

ASD GOVT. DEGREE COLLEGE FOR WOMEN (A)

(Re- Accredited by NAAC with B Grade)

Jagannaickpur, Kakinada, East Godavari, AP – 533002

DEPARTMENT OF ZOOLOGY & AQUACULTURE TECHNOLOGY

AQUACULTURE TECHNOLOGY



2023-2024

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AQUACULTURE TECHNOLOGY

SEMESTER: III PAPER-III (2023-2024)

FISH NUTRITION & FEED TECHNOLOGY

(Course code: AQ203308)

Credits: 4

Hrs. /Wk.: 4

Syllabus:

UNIT I: Nutritional Requirements of Cultivable Fish:

- 1.1 Requirements for energy, proteins, carbohydrates, lipids, fiber, micronutrients for different stages of cultivable fish and prawns
- 1.2 Essential amino acids and fatty acids, protein to energy ratio, nutrient interactions and protein sparing effect
- 1.3 Dietary sources of energy, effect of ration on growth, determination of feeding rate, check tray
- 1.4 Factors affecting energy partitioning and feeding.

UNIT II: Forms of Feeds & Feeding Methods:

- 2.1 Feed conversion efficiency, feed conversion ratio and protein efficiency ratio
- 2.2 Wet feeds, moist feeds, dry feeds, mash, pelleted feeds, floating and sinking pellets, advantages of pelletization
- 2.3 Manual feeding, demand feeders, automatic feeders, surface spraying, bag feeding and tray feeding
- 2.4 Frequency of feeding

UNIT III: Feed Manufacture & Storage:

- 3.1 Feed ingredients and their selection, nutrient composition, and nutrient availability of feed ingredients
- 3.2 Feed formulation – extrusion processing and steam pelleting, grinding, mixing and drying, pelletization, and packing
- 3.3 Water stability of feeds, farm made aqua feeds, micro-coated feeds, micro-encapsulated feeds, and micro-bound diets
- 3.4 Microbial, insect and rodent damage of feed, chemical spoilage during storage period and proper storage methods

UNIT IV: Feed Additives & Non-Nutrient Ingredients:

- 4.1 Binders, anti-oxidants, probiotics
- 4.2 Feed attractants and feed stimulants
- 4.3 Enzymes, hormones, growth promoters and pigments
- 4.4 Anti-metabolites, aflatoxins and fiber

UNIT V: Nutritional Deficiency in Cultivable Fish:

- 5.1 Protein deficiency, vitamin, and mineral deficiency symptoms
- 5.2 Nutritional pathology and anti-nutrients
- 5.3 Importance of natural and supplementary feeds,
- 5.4 Importance of balanced diet

Additional Inputs:

1. Prebiotics
2. Nutritional composition of commercially available fish feeds
3. Fish feed preservatives
4. Isocaloric diets

PRESCRIBED BOOKS:

HALVER JE 1989. Fish nutrition. Academic press, San diego

REFERENCES:

1. Lovell rt 1998. Nutrition and feeding of fishes, Chapmann & Hall, New York
2. Sena de silva, trevor a anderson 1995. Fish nutrition in aquaculture. Chapmann & Hall, New York

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AQUACULTURE TECHNOLOGY SEMESTER-III, PAPER-III

FISH NUTRITION & FEED TECHNOLOGY LAB
(Course code: AQ203308P)

Credits: 1

Hrs/Wk:2

PRACTICALS:

1. Estimation of protein content in aquaculture feeds
2. Estimation of carbohydrate content in aquaculture feeds
3. Estimation of lipid content in aquaculture feeds
4. Estimation of ash in aquaculture feed
5. Study of water stability of pellet feeds
6. Feed formulation and preparation in the lab
7. Study of binders used in aquaculture feeds
8. Study of feed packing materials
9. Study of physical and chemical change during storage
10. Study on physical characteristics of floating and sinking feeds
11. Visit to a aqua-feed production unit
12. Visit to a farm for studying feeding practices

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AQUACULTURE TECHNOLOGY SEMESTER-IV, PAPER-IV (2023-2024)

FRESH WATER & BRACKISH WATER AQUACULTURE
(Course code: AQ204315)

Credits: 4

Hrs. /Wk.: 4

Syllabus:

UNIT I: Introduction to Freshwater Aquaculture

- 1.1 Status, scope, and prospects of fresh water aquaculture in the world, India, and AP
- 1.2 Different fresh water aquaculture systems

UNIT II: Carp Culture:

- 2.1 Major cultivable Indian carps – Labeo, Catla and Cirrhinus & Minor carps
- 2.2 Exotic fish species introduced to India – Tilapia, Pangassius and Clariussp.
- 2.3 Composite fish culture system of Indian and exotic carps
- 2.4 Impact of exotic fish, Compatibility of Indian and exotic carps, and competition among them.

