biotic factors#. Selection of site, general planning and design of brackish water farms.

UNIT 2: Finfish Culture **12Hrs**

Brackishwater Finfish Culture: Cultivable species in brackish water systems. Culture practices – Monoculture and Polyculture of *Chanos chanos, Mugil cephalus, Lates calcarifer, Etroplus suratensis, Oreochromis mossambicus*. #Nursery#, rearing and grow out in ponds, cages and pens.

UNIT 3: Crustacean Culture **12Hrs**

Crustacean Culture: Species of shrimps cultured in brackishwater – *Penaeus mondon and Fennero Penaeus indicus.* Extensive, semi-intensive and intensive shrimp farming practices. Species of crabs (*Scylla serrata, Scylla olivacea and Charybdis* sp.), #cultured and culture techniques#- cage culture and pen culture. Species of lobsters.

UNIT 4: **Mariculture** **12Hrs**

Mariculture: Open sea farming – scope and species cultured. Selection of site for open sea farming. Different designs of open sea farming structures – #construction of cage culture# – Integrated Multi-Trophic Aquaculture (IMTA).

UNIT 5: **Hatchery Technology** **12Hrs**

Culture and use of different live feed in shellfish hatcheries; larval diseases and their management; different chemicals and drugs used; Hatchery standards and biosecurity; better management practices (BMPs); packaging and transport of seed. Quarantine and disease management in hatcheries. #Quality assessment of seeds#.

#....# Self study

Text Book:

1. Jhingwa V.A – Fish and Fisheries of India.

Books for Reference:

1.Welch, P.S. Limnology. McGrawHill, NY, 1952.

2.Ruttner, F. Fundamentals of Limnology. Translated by D.G. Frey and F.E.Fry. University of Toronto Press, 1968.

3. Kurian,C.V and Sebastian V.O. – Prawn and Prawn fisheries of India.

4. Advance in Marine and Brakishwater Aquaculture. Perumal, Santhanam A.R., Thirunavukkarasu Pachiappan, Perumal-Eds.

Relationship Matrix for Course Outcomes, Programme Outcomes and Programme Specific Outcomes:

Semester	**Code**			**Title of the Paper**			**Hours**		**Credits**	
II	**20DAQ2CC6**			**Brackishwater Aquaculture and Mariculture**			**4**		**4**	
Course Outcomes (COs)	Programme Outcomes (POs)					Programme Specific Outcomes (PSOs)				
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
CO2	✓			✓	✓					✓
CO3		✓	✓	✓			✓	✓	✓	
CO4	✓	✓	✓		✓	✓		✓		✓
CO5				✓	✓	✓	✓		✓	✓
Number of Matches= 34, Relationship : Moderate										

Prepared by: *Dr. Prabakar K.*

Checked by: *Dr. I. Joseph Antony Jerald*

Note:

Mapping	1-29%	30-59%	60-69%	70-89%	90-100%
Matches	1-14	15-29	30-34	35-44	45-50
Relationship	Very poor	Poor	Moderate	High	Very high

Semester	Code	Course	Title of the Course	Hours	Credits	Max. marks	Internal marks	External marks
II	20DAQ2CC7	General	Ornamental Fish Culture and Aquarium Keeping	4	4	100	25	75

Course Outcomes:

At the end of the course, students will be able to:

1. Design aquarium keeping; acquire knowledge on aquarium accessories
2. Describe management of aquarium
3. Explain freshwater ornamental fishes and feed formulation
4. Discuss methods for rearing marine ornamental fishes and disease management
5. Report commercial production of ornamental fishes, their disease control and apply marketing strategy

UNIT 1: Aquarium Keeping **12 Hrs.**

Aquarium design and Construction: Introduction to aquarium. World aquarium trade and present status. Design and construction of home and public aquaria (freshwater and marine), oceanarium. Aquarium accessories - Aerators, filters (different types) and lighting. #Water quality requirements#.

UNIT 2: Aquarium Management **12 Hrs.**

Aquarium Management: Setting up of aquarium – under gravel filter, pebbles, plants, drift wood, ornamental objects and selection of fishes, #Aquarium maintenance and water quality management#. Control of algal growth. Handling, care, packing and transportation of fishes - Use of anesthetics. Temperature acclimation.

