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Jagannaickpur, Kakinada, East Godavari, AP – 533002

DEPARTMENT OF ZOOLOGY & AQUACULTURE TECHNOLOGY

AQUACULTURE TECHNOLOGY

2024-2025

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Jagannaickpur, Kakinada, East Godavari, AP – 533002

AQUACULTURE TECHNOLOGY SEMESTER- II (2024-2025)

Course No: 3 Taxonomy and Functional Anatomy of Fin Fish and Shellfish (Minor 1)

Hrs./Week: 4 **Credits :3**

Syllabus:

Unit I: General characters & Classification of Cultivable fin fish and shell fish

1.1 General Characters of Crustacea

1.2 Classification of Crustacea: Major groups up to orders and their important characters.1.3 General Characters of fishes

1.4 Classification of Fishes**:** Major groups up to subclass and their important characters.

Unit 2: Digestive and Respiratory systems of Fish and shell fish

2.1: Digestive system of fish

2.2 Respiratory system of fish

2.3 Digestive system of Prawn

2.4 Respiratory system of prawn

Unit 3: Circulatory systems of Fish and shell fish

3.1 Cardiovascular system: Structure of heart in fishes

3.2 Blood vascular system in prawn

Unit 4: Nervous system of Fish and shell fish

4.1 Nervous system in fish: Structure and functions of Brain

4.2 Central Nervous system in prawn.

Unit 5 Reproductive system of Fish and shell fish

5.1 Urino -genital system in fishes

5.2 Reproductive system in prawn

Additional Inputs:

1. Commercial importance of crustacea
2. Commercial importance of fishes
3. Peripheral nervous system in prawn
4. Autonomic nervous system on prawn

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AQUACULTURE TECHNOLOGY SEMESTER- II (2024-2025)

Course No: 3 (Minor 1) Taxonomy and Functional Anatomy of Fin Fish and Shellfish Practicals

Hrs./Week: 2 **Credits :1**

1. Study of mouth parts in herbivorous and carnivorous fishes
2. Comparative study of digestive system of herbivorous and carnivorous fishes
3. Demonstration of brain of fish
4. Demonstration of cranial nerves of fish
5. Demonstration of Nervous system of prawn
6. Exposure of gills of prawn
7. Exposure of gills of fish

REFERENCE BOOKS

1. Bond E. Carl. 1979. *Biology of Fishes*, Saunders.
2. Halver JE. 1972. *Fish Nutrition.* Academic Press.
3. Hoar WS and Randall DJ. 1970. *Fish Physiology*, Vol. I-IX, Academic Press, New York.
4. Lagler KF, Bardach, JE, Miller, RR, Passino DRM. 1977. *Ichthyology*, 2nd Ed. John Wiley& Sons, New York.
5. Lovell J. 1989. *Nutrition and Feeding of Fish.* Van Nostrand Reinhold, New York.
6. Moyle PB and Joseph J. Cech Jr. 2004. *Fishes: An Introduction to Ichthyology*. 5th Ed.Prentice Hall.
7. Nikolsky GV. 1963. *Ecology of Fishes,* Academic Press.
8. Norman JR and Greenwood PH. 1975. *A History of Fishes,* Halsted Press.
9. Potts GW and Wootten RJ. 1984. *Fish Reproduction: Strategies and Tactics,* AcademicPress.

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AQUACULTURE TECHNOLOGY SEMESTER: III (2024-2025)

Course No.:5 (Minor II) - Basic Principles of Aquaculture

Credits: 3 *Hrs. /Wk.: 3*

Syllabus:

UNIT-I (Introduction)

1. Definition and History of Aquaculture
2. Concept of Blue Revolution and Pradhan Mantri Matsya Sampada Yojana (PMMSY)
3. Present status of Aquaculture at global level, India and Andhra Pradesh
4. Aquaculture versus Agriculture; Present day needs with special reference to Andhra Pradesh

UNIT-II (Types of Fish Ponds)