UNIT III: Culture of Air-Breathing and Cold-Water Fish

- 3.1 Recent developments in the culture of Clarius, Anabas, Murrels,
- 3.2 Advantages and constraints in the culture of air-breathing and cold-water fishes-seed resources, feeding, management and production.
- 3.3 Special systems of Aquaculture- brief study of culture in running water, re-circulatory systems, cages and pens, sewage-fed fish culture.

UNIT IV: Culture of Prawn

- 4.1 Fresh water prawns of India - commercial value
- 4.2 Macrobrachium rosenbergii and M. Malcomsonii – biology, seed production,
- 4.3 Pond preparation, stocking, management of nursery and grow-out ponds, feeding, and harvesting

UNIT V: Culture of Brackish water Species

- 5.1 Culture of Penaeus monodon – Hatchery technology and Culture practices including feed and disease management
- 5.2 Culture of Litopenaeus Vannamei – hatchery technology and culture practices including feed and disease management.
- 5.3 Mixed culture of fish and prawns

Additional Inputs:

1. Advantages and disadvantages of culture of cold -water fishes
2. Importance of minerals in culture of penaeus monodon
3. Biology of Litopenaeus vannamei
4. Bundh breeding
5. Integrated fish farming

PRESCRIBED BOOKS:

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

REFERENCES BOOKS:

1. Santharam R, N Sukumaran and P Natarajan 1987. A manual of aquaculture, Oxford- IBH, New Delhi
2. Srivatsava 1993. Fresh water aquaculture in India, Oxford-IBH, New Delhi
3. Marcel H 1972. Text book of fish culture. Oxford fishing news books.

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AQUACULTURE TECHNOLOGY SEMESTER-IV, PAPER-IV (2023-2024)

FRESH WATER & BRACKISH WATER AQUACULTURE Lab
(Course code: AQ204315P)

Credits: 4

Hrs. /Wk.: 4

PRACTICALS:

1. Identification of important cultivable carps
2. Identification of important cultivable air-breathingfishes
3. Identification of important cultivable fresh waterprawns
4. Identification of different life history stages of fish
5. Identification of different life history stages of fresh water prawn
6. Collection and study of weed fish
7. Identification of commercially viable crabs – *Scylla cerrata*, *Portunus pelagicus*, *P.sanguinolentus*, *Neptunus pelagicus*, *N. Sanguinolentus*
8. Identification of lobsters – *Panulirus polyphagus*, *P.ornatus*, *P.homarus*, *P.sewelli*, *P.penicillatus*
9. Identification of oysters of nutritional significance *Crossostrea madrasensis*, *C.gryphoides*, *C. cucullata*, *C.rivularis* , *Picnodanta*
10. Identification of mussels and clams
11. Identification of developmental stages of oysters
12. Field visit to aqua farm and study of different components like dykes etc.

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AQUACULTURE TECHNOLOGY SEMESTER-IV, PAPER-V (2023-2024)
FISH HEALTH MANGEMENT & FISHERIES ECONOMICS
(Course code: AQ204316)

Credits: 4 Hrs./Wk.: 4

Syllabus:

UNIT I: Diseases of Fin Fish

- 1.1 Fungal diseases– Saprolegniosis, Branchiomycosis, Ichthyophorus diseases – Lagenidium diseases – Fusarium disease, prevention and therapy
- 1.2 Viral diseases – Emerging viral diseases in fish, hemorrhagic septicemia, spring viremia of carps, infectious hematopoietic necrosis in trout, infectious pancreatic necrosis in salmonids, swim-bladder inflammation in cyprinids, channel cat fish viral disease, prevention and therapy
- 1.3 Bacterial diseases – Emerging bacterial diseases, Aeromonas, Pseudomonas and vibrio infections, columnaris, furunculosis, epizootic ulcerative syndrome, infectious abdominal dropsy, bacterial gill disease, enteric red mouth, bacterial kidney disease, proliferative kidney disease, prevention and therapy