UNIT 3: Freshwater Ornamental Fishes and Feed **12 Hrs.**

Freshwater Ornamental Fishes: Species of ornamental fishes - Live bearers, Gold fish and koi, Gourami, Barbs and Tetras, angel fish, cichlids. Breeding habits, spawning, fertilization and #development of eggs#. Hatching, larval rearing and their health management. Food and feeding. Live feed. Micro diets and probiotics. Freshwater plants- exotic and indigenous

UNIT 4. Marine Ornamental Fishes and Diseases **12 Hrs.**

Marine ornamental fishes – varieties and their habitat. Major marine ornamental fish resources of India. Method of collection of live fish. Breeding of marine ornamental fishes (clown fishes and Damsel fishes). Marine live feed. #Reef aquarium# and live rocks#. Infections bacterial, viral, parasitic and mycotic diseases. Quarantine tanks - prophylaxis – vaccines and immune stimulants.

UNIT 5: Commercial Production and Economics **12 Hrs.**

Commercial Production: Requirements and design for the commercial production of ornamental fishes. Commercial production of goldfish, live bearers, #gouramies#, barbs and tetras, angel fish. Natural ponds for the mass production of ornamental fishes. Mass production of live feeds and live feed value additions. Mass production of aquarium plants. Pet shops and fish dealers.

#...# Self study

Text Book:

1. Biswas. S.P., J.N.Das, U.K.Sarkar and Lakra W.S. 2007 Ornamental fishes of North East India an Atlas: NBFGR

Book for References:

1. Yadav, B.N 2006. Fish and fisheries 4th edition. Daya publishing House.
2. Stickney, R.R.1979 Principles of Aquaculture. John wiley & Sons, NY
3. Axelrod, H.R., 1967.Breeding aquarium fishes. TFH publications Inc. England.
4. Srivastava, C.B.L., 1985.Textbook of fishery scienceand Indian Fisheries. Kutub Mahal Publications, Allahabad.
5. Thabrow De, W.V. 1981.Popular aquarium plants. Thornbill Press.UK.
6. Madhusoodanakurup. *et al,* ornamental fish – breeding, farming and trade.

Relationship Matrix for Course Outcomes, Programme Outcomes and Programme Specific Outcomes:

Semester	**Code**			**Title of the Paper**			**Hours**		**Credits**	
II	**20DAQ2CC6**			**Ornamental Fish Culture and Aquarium Keeping**			**4**		**4**	
Course Outcomes (COs)	Programme Outcomes (POs)					Programme Specific Outcomes (PSOs)				
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
CO2	✓	✓		✓	✓	✓		✓		✓
CO3		✓	✓	✓	✓		✓	✓	✓	✓
CO4	✓	✓	✓		✓	✓		✓		✓
CO5	✓			✓	✓	✓	✓		✓	✓
Number of Matches= 39, Relationship : High										

Prepared by: *Dr. Prabakar K.*

Checked by: *Dr. I. Joseph Antony Jerald*

Note:

Mapping	1-29%	30-59%	60-69%	70-89%	90-100%
Matches	1-14	15-29	30-34	35-44	45-50
Relationship	Very poor	Poor	Moderate	High	Very high

Semester	Code	Course	Title of the Course	Hours	Credits	Max. marks	Internal marks	External marks
II	20DAQ2CC8	General	Aquaculture Farm Management and Aquatic Nutrition & Animal Health	4	4	100	25	75

Course Outcomes:

At the end of the course, students will be able to:

1. Observe aquaculture systems and apply farm management
2. Acquire knowledge on culture phases and management practices
3. Explain the various feed formulation for better nutritioning
4. Identify causes and diagnosis of non-infectious diseases and the influencing environmental factors
5. Describe the harvest techniques and by-products

UNIT: 1 Aquaculture System **12 Hrs**

Study the Scope & importance of Aquaculture in India. Systems of aquaculture: pond culture, pen culture, cage culture, running water culture and #zero water exchange system#. Pre-stocking and post-stocking pond management; Soil and water quality standards. Wintering ponds, quarantine ponds and isolation ponds.

