

DEPARTMENT OF ZOOLOGY

COURSE STRUCTURE & SYLLABI
(For the students admitted from year 2023-2024 onwards)

Programme: DIPLOMA IN AQUACULTURE



JAMAL MOHAMED COLLEGE (AUTONOMOUS)
Accredited with A++ Grade by NAAC (4th Cycle) with CGPA 3.69 out of 4.0
(Affiliated to Bharathidasan University)
TIRUCHIRAPPALLI – 620 020

DIPLOMA IN AQUACULTURE

[National Skill Development Corporation (NSDC) & Agriculture Skill Council of India (ASCI) - LEVELS OF ASSESSMENT (4 & 5)]

Sem	Course Code	Part	Course	Course Title	Total Hours	Credit	Marks		
							CIA	ESE	Total
I	23DAQ1CC1	I	General	Principles of Aquaculture and Biology of Fishes	60	4	25	75	100
	23DAQ1CC2	I	General	Freshwater Aquaculture	60	4	25	75	100
	23DAQ1CC3	I	General	Shrimp Farming	60	4	25	75	100
	23DAQ1CC4P	II	Skill	Principles of Aquaculture and Biology of Fishes - Practical	180	6	20	80	100
	23DAQ1CC5P	II	Skill	Freshwater Aquaculture - Practical	180	6	20	80	100
	23DAQ1IN	III	Skill	Shrimp Farming - Internship	180	6	-	100	100
Total					720	30	115	485	600
Exit Qualification: Certificate NSQF Level: 4 Exit Qualification Pack: Shrimp Farmer Landscaper AGR/Q4902									
II	23DAQ2CC6	I	General	Brackishwater Aquaculture and Mariculture	60	4	25	75	100
	23DAQ2CC7	I	General	Ornamental Fish Culture and Aquarium Keeping	60	4	25	75	100
	23DAQ2CC8	I	General	Aquaculture Farm Management and Aquatic Nutrition & Animal Health	60	4	25	75	100
	23DAQ2CC9P	II	Skill	Brackishwater Aquaculture and Mariculture - Practical	180	6	20	80	100
	23DAQ2CC10P	II	Skill	Ornamental Fish Culture and Aquarium Keeping - Practical	180	6	20	80	100
	23DAQ2IN	III	Skill	Aquaculture Farm Management and Aquatic Nutrition & Animal Health - Internship	180	6	-	100	100
Total					720	30	115	485	600
Grand Total					1440	60	230	970	1200
Exit Qualification: Diploma NSQF Level: 5 Exit Qualification Pack: Fish Seed Grower AGR/Q4908 Aquarium Technician AGR/Q5108 Aquaculture Technician AGR/Q4903									

Semester	Course Code	Course Category	Total Hours	Credits	Marks for Evaluation		
					CIA	ESE	Total
I	23DAQ1CC1	General	60	4	25	75	100

Course Title	Principles of Aquaculture and Biology of Fishes
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SYLLABUS		
Unit	Contents	Hours
I	History and Scope 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*.	12
II	General Characteristics and Taxonomy of Fishes General characters and Classification of fishes. Morphology and taxonomy of major fish groups. *Bioluminescence in fishes*.	12
III	Types and Practices of Aquaculture 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.	12
IV	Food, Feeding, Growth, Digestion and Respiration 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*.	12
V	Reproduction and Endocrine glands 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.	12

..... Self Study

Text Book(s):
1. Jingaran, V.G.1991. Fish and Fisheries of India. Hindustan Publ. Corporation (India).
Reference Book(s):
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.