UNIT II: Diseases of Shell Fish

- 2.1 Major shrimp viral diseases – Baculovirus penaeii, Monodon Baculovirus, Baculoviral midgut necrosis, Infectious hypodermal and hematopoietic necrosis virus, Hepatopancreatic parvo like virus, yellow head baculovirus, white spot baculovirus.
- 2.2 Bacterial diseases of shell fish – Aeromonas, pseudomonas and vibrio infections, luminous bacterial disease, filamentous bacterial disease. Prevention and therapy.
- 2.3 Protozoan diseases- Ichthyophthiriasis, Costiasis, whirling diseases, trypanosomiasis. Prevention and therapy

UNIT III: Fish Health Management

- 3.1 Diagnostic tools – immune detection- DNA/RNA techniques, General preventive methods and prophylaxis. Application and development of vaccines.
- 3.2 Quarantine – Significance, methods and regulations for transplants.
- 3.3 Good Feed management for healthy organisms, zero water exchange, Probiotics in health management, Issues of biosecurity.

UNIT IV: Fisheries Economics- I

- 4.1 Methods of economic analysis of business organizations
- 4.2 Aquaculture economics- application of economics principles to aquaculture operations, Various inputs and production function laws of variable proportions
- 4.3 Cost and earnings of aquaculture systems – carp culture, shrimp farming systems,

UNIT V: Fisheries Economics- II

- 5.1 Socio-economic conditions of fishermen in Andhra Pradesh
- 5.2 Role of Matsyafed and NABARD in uplifting fishermen's conditions, fishermen cooperatives
Contribution of fisheries to the national economy
- 5.3 Economic analysis preparation of project and project appraisal

ADDITIONAL INPUTS:

Ecological diseases in fish (gas bubble and lack of oxygen)
Dermatomycosis
Socio-economic condition of fisherman in India
Biofilms and its impacts on health management
Role of state government in various fishery activities.

PRESCRIBED BOOKS:

1. Shaperclaus W. 1991 Fish Diseases- Vol.I & II. Oxonian Press Pvt.ltd
2. Roberts RJ 1989. Fish pathology. Bailliere Tindall, New York
3. Lydia Brown 1993. Aquaculture for veterinarians- fish husbandry and medicine. Pergamon Press. Oxford
4. Jayaraman R 1996. Fisheries Economics. Tamilnadu Veterinary and Animal Science University. Tuticorn
5. Subba Rao N 1986. Economics of Fisheries. Daya publishing house, Delhi

REFERENCES BOOKS:

1. Shankar KM & Mohan CV. 2002. Fish and Shellfish Health Management. UNESCO Publ. Sindermann CJ. 1990
2. Walker P & Subasinghe RP. (Eds.). 2005 Principal Diseases of Marine Fish and Shellfish. Vols. I, II. 2nd Ed. Academic Press
3. DNA Based Molecular Diagnostic Techniques: Research Needs for Standardization and Validation of the Detection of Aquatic Animal Pathogens and Diseases. FAO Publ. Wedmeyer G, Meyer FP & Smith L. 1999.
4. Bullock G et.al., 1972 Bacterial diseases of fishes. TFH publications, New Jersey
5. Post G 1987. Text book of Fish Health. TFH publications, New Jersey
6. Johnson SK 1995. Handbook of shrimp diseases. Texas A & M University, Texas

7. Dewwett KK and Varma JD 1993. Elementary economic theory. S.chand, NewDelhi
8. Korakandy R 1996. Economics of Fisheries Mangement. Daya Publishing House,Delhi
9. Tripathi SD 1992. Aquaculture Economics. Asian Fisheries Society, Mangalore

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AQUACULTURE TECHNOLOGY SEMESTER-IV, PAPER-V (2023-2024)
FISH HEALTH MANGEMENT & FISHERIES ECONOMICS LAB
(Course code: AQ204316P)

Credits: 1

Hrs. /Wk.: 2

PRACTICALS:

1. Enumeration of Bacteria by TPC Method
2. Enumeration of total Coliforms
3. Observation of gross pathology and external lesions of fish and prawn with reference to the common diseases in aquaculture.
4. Examination of pathological changes in gills and gut lumen, lymphoid organ, muscles, and nerves of fish.
5. Examination of pathological changes in gut lumen, hepatopancreas, lymphoid organ, muscles and nerves of prawn and shrimp.
6. Collection, processing, and analysis of data for epidemiological investigations of viral diseases.
7. Bacterial pathogens – isolation, culture, and characterization.
8. Identification of parasites in fishes: Protozoan, Helminths, Crustaceans.
9. AntibioGrams – preparation and evaluation.
10. Molecular and immunological techniques; Biochemical tests; PCR; ELISA; Agglutination test; Challenge tests; Purification of virus for development of vaccines (Demonstration at institutes/labs)
11. Estimation of dose, calculation of concentration, methods of administration of various chemotherapeutics to fish and shell fish
12. Estimation of antibiotics used in aquaculture practices
13. Estimation of probiotics used in aquaculture
14. Field visit to farm for health monitoring and disease diagnosis
15. Cost benefit analysis calculations

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AQUACULTURE TECHNOLOGY

SEMESTER: V PAPER-6A (2023-2024)
Course 6A: SOIL AND WATER QUALITY MANAGEMENT
(Course code: AQ205315-6A)

Credits: 4

Hrs. /Wk.: 4

Syllabus: (Total Hours: 90 including Teaching, Lab, Field Training and Unit tests, etc.)

UNIT I: Soil quality

(10h)

1. Soil types and their distribution. Physical and chemical properties of soil: Soil colour, texture, structure, pore space, bulk density, and water holding capacity; Conductivity, pH, redox potential, soil salinity, calcium carbonate, organic carbon, available nitrogen, available phosphorus, Carbon-Nitrogen ratio, organic matter and soil fertility.
2. Properties of water-logged soils, methane and hydrogen sulphide formation. Problem soils: Saline soils, Alkali soils, Acid sulphate soils (ASS), and their reclamation.
3. Pond Seepage and its control. Soil quality criteria/requirements for aquaculture.

UNIT II: Water quality

(10h)

1. Water quality parameters: Temperature, transparency, salinity, dissolved oxygen, carbon dioxide, pH, alkalinity, hardness, conductivity, ammonia, nitrites, nitrates, orthophosphates and hydrogen sulphide; phytoplankton, zooplankton and benthos.
2. Role of aquatic microorganisms in carbon, nitrogen, phosphorus and Sulphur cycles.
3. Water quality criteria for freshwater and brackish water aquaculture.

UNIT III: Soil and Water amendments

(10h)

1. Liming: Liming materials, effects of liming on pond ecosystem, liming rates for ponds, calculation of lime requirements and application of liming materials to ponds.
2. Manures and Fertilizers: Types of manures and fertilizers, primary nutrients, micronutrients, fertilizer grades, quantity and method of application; Bio fertilizers.
3. Pond fertilization: Role of organic and inorganic fertilizers in aquaculture; Problems in ponds with indiscriminate fertilization.

UNIT IV: Pond water management

(10h)

1. Dial changes in dissolved oxygen concentration, oxygen depletion in ponds, Aeration, Water exchange, Bio-floc technology.

2. Water treatment, Water filtration devices, Waste water treatment practices, Waste discharge standards, Re circulatory aquaculture system (RAS).
3. Water quality management in freshwater carp culture; brackish water shrimp culture; and hatcheries.

UNIT V: Pond treatments

(10h)

1. Pond conditioners and Chemical treatments: Potassium permanganate, Hydrogen peroxide, Calcium hydroxide, Rotenone, Formalin and Malachite green. Methods of applying chemicals.
2. Reduction of pH; Control of turbidity, salinity, hardness and chlorides; Chlorine removal; Removal of toxic gases.
3. Control of algal blooms and aquatic weeds. Bioremediation: Soil and water probiotics for aquaculture ponds.