UNIT 2: Culture phases and Management practices **12 Hrs**

Nursery, rearing and grow- out pond preparation; Management: control of aquatic weeds, algal blooms, predatory and weed fishes; management practices: Liming, #fertilization/manuring#, use of biofertilizers, supplementary feeding and water quality management. Selection, safety, hygiene, and Sanitation.

UNIT 3. Nutrition and Feed formulation **12 Hrs**

Nutrient sources. proteins, lipids, carbohydrates, vitamins, minerals and their role in fish and shellfish nutrition. Fish feed ingredients. Types of feed.-Animal, plant and microbial origin, #SCP#, compound feed, pellets, scrambles and micro encapsulated feed.

UNIT 4: Health Management **12 Hrs**

Symptoms and diagnosis- prevention and treatment- EHNV, KHV, SVCV, VNNV- white spot and Taura syndrome. Nutritional diseases- Environmental parameters and their effect on fish health diseases in hatchery- Vaccines and adjuvant. #Fish health and quarantine system#.

UNIT 5: Harvesting Technology **12 Hrs**

Methods and importance of fish preservation- Icing, Freezing, Cold storage, Drying, Salting, Smoking, Canning and #Fish Pickling#. Fish product and By-product: Fish Oil, Fish liver oil, Fish meal, Fish manure, Fish flour, fish glue and isinglass. Quality control, Factory sanitation and personal hygiene,

#...# Self study

Text Book:

1. ICAR. 2006. Hand Book of Fisheries and Aquaculture. ICAR.

Books for Reference:

1. Bose AN,Ghosh SN, Yang CT & Mitra A. 1991. *Coastal Aquaculture Engineering*. E. Arnold.
2. Ivar LO. 2007. *Aquaculture Engineering*. Daya Publ. House.
3. Lawson TB. 1997. *Fundamentals of Aquaculture Engineering*. CBS.
4. Wheaton EW. 1970. *Aquaculture Engineering*. Wiley-Interscience.
5. Arup Kumar Sadhu & Chiranjib Chakraborty – Biology, hatchery and culture technology of tiger prawn and giant freshwater prawn.
6. FAO. 1992. Manual of Seed Production of Carps. FAO Publ.
7. Jhingran VG & Pullin RSV. 1985. Hatchery Manual for the Common, Chinese and Indian Major Carps. ICLARM, Philippines.
8. Mcvey JP. 1983. Handbook of Mariculture. CRC Press.
9. Thomas PC, Rath SC & Mohapatra KD. 2003. Breeding and Seed Production of Finfish and Shellfish. Daya Publ.
10. FAO. 2007. Manual for Operating a Small Scale Recirculation Freshwater Prawn Hatchery.

Relationship Matrix for Course Outcomes, Programme Outcomes and Programme Specific Outcomes:

Semester	**Code**			**Title of the Paper**			**Hours**		**Credits**	
II	**20DAQ2CC7**			**Aquaculture Farm Management and Aquatic Nutrition & Animal Health**			**4**		**4**	
Course Outcomes (COs)	Programme Outcomes (POs)					Programme Specific Outcomes (PSOs)				
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	✓	✓	✓	✓	✓		✓		✓	✓
CO2	✓			✓	✓	✓		✓		✓
CO3		✓	✓	✓	✓		✓	✓	✓	
CO4	✓	✓	✓			✓		✓		✓
CO5	✓			✓	✓	✓	✓		✓	
Number of Matches= 33, Relationship : Moderate										

Prepared by: *Dr. Prabakar K.*

Checked by: *Dr. I. Joseph Antony Jerald*

Note:

Mapping	1-29%	30-59%	60-69%	70-89%	90-100%

Matches	1-14	15-29	30-34	35-44	45-50
Relationship	Very poor	Poor	Moderate	High	Very high

Semester	Code	Course	Title of the Course	Hours	Credits	Max. marks	Internal marks	External marks
II	**20DAQ2CC9P**	**Skill**	**Brackishwater Aquaculture and Mariculture - Practical**	**6**	**6**	**100**	**20**	**80**

Course Outcomes:

At the end of the course, students will be able to:

1. Analyse water quality parameters
2. Explain the procedure for soil analysis
3. Identify the marine and brackish water shrimps.
4. Design infra-structure for cultivating Aquaculture products
5. Acquire and apply knowledge on breeding ponds and hatcheries of finfish and shellfish

I. Analysis of water quality parameters(Brackishwater/Marine water) by D.O, Free CO_2, Total alkalinity, Total Hardness, Salinity, Organic Carbon, Nitrogen, Phosphate, Sulphate and Chloride.