1. Lotic and lentic systems, streams, and springs Classification of ponds based on water resources – spring, rainwater, flood water, well water, and watercourse ponds
2. Functional classification of ponds – head pond, hatchery, nursery, rearing, production and stocking
3. Ponds; quarantine ponds, isolation ponds and wintering ponds

UNIT- III (Design and Construction of Aqua Farms)

1. Important factors in the construction of an ideal fish pond – site selection, topography, nature of the soil, water resources
2. Lay out and arrangement of ponds in a fish farm
3. Construction of an ideal fish pond – space allocation, structure and components of barrage Pond

UNIT-IV (Aquaculture Systems and Practices)

1. Types of aquaculture Freshwater aquaculture - Brackish water aquaculture - Mari culture
2. Aquaculture Systems – Pond, Raceways, Cage, Pen, Rafts, Running water, Water Recirculating Systems, Biofloc Technology and 3-C System
3. Pond culture practices- Traditional, Extensive, Modified Extensive, Semi-Intensive, Intensive & Super-intensive systems of fish and shrimp and their significance.
4. Fin fish culture methods - Monoculture, Poly culture and Monosex culture and integrated fish farming.

UNIT-V (Management Factors of Culture Ponds, Pre-stocking Management)

1. Dewatering, drying, ploughing/desilting
2. Predators, weeds and weed fish in culture ponds - Advantages and disadvantages of weed plants; Toxins used for weed control and control of predators. Liming and fertilization;
3. Algal blooms and their control

4. Stocking Management – Stocking density and stocking

5. Post-stocking Management Feeding: Role of nutrients

6. Water quality: Physico-chemical conditions of soil and water optimum for culture – temperature, depth, turbidity, light, water and shore currents, PH, DOD, CO_2, NH_3, NO_2.

ADDITIONAL INPUTS:

1. Scope of aquaculture
2. Importance of aquaculture.
3. Awareness of entrepreneurship & employability opportunities in Aquaculture.
4. Fish hatchery
5. Biosecurity methods for aquaculture ponds.

PRESCRIBED BOOKS: 1. Jhingran VG 1998. Fish and Fisheries of India. Hindusthan Publishing Corporation,New Delhi

2. Pillay TVR, 1996. Aquaculture Principles and Practices, Fishing News Books Ltd., London

REFERENCES: 1. Pillay TVR &M.A.Dill, 1979. Advances in Aquaculture. Fishing News BooksLtd., London

2. Stickney RR 1979. Principles of Warm Water Aquaculture. John Wiley & SonsInc. 1981

3. Boyd CE 1982. Water Quality Management for Pond Fish Culture. Elsivier Scientific Publishing

4. Bose AN et.al, 1991. Costal Aquaculture Engineering. Oxford & IBH Publishing Company.

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AQUACULTURE TECHNOLOGY SEMESTER-III

Course No.: 5 (Minor II) - Basic Principles of Aquaculture

Credits: 1 Hrs/Wk:2

PRACTICALS:

1. Estimation of Carbonates and bicarbonates in water samples
2. Estimation of dissolved oxygen
3. Estimation of Ammonia in water.
4. Estimation of Total Hardness of water sample.
5. Study of beneficial and harmful algal species
6. Collection, identification, and isolation of zooplankton and phytoplankton

7 Collection and study of aquatic weeds, aquatic insects, weed fish, and larvivorous fish

8. Field visit to hatchery, nursery, rearing and stocking ponds of aqua farms.

REFERENCES

1. Boyd CE. 1979. Water Quality in Warm Water Fish Ponds. Auburn University
2. Boyd, CE. 1982. Water Quality Management for Pond Fish Culture. Elsevier Sci. Publ. Co.
3. FAO. 2007.Manual on Freshwater Prawn Farming.