Course Outcomes	
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Upon successful completion of this course, the student will be able to:	
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CO No.	CO Statement
CO1	Define, comprehend, scope and significance of aquaculture
CO2	Acquire knowledge on taxonomy and morphology of fishes
CO3	Examine the types and practices of Aquaculture
CO4	Describe the food, feeding, growth, digestion and respiration in fishes
CO5	Estimate and evaluate the functions of reproduction and endocrine glands

Course Coordinator: Dr. K. Prabakar

Semester	Course Code	Course Category	Total Hours	Credits	Marks for Evaluation		
					CIA	ESE	Total
I	23DAQ1CC2	General	60	4	25	75	100

Course Title	Freshwater Aquaculture
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SYLLABUS		
Unit	Contents	Hours
I	<p>Culture of Freshwater Fishes</p> <p>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.</p>	12
II	<p>Prawns and Molluscs</p> <p>Prawns - Cultivable species of freshwater prawns and their biology – Culture of <i>Macrobrachium rosenbergii</i>.</p> <p>Molluscs- Important freshwater molluscs of Tamilnadu. *Freshwater pearl oyster culture* – Present status of freshwater pearl oyster culture and production in India.</p>	12
III	<p>Reservoir Fisheries and Integrated Farming</p> <p>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.</p>	12
IV	<p>Water quality and Nutrition</p> <p>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.</p>	12
V	<p>Microbial infections, disease diagnosis and control measures</p> <p>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.</p>	12

** Self Study

Text Book(s):
1. Jhingran, V.G. Fish and fisheries of India. Hindustan Publ. Corporation (India), 1982.
Reference Book(s):
1. Jhingran, 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.

Course Outcomes	
Upon successful completion of this course, the student will be able to:	
CO No.	CO Statement
CO1	Acquire the knowledge on culture of Freshwater Fishes
CO2	Describe the culturable characteristics of Prawns and Molluscs; explain the economic importance of Peal oyster
CO3	Report the reservoir fisheries; apply integrated farming
CO4	Estimate water quality; evaluate nutrition in Aqua farming
CO5	Apply the knowledge on microbial infection, disease diagnosis and control measures

Course Coordinator: *Dr. Prabakar K.*

Semester	Course Code	Course Category	Total Hours	Credits	Marks for Evaluation		
					CIA	ESE	Total
I	23DAQ1CC3	General	60	4	25	75	100

Course Title	Shrimp Farming
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SYLLABUS		
Unit	Contents	Hours
I	Shrimp Biology Habit, Habitat, Life cycle and cultivable species of <i>Penaeus monodon</i> and <i>Penaeus indicus</i> . Developmental stages-culture based on types and *best culture practices*.	12
II	Breeding and Seed Production 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.	12
III	Culture Methods 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.	12
IV	Feeding, disease, diagnosis and treatment 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.	12
V	. Harvesting, preservation, Export, Government Agencies 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.	12

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Text Book(s):
Kurien, C.V and Sebastian.V.O. 1976 Prawns and prawn Fisheries of India. Hindustan Pub.Co.

Reference Book(s):

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.

Course Outcomes

Upon successful completion of this course, the student will be able to:

CO No.	CO Statement
CO1	Acquire knowledge on Shrimp biology and best culture practices
CO2	Demonstrate the different breeding techniques;explain growth promoters and live feed significance
CO3	Describe the various culture methods and water quality maintenance in shrimp farming
CO4	Analyse feeding, disease diagnosis in shrimp culture and methods of treatment
CO5	Apply the knowledge on harvesting, preservation and export through agencies

Course Coordinator: *Dr. Prabakar K*

Semester	Course Code	Course Category	Total Hours	Credits	Marks for Evaluation		
					CIA	ESE	Total
I	23DAQ1CC4P	Skill	180	6	20	80	100

Course Title	Principles of Aquaculture and Biology of Fishes - Practical
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SYLLABUS					
Unit	Contents				Hours
	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 <i>Catla catla</i> , <i>Labeo rohita</i> <i>Cirrhirus mrigala</i> , <i>Lates calcarifer</i>	B. Exotic fishes <i>Tilapia mossambica</i> , <i>Hypophthalmichthys molitrix</i> , <i>Ctenopharyngodon idella</i> , <i>Cyprinus carpio</i>		C. Migratory fishes <i>Hilsa ilisha</i> <i>Anguilla anguilla</i>	
	D. Aquatic weeds				180
	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.				