II. Analysis of Soil parameters: pH, Nitrate, Potassium and Organic Carbon.

III. Biology and Identification of shrimps (Marine/Brackish water)

1. *Penaeus monodon*
2. *Fennero Penaeus. indicus*

IV. Biology and Identification of crabs

1. *Scylla serrata*
2. *S. olivacea*

V. Designing of different farming system – Ponds, cages and pens,

VI. Visiting finfish and shellfish hatcheries.

Book for References:

1. Shankar KM & Mohan CU 2002. Fish and shell fish health management UNESCO publ.
2. Srivastava. C.B.L. 1985 Text book of Fishery science and Indian Fisheries. Kitab Mahal publications.

Relationship Matrix for Course Outcomes, Programme Outcomes and Programme Specific Outcomes:

Semester	Code			Title of the Paper			Hours		Credits	
II	**20DAQ2CC9P**			**Brackishwater Aquaculture and Mariculture - Practical**			**4**		**4**	
Course Outcomes (COs)	Programme Outcomes (POs)					Programme Specific Outcomes (PSOs)				
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	✓	✓	✓	✓	✓		✓		✓	✓
CO2	✓			✓	✓	✓	✓	✓		✓
CO3	✓	✓	✓	✓	✓		✓	✓	✓	
CO4	✓	✓	✓			✓		✓		✓
CO5	✓		✓	✓	✓	✓	✓	✓	✓	✓
Number of Matches= 38, Relationship : High										

Prepared by: **Checked by:**

Mapping	1-29%	30-59%	60-69%	70-89%	90-100%

Matches	1-14	15-29	30-34	35-44	45-50
Relationship	Very poor	Poor	Moderate	High	Very high

Dr. Prabakar K. *Dr. I. Joseph Antony Jerald*

Semester	Code	Course	Title of the Course	Hours	Credits	Max. marks	Internal marks	External marks
II	**20DAQ2CC10P**	**Skill**	**Ornamental Fish Culture and Aquarium Keeping -Practical**	**6**	**6**	**100**	**20**	**80**

Course Outcomes:

At the end of the course, students will be able to:

1. Describe and identify the characters of commercially important ornamental fishes
2. Explain the procedure for transportation fish and feed preparation
3. Identify the diagnosing procedure for ornamental fish diseases
4. Construct aquarium and analyse water quality parameters
5. Access the role of pathogenic microbes on ornamental fish diseases

1. Identification of common Freshwater, Brackishwater and Marine aquarium fishes.
3. Construction of glass aquarium. 4. Setting up of aquarium (maintained by students can be evaluated after one month). 5. Water quality management in aquariums.6. Preparation of feed for ornamental fishes. 7. Aquarium plants and decor materials.8. Air pump and biological filter. 9. Breeding of live bearers- Guppy. 10. Breeding of egg layers- Gold fish and Zebra fish.11. Breeding of bubble nest builder- Gourami. 12. Identification of live feed organisms. 13. Treatment dose calculation for ornamental fish diseases. 14. Visit to an ornamental fish farm.15. Visit to an aquarium shop.

Book for References:

1. Axelrod, H.R., 1967.Breeding aquarium fishes. TFH publications Inc. England.

Relationship Matrix for Course Outcomes, Programme Outcomes and Programme Specific Outcomes:

Semester	Code			Title of the Paper			Hours		Credits	
I	20DAQ2CC11P			Ornamental Fish Culture and Aquarium Keeping -Practical			6		6	
Course Outcomes (COs)	Programme Outcomes (POs)					Programme Specific Outcomes (PSOs)				
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	✓	✓	✓	✓	✓		✓		✓	✓
CO2	✓			✓	✓	✓	✓	✓		✓
CO3	✓	✓	✓	✓	✓		✓	✓	✓	
CO4	✓	✓	✓		✓	✓		✓		✓
CO5	✓		✓	✓	✓	✓	✓	✓	✓	✓
Number of Matches= 39, Relationship : High										