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AQUACULTURE TECHNOLOGY SEMESTER-IV, (2024-2025)

Course No.: 9 (Minor III) **- Fish Health Management**

Credits: 3 Hrs./Wk.:3

Syllabus:

UNIT I: **Pathology and parasitology**

1-1 Introduction to fish diseases –Definition and categories of diseases – Disease and environment

1-2 Disturbance in cell structure – changes in cell metabolism, progressive and retrogressive tissue changes, types of degeneration, infiltration, necrosis, cell death and causes

1-3 Atrophy, hypertrophy, neoplasms, inflammation, healing and repair

UNIT II: Fungal and viral Diseases of fin fish.

2-1 Fungal diseases (both of shell and finfish) – Saprolegniosis, brachiomycosis, ichthyophorus diseases – Lagenidium diseases – Fusarium disease, prevention and therapy

2-2 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 catfish viral disease, prevention and therapy

UNIT III: bacterial Diseases of fin fish.

3-3 Baterial 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 IV: Protozoan Diseases of fin fish.

4-1 Protozoan diseases: Ichthyophthiriasis (White spot Disease), Costiasis, Whirling disease

UNIT V: Nutritional diseases

5-1 Nutritional pathology – lipid liver degeneration, Vitamin and mineral deficiency diseases. Aflatoxin and dinoflagellates.

5-2 Antibiotic and chemotherapeutics. Nutritional cataract. Genetically and environmentally induced diseases.

ADDITIONAL INPUTS:

1. Dermatomycosis fungal disease in fin fish.
2. Lymphocystis viral disease in fin fish.
3. Edwardsielosis bacterial disease.
4. Velvet and Microsporidiosis diseases.
5. Fish scurvy

PRESCRIBED BOOK(S):

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 husbandray and medicine. Pergamon Press. Oxford

REFERENCES:

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

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AQUACULTURE TECHNOLOGY SEMESTER-IV, (2024-2025)

Course No.: 9 (Minor III) - **Fish Health Management**

Credits: 1 Hrs. /Wk.: 2

PRACTICALS:

1. Enumeration of Bacteria by TPC Method
2. Enumeration of total Coli forms
3. Observation of gross pathology and external lesions of fish 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. Collection, processing and analysis of data for epidemiological investigations of viral diseases
6. Bacterial pathogens – isolation, culture and characterization
7. Identification of parasites in fishes: Protozoan, Helmiths, Crustaceans
8. Estimation of dose, calculation of concentration, methods of administration of various chemotherapeutics to fish and shell fish
9. Estimation of antibiotics used in aquaculture practices

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AQUACULTURE TECHNOLOGY SEMESTER-IV, (2024-2025)

Course No.: 10 (Minor IV) - **Shrimp Health Management**

Credits: 3 *Hrs./Wk.:3*

Syllabus

UNIT I: Viral Diseases of shell fish (Symptoms, Treatment and Prophylaxis)

1-1 Major shrimp viral diseases – Bacculovirus penaeii, Monodon Bacculovirus,

1-2 Bacculoviral midgut necrosis, Infectious hypodermal and haematopoietic necrosis virus, Hepatopancreatic parvo like virus,

1-3 Yellow head bacculovirus, white spot bacculovirus.

UNIT II: Bacterial Diseases of shell fish(Symptoms, Treatment and Prophylaxis)

2.1 Bacterial diseases of shell fish – aeromonas, pseudomonas and vibrio infections,

2.2Luminous bacterial disease, filamentous bacterial disease. Prevention and therapy

UNIT III: Protozoan Diseases of shell fish (Symptoms, Treatment and Prophylaxis)

3-1 Protozoan diseases- Ichthyophthiriasis, Costiasis,

3-2Whirling diseases, trypanosomiasis

UNIT IV: Health management

4-1 Diagnostic tools – immune detection- DNA/RNA techniques, General preventive methods and prophylaxis. Application and development of vaccines.

4-2 Quarantine – Significance, methods and regulations for transplants.

UNIT V: Production of disease free seeds

5-1 Production of disease-free seeds. Evaluation criteria of healthy seeds.

5-2Good Feed management for healthy organisms, Zero water exchange, Probiotics in

ADDITIONAL