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

Course Outcomes	
Upon successful completion of this course, the student will be able to:	
CO No.	CO Statement
CO1	Identify commercially important fish species; acquire knowledge on pond morphometry
CO2	Analyse the different scales of fishes
CO3	Identify cultivable fishes and apply aquatic weeds
CO4	Analyse the alimentary canal and gut of fishes
CO5	Explain the functioning of different Aqua farms and report healthy practices

Course Coordinator: Dr. Prabakar K

Semester	Course Code	Course Category	Total Hours	Credits	Marks for Evaluation		
					CIA	ESE	Total
I	23DAQ1CC5P	Skill	180	6	20	80	100

Course Title	Freshwater Aquaculture - Practical
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SYLLABUS		
Unit	Contents	Hours
	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.	180

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

Course Outcomes	
Upon successful completion of this course, the student will be able to:	
CO No.	CO Statement
CO1	Analyse water quality parameters and display the appendages of prawns
CO2	Calculate lime and fertilizer requirement
CO3	Discuss various method of culture of live feed organisms
CO4	Examine and estimate primary productivity
CO5	Apply knowledge to enhance production of breeding ponds and hatcheries

Course Coordinator: Dr. Prabakar K.

Semester	Course Code	Course Category	Total Hours	Credits	Marks for Evaluation		
					CIA	ESE	Total
I	23DAQ1IN	Skill	180	6	--	100	100

Course Title	Shrimp Farming - Internship
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SYLLABUS		
Unit	Contents	Hours
	<p><u>Internship: Field Practical and Hands on Training</u></p> <ol style="list-style-type: none"> Design and construction for shrimp seed farms. Collection and identification of commercially important shrimps. Types of fertilizers; pond preparation for shrimp culture. Analysis of water quality parameters. Estimation of feed intake and growth monitoring-FCR (Feed Conventional Ratio). Study of disease causing microbes. Estimation of bacterial population in water and shrimps. Feed formulation and preparation of feed in the labs. Flow chart study of shrimp feed manufacture. <p><i>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.</i></p>	180

Text Book(s):
<ol style="list-style-type: none"> Halver, J.E. 1989. Fish Nutrition, Academic Press, San Diego, CA. NRC. Nutritional Requirements of Warm Water Fishes. National Academy of Sciences, Washington.

Reference Book(s):

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.

Course Outcomes

Upon successful completion of this course, the student will be able to:

CO No.	CO Statement
CO1	Design and construct shrimp seed farms
CO2	Acquire knowledge on collection and identification of commercially important shrimps
CO3	Record the types of fertilizers; examine pond preparation for shrimp culture.
CO4	Investigate pathogenic microbes affecting shrimp farms; estimate feed intake and growth monitoring
CO5	Formulate shrimp feed

Course Coordinator: *Dr. Prabakar K.*

Semester	Course Code	Course Category	Total Hours	Credits	Marks for Evaluation		
					CIA	ESE	Total
II	23DAQ2CC6	General	60	4	25	75	100

Course Title	Brackishwater Aquaculture and Mariculture
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SYLLABUS		
Unit	Contents	Hours
I	Brackishwater Farms 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.	12
II	Finfish Culture Brackishwater Finfish Culture: Cultivable species in brackish water systems. Culture practices – Monoculture and Polyculture of <i>Chanos chanos</i> , <i>Mugil cephalus</i> , <i>Lates calcarifer</i> , <i>Etroplus suratensis</i> , <i>Oreochromis mossambicus</i> . *Nursery*, rearing and grow out in ponds, cages and pens.	12
III	Crustacean Culture Crustacean Culture: Species of shrimps cultured in brackishwater – <i>Penaeus mondon</i> and <i>Fennero Penaeus indicus</i> . Extensive, semi-intensive and intensive shrimp farming practices. Species of crabs (<i>Scylla serrata</i> , <i>Scylla olivacea</i> and <i>Charybdis</i> sp.), *cultured and culture techniques*- cage culture and pen culture. Species of lobsters.	12
IV	Mariculture 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).	12
V	Hatchery Technology 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*.	12

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Text Book(s):
Jhingwa V.A – Fish and Fisheries of India.