ADDITIONAL INPUTS:

1. Calcium hypochlorite
2. Sulphonamides.
3. Bacterioplankton as larval feed and for water quality improvement
4. Effects of light on Productivity

REFERENCES:

1. Boyd, C.E. (1982). Water Quality Management for Pond Fish Culture. ElsevierSci. Publishing Co.
2. Boyd, C.E. and Tucker, C.S. (1992). Water Quality and Pond Soil Analyses for Aquaculture. Alabama Agricultural Experimental Station, Auburn University, USA.
3. Boyd, C.E. and Tucker, C.S. (2012). Pond aquaculture water quality management. Springer Science & Business Media.
4. ICAR. (2006). Hand Book of Fisheries and Aquaculture. ICAR.
5. MPEDA: Handbooks on culture of carp, shrimp, etc.
6. Training Manual on Recent advances in soil and water management in brackishwater aquaculture (2018). Saraswathy, R., Kumararaja, P., Lalitha, N., Suvana, S., Satheesha Avunje, Muralidhar, M. (Eds.), CIBA-TM Series –No.8 (2nd Ed), ICAR–Central Institute of Brackish water Aquaculture, Chennai, India pp.137.
7. Boyd, C.E. (1995). Soil and water quality management in aquaculture ponds. INFOFISH international, 5(95), 29-36.
8. Boyd, C.E. (1995). Bottom soils, sediment, and pond aquaculture. Springer Science & Business Media.
9. Pillay, T.V.R. and Kutty, M.N. (2005). Aquaculture- Principles and Practices. 2nd Ed. Blackwell
10. Dhevendaran, K. (2008). Aquatic Microbiology, Daya Publ. House.
11. APHA, AWWA, WPCF. (1998). Standard Methods for the Examination of Water and Wastewater, 20th Ed. American Public Health Association, American Water Works Association and Water Pollution Control Federation, Washington, D.C.

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AQUACULTURE TECHNOLOGY SEMESTER: V PAPER-6A (2023-2024)

Course 6A: SOIL AND WATER QUALITY MANAGEMENT LAB

(Course code: AQ205315-6AP)

Credits: 1

Hrs. /Wk.: 2

Practical Syllabus:

Skills Outcomes:

On successful completion of this practical course, student shall be able to:

1. Identify and handle various glassware, equipment and analytical instruments used for soil and water analyses.
2. Exhibit skills for preparing standard and working solutions for soil & water analyses.
3. Collect and analyze the physico-chemical and biological parameters of soil & water.
4. Calculate the dosages of lime and fertilizers required in ponds.
5. Apply the advanced techniques for quality improvement in ponds for better yields.

Practical Syllabus:

1. Demonstration of laboratory glassware and equipment used in water and soil analysis.
2. Principles of Titrimetry, Gravimetry, Potentiometry, Conductometry, Refractometry, Colorimetry, Turbidimetry, Spectrophotometry (Vis, UV-Vis, Flame, Atomic Absorption Spectrophotometer (AAS)).
3. Solutions: Standard, and dilute solutions; units of concentration; standard curve.

Soil Analysis:

4. Collection and Processing of soil samples
5. Determination of Soil texture, pH, Redox potential and Conductivity.
6. Determination of Organic carbon, available nitrogen and available phosphorus.

Water Analysis:

7. Measurement of Temperature, Transparency, Turbidity, and Salinity of water.
8. Estimation of Dissolved oxygen, Free carbon dioxide, Total alkalinity and Total hardness in water.
9. Estimation of ammonia, nitrites, nitrates, and orthophosphates.
10. Collection and identification of phytoplankton, zooplankton and benthos

11. Calculation of doses of lime and fertilizers for ponds
12. Design and fabrication of different filters.

Co-Curricular Activities:

a) Mandatory:(Training of students by teacher on field related skills: 15 hours)

1. **For Teacher:** Training of students by teacher in laboratory and field for a total of 15 hours on handling and operation of glassware, equipment and instruments; preparation of standard and working solutions, and standard curves; collection and processing of soil and water samples in the field; estimation of physico-chemical parameters of soil and water; collection and identification of plankton and benthos; calculation of doses for pond liming and fertilization; and design and fabrication of water filtering devices.
2. **For Student:** Individual visit to a local fish/ shrimp farms and hatcheries or to a laboratory in college/university/research organization/private sector and study the soil and water quality. Submission of a hand-written Fieldwork Report not exceeding 10 pages in the given format.
3. Max marks for Field Work Report: 05.
4. Suggested Format for Field work: Title page, student details, content page, introduction, work done, findings, conclusions and acknowledgements.
5. Unit tests (IE).

b) Suggested Co-Curricular Activities:

1. Training of students by related industrial experts.
2. Assignments (including technical assignments like identifying tools /kits used for soil and water analyses and their handling, operational techniques with safety and security, IPR)
3. Seminars, Group discussions, Quiz, Debates etc. (on related topics).
4. Preparation of videos on tools and techniques in soil and water analyses.
5. Collection of material/figures/photos related to the topic, writing and organizing them in a systematic way in a file.
6. Visits to fish and shellfish culture farms, hatcheries, research organizations, etc.
7. Invited lectures and presentations on related topics by field/industrial experts.