Prepared by: *Dr. Prabakar K.*

Checked by: *Dr. I. Joseph Antony Jerald*

Note:

Mapping	1-29%	30-59%	60-69%	70-89%	90-100%

Matches	1-14	15-29	30-34	35-44	45-50
Relationship	Very poor	Poor	Moderate	High	Very high

Semester	Code	Course	Title of the Course	Hours	Credits	Max. marks	Internal marks	External marks
I	**20DAQ2IN**	**Skill**	**Aquaculture Farm Management and Aquatic Nutrition & Animal Health - Internship**	**6**	**6**	**100**	**-**	**100**

Course Outcomes:

At the end of the course, students will be able to:

1. Acquire knowledge on management of nursery and grow-out pond; identify the major live feed organisms
2. Access manuring and fertilization; Hydrobiology of pond and examine growth of finfish and shellfish
3. Discuss the control of aquatic weeds, insects and predatory fishes
4. Design and explain working of hatchery; apply farm laboratory equipments use
5. Evaluate the preparation of fishery by products

Internship: Field Practical

#1. Preparation and management of nursery, rearing and grow-out pond.
2. Study on effect of liming on hydrobiology of pond.
3. Study on effect of manuring and fertilization on hydrobiology of pond and growth of fin fish and shellfish.
4. Collection, identification and control of aquatic weeds.
5. Collection, identification and control of aquatic insects.
6. Collection, identification and control of predatory fishes.
7. Collection, identification and control of weed fishes and eggs and larval forms of fishes.
8. Algal blooms and their control.
9. Practices on pre-stocking management and Post-stocking management.
10. Hatchery and farm layout installation and operation of hatchery farm laboratory equipments.
11. Identification of major live feeds –Phytoplankton, Zooplankton, Green algae, diatoms, microalgae, Rotifers, Daphnia, Moina , Artemia and Copepods.
12. Induced breeding in Fish and shrimps (demonstration)
13. Preparation of fishery by products
14. Field visit to finfish, shrimp, fish culture ponds, feed mill, aquatic health laboratory and fish processing industry.#

Students have to undergo internship in a recognized shrimp hatchery for a period of one month in different aspects of Breeding, Larval Rearing, Feed Management, Seed Management and Equipment Handling. At the end of the internship, each student has to submit a comprehensive project report (not less than 40 pages, A4 size) and present the report with the aid of PPT to the corresponding teachers. The report should be attested by the organization. Student should also produce a certificate of

internship from the organization. All the above details (1-13) should be submitted to the Department for evaluation.

#....# Internship

Text Book:

1. Jhingran, V.G. 1998. Fish and Fisheries of India. Hindustan Publishing Corporation, New Delhi.

Books for References:

1. Huet Marcel. 1972. Text book of fish culture. Oxford Fishing news books.
2. Santhanam, R., Sukumaran, N. and Natarajan, P. 1987. A manual of Aquaculture. Oxford- IBH, New Delhi.
3. Srivatsava. 1993. Freshwater Aquaculture in India, Oxford and IBH Publishing Co.Pvt.Ltd., New Delhi.

Relationship Matrix for Course Outcomes, Programme Outcomes and Programme Specific Outcomes:

Semester	**Code**			**Title of the Paper**			**Hours**		**Credits**	
I	**20DAQ2IN**			**Aquaculture Farm Management and Aquatic Nutrition & Animal Health - Internship**			**6**		**6**	
Course Outcomes (COs)	Programme Outcomes (POs)					Programme Specific Outcomes (PSOs)				
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
CO2	✓			✓	✓			✓	✓	✓
CO3		✓	✓	✓			✓	✓	✓	✓
CO4	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
CO5	✓			✓	✓	✓	✓		✓	✓
Number of Matches= 40, Relationship : High										

Prepared by: *Dr. Prabakar K.*

Checked by: *Dr. I. Joseph Antony Jerald*

Note:

Mapping	1-29%	30-59%	60-69%	70-89%	90-100%
Matches	1-14	15-29	30-34	35-44	45-50
Relationship	Very poor	Poor	Moderate	High	Very high

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25.11.2020