Reference Book(s):
<p>1. Welch, P.S. Limnology. McGrawHill, NY, 1952.</p> <p>2. Ruttner, F. Fundamentals of Limnology. Translated by D.G. Frey and F.E. Fry. University of Toronto Press, 1968.</p> <p>3. Kurian, C.V and Sebastian V.O. – Prawn and Prawn fisheries of India.</p> <p>4. Advance in Marine and Brackishwater Aquaculture. Perumal, Santhanam A.R., Thirunavukkarasu Pachiappan, Perumal-Eds.</p>
Web Resource(s):

Course Outcomes	
Upon successful completion of this course, the student will be able to:	
CO No.	CO Statement
CO1	Describe brackishwater farms
CO2	Examine finfish culture.
CO3	Acquire knowledge on Crustacean culture.
CO4	Discuss Mariculture.
CO5	Investigate and apply hatchery technology for better management practices.

Course Coordinator: *Dr. Prabakar K*

Semester	Course Code	Course Category	Total Hours	Credits	Marks for Evaluation		
					CIA	ESE	Total
II	23DAQ2CC7	General	60	4	25	75	100

Course Title	Ornamental Fish Culture and Aquarium Keeping
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SYLLABUS		
Unit	Contents	Hours
I	Aquarium Keeping 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*.	12
II	Aquarium Management 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.	12
III	Freshwater Ornamental Fishes and Feed 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	12
IV	Marine Ornamental Fishes and Diseases 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	12
V	Commercial Production and Economics 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.	12

..... Self Study

Text Book(s):	
1. Biswas. S.P., J.N.Das, U.K.Sarkar and Lakra W.S. 2007 Ornamental fishes of North East India an Atlas: NBFGR	
Reference Book(s):	
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 science and Indian Fisheries. Kutub Mahal Publications, Allahabad.
5.	Thabrow De, W.V. 1981.Popular aquarium plants. Thornbill Press.UK.
6.	Madhusoodanakurup. <i>et al</i> , ornamental fish – breeding, farming and trade.

Course Outcomes	
Upon successful completion of this course, the student will be able to:	
CO No.	CO Statement
CO1	Design aquarium keeping; acquire knowledge on aquarium accessories
CO2	Describe management of aquarium
CO3	Explain freshwater ornamental fishes and feed formulation
CO4	Discuss methods for rearing marine ornamental fishes and disease management
CO5	Report commercial production of ornamental fishes, their disease control and apply marketing strategy

Course Coordinator: Dr. Prabakar K.

Semester	Course Code	Course Category	Total Hours	Credits	Marks for Evaluation		
					CIA	ESE	Total
II	23DAQ2CC8	General	60	4	25	75	100

Course Title	Aquaculture Farm Management and Aquatic Nutrition & Animal Health
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SYLLABUS		
Unit	Contents	Hours
I	Aquaculture System 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.	12
II	Culture phases and Management practices 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.	12
III	Nutrition and Feed formulation 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.	12
IV	Health Management 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*.	12
V	Harvesting Technology 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,	12

..... Self Study

Text Book(s):
1. ICAR. 2006. Hand Book of Fisheries and Aquaculture. ICAR.
Reference Book(s):
<ol style="list-style-type: none"> 1. Bose AN, Ghosh SN, Yang CT & Mitra A. 1991. <i>Coastal Aquaculture Engineering</i>. E. Arnold. 2. Ivar LO. 2007. <i>Aquaculture Engineering</i>. Daya Publ. House. 3. Lawson TB. 1997. <i>Fundamentals of Aquaculture Engineering</i>. CBS. 4. Wheaton EW. 1970. <i>Aquaculture Engineering</i>. 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.