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AQUACULTURE TECHNOLOGY SEMESTER: V PAPER-7A (2023-2024)

ORNAMENTAL FISH CULTURE
(Course code: AQ205316-7A)

Credits: 4 Hrs. /Wk.: 4

Syllabus: (Total Hours: 90 including Teaching, Lab, Field Training and Unit tests, etc.)

UNIT I: Status of Ornamental fish farming and trade (10h)

1. Global status of ornamental fish trade and export potential.
2. Present status and prospects of ornamental fish farming and trade in India. Indian ornamental fish diversity and its status. Major marine ornamental fish resources of India. Method of collection of live fish.
3. Types of aquaria – Home and Public aquaria (freshwater and marine), Oceanarium.

UNIT II: Ornamental fishes (10h)

1. Origin and Benefits of ornamental fish keeping as a hobby.
2. Freshwater ornamental fishes – their taxonomy and biology - varieties of Gold fish Koi, Barbs, Danios (cyprinids); Gourami, Betta (anabantids); Tetras (characins), Live bearers (Guppy, molly, sword tail, platy); Angel fish and other Cichlids, Catfishes, Loaches.
3. Marine ornamental fishes– varieties and their habitats. Other ornamental organisms– anemones, worms, lobsters, shrimps, octopus, starfish.

UNIT III: Aquarium Management (10h)

1. Fabrication, setting up and maintenance of freshwater and marine aquarium - Lighting and aeration - Aquarium plants and their propagation methods - Aquarium accessories and decoratives. Selection of fishes and Species compatibility for aquarium keeping.
2. Water quality management for freshwater and marine aquariums. Water filtration systems – biological, mechanical and chemical. Types of filters.
3. Aquarium fish feeds – Live feeds, Dry and wet feeds. Pigmented feeds for color enhancement, larval feeds and feeding.
4. Common diseases of aquarium fish - diagnosis and treatment. Control of snail and algal growth. Medicines and chemicals used in aquaria.

UNIT IV: Breeding and Rearing of ornamental fishes (10h)

1. Breeding of Live bearers and Egg layers – sex identification, conditioning of parent fish, stimulating spawning, parental care, hatching, and fry rearing.

2. Breeding of marine ornamental fishes (clown and damsel fishes) and larval rearing.
3. Application of genetics and biotechnology for quality strain production.

UNIT V: Commercial Production of Aquarium fish and Plants (10h)

1. Commercial production units of ornamental fish - requirements and design
2. Commercial production of live bearers, goldfishes, gouramies, barbs, angels and tetras.
3. Mass production of aquarium plants.
4. Fish conditioning, packing, transport and quarantine methods. Retail marketing and export of ornamental fish.

ADDITIONAL INPUTS

1. Status of ornamental fish diversity in Andhra Pradesh.
2. Fresh water ornamental fish resources in India
3. Marine aquarium plants
4. Ornamental tortoise
5. Problems of ornamental fish industry.
6. Strategies for improvement of ornamental fish industry in India

REFERENCES:

1. Ramachandran, A. (2002). Manual on breeding, farming and management of ornamental fishes. School of Industrial Fisheries, Cochin, India.
2. Biswas, SP., Das, JN., Sarkar, UK and Lakra, WS (2007). Ornamental Fishes of North East India: An Atlas. ICAR, National Bureau of Fish Genetic Resources, Lucknow, India.
3. Dick Mills (1998). Aquarium Fishes, Dorling Kindersly Ltd., London.
4. Spotte, S. (1993). Marine Aquarium Keeping. John Wiley and Sons, USA.
5. Kurup, BM., Harikrishnan, M. and Renjithkumar, CR (2012). Breeding, farming and trade of ornamental fishes in India-Prospects and challenges. Souvenir- Ornamentals Kerala 2012.
6. Jameson, JD. and Santhanan, R. (1996). Manual of Ornamental Fishes and Farming Technologies, Fisheries College and Research Institute, Tuticorin.
7. Murthy, VS. (2002). Marine ornamental fish resources of Lakshadweep. CMFRI special publication, 72, 1-134.
8. Olivier, K. (2003). World trade in ornamental species (pp.49-63). Iowa State Press.
9. Van Ramshorrt, JD. (1978). The complete aquarium encyclopedia, Elsevier publishers.
10. Zaidi, S.G.S. Training manual on Ornamental fish culture. CIFE-ICAR, Mumbai.
11. Cato, JC. And Brown, CL. (Eds.) (2008). Marine ornamental species: collection, culture and conservation. John Wiley & Sons.
12. Bunting, BW., Holthus, P. and Spalding, S. (2003). The marine aquarium industry and reef

conservation. *Marine Ornamental Species: Collection, Culture and Conservation*, 109- 124.

13. Santhanam, R., Sukumaran, N. and Natarajan, P. (1987). *Manual of Freshwater Aquaculture*. Oxford & IBH Publishing.

14. Sirajudheen, TK., Salim, SS., Bijukumar, A. and Antony, B. (2014). Problems and prospects of marine ornamental fish trade in Kerala, India. *J. Fish. Eco. Dev.*, 1151:14-30.

15. Web resources suggested by the teacher concerned and the college librarian including reading material.

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AQUACULTURE TECHNOLOGY SEMESTER: V PAPER-VIIA (2023-2024)

ORNAMENTAL FISH CULTURE LAB

(Course code: AQ205316-7AP)

Credits: 1

Hrs. /Wk.: 2

Skills Outcomes:

On successful completion of this practical course, student shall be able to:

1. Identify the common ornamental fishes and aquarium plants.
2. Fabricate a glass aquarium and set up with equipment and accessories
3. Maintain the fishes in aquarium with proper water quality, feeding and disease management.
4. Exhibit skills for breeding egg-layers and live-bearers and fry rearing.
5. Condition the fish for packing and transport.

Practical Syllabus:

1. Identification of common freshwater and marine aquarium fishes
2. Construction of a glass aquarium
3. Setting up and maintenance of aquarium (maintained by students can be evaluated after one month)
4. Water quality management in freshwater and marine aquariums
5. Identification of Aquarium plants and live food organisms, and decoratives
6. Aerators and Types of Filters
7. Breeding of egg layers (Gold fish), live bearers (Guppy) and bubble nest builder (Gourami)
8. Ornamental fish diseases and their diagnosis and treatment. Calculation of medicine/ chemical treatment dosages.
9. Conditioning and packing of ornamental fishes.

Co-Curricular Activities:

a) Mandatory: (Training of students by teacher on field related skills: 15 hours)

1. **For Teacher:** Training of students by teacher in laboratory and field for a total of 15 hours on the biology of freshwater and marine ornamental fishes, setting up and maintenance of aquarium, breeding and commercial production of aquarium fishes and plants, and packing and transport of ornamental fishes.
2. **For Student:** Individual visit to public aquaria, oceanarium, and commercial ornamental

fish production farms, or to a university/research organization with ornamental fish production units and study the breeding, culture, marketing and export of ornamental fish. Submission of a hand written Field work Report not exceeding 10 pages in the given format.

3. Max marks for Field Work Report: 05
4. Suggested Format for Field Report: Title page, student details, content page, introduction, work done, findings, conclusions and acknowledgements.
5. Unit tests (IE).

b) Suggested Co-Curricular Activities:

1. Training of students by related industrial experts.
2. Assignments (including technical assignments like identifying biofilters, aerators, accessories and their maintenance).
3. Seminars, Group discussions, Quiz, Debates, etc. (on related topics).
4. Preparation of videos on aquarium keeping, breeding and larval rearing of ornamental fishes
5. Collection of material/figures/photos related to the topic, writing and organizing them in a systematic way in a file.
6. Visits to ornamental fish farms, public aquaria, oceanarium and aquarium fish production facilities in research organizations, etc.
7. Invited lectures and presentations on related topics by field/industrial experts.