Course Outcomes	
Upon successful completion of this course, the student will be able to:	
CO No.	CO Statement
CO1	Observe aquaculture systems and apply farm management
CO2	Acquire knowledge on culture phases and management practices
CO3	Explain the various feed formulation for better nutritioning
CO4	Identify causes and diagnosis of non-infectious diseases and the influencing environmental factors
CO5	Describe the harvest techniques and by-products

Course Coordinator: Dr. Prabakar K.

Semester	Course Code	Course Category	Total Hours	Credits	Marks for Evaluation		
					CIA	ESE	Total
II	23DAQ2CC9P	Skill	180	6	20	80	100

Course Title	Brackishwater Aquaculture and Mariculture - Practical
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SYLLABUS		
Unit	Contents	Hours
	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.	180
	II. Analysis of Soil parameters: pH, Nitrate, Potassium and Organic Carbon.	
	III. Biology and Identification of shrimps (Marine/Brackish water)	
	1. <i>Penaeus monodon</i>	
	2. <i>Fennero Penaeus. Indicus</i>	
	IV. Biology and Identification of crabs	
	1. <i>Scylla serrata</i>	
	2. <i>S. olivacea</i>	
	V. Designing of different farming system – Ponds, cages and pens,	
	VI. Visiting finfish and shellfish hatcheries.	

Text Book(s):
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.

Course Outcomes	
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Upon successful completion of this course, the student will be able to:	
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CO No.	CO Statement
CO1	Analyse water quality parameters
CO2	Explain the procedure for soil analysis
CO3	Identify the marine and brackish water shrimps.
CO4	Design infra-structure for cultivating Aquaculture products
CO5	Acquire and apply knowledge on breeding ponds and hatcheries of finfish and shellfish

Course Coordinator: *Dr. Prabakar K.*

Semester	Course Code	Course Category	Total Hours	Credits	Marks for Evaluation		
					CIA	ESE	Total
II	23DAQ2CC10P	Skill	180	6	20	80	100

Course Title	Ornamental Fish Culture and Aquarium Keeping - Practical
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SYLLABUS		
Unit	Contents	Hours
	1. Identification of common Freshwater, 2. 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.	180

Text Book(s):
Axelrod, H.R., 1967. Breeding aquarium fishes. TFH publications Inc. England.
Reference Book(s):
Axelrod, H.R., 1967. Breeding aquarium fishes. TFH publications Inc. England.

Course Outcomes	
Upon successful completion of this course, the student will be able to:	
CO No.	CO Statement
CO1	Describe and identify the characters of commercially important ornamental fishes
CO2	Explain the procedure for transportation fish and feed preparation
CO3	Identify the diagnosing procedure for ornamental fish diseases
CO4	Construct aquarium and analyse water quality parameters
CO5	Access the role of pathogenic microbes on ornamental fish diseases

Course Coordinator: Dr. Prabakar K.

Semester	Course Code	Course Category	Total Hours	Credits	Marks for Evaluation		
					CIA	ESE	Total
II	23DAQ2IN	Skill	180	6	--	100	100

Course Title	Aquaculture Farm Management and Aquatic Nutrition & Animal Health - Internship
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SYLLABUS		
Unit	Contents	Hours
	<p>Internship: Field Practical</p> <ol style="list-style-type: none"> 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. <p><i>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.</i></p>	180

Text Book(s):
1. Jhingran, V.G. 1998. Fish and Fisheries of India. Hindustan Publishing Corporation, New Delhi.
Reference Book(s):
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.

Course Outcomes	
Upon successful completion of this course, the student will be able to:	
CO No.	CO Statement
CO1	Acquire knowledge on management of nursery and grow-out pond; identify the major live feed organisms
CO2	Access manuring and fertilization; Hydrobiology of pond and examine growth of finfish and shellfish
CO3	Discuss the control of aquatic weeds, insects and predatory fishes
CO4	Design and explain working of hatchery; apply farm laboratory equipments use
CO5	Evaluate the preparation of fishery by products

Course Coordinator: *Dr. Prabakar K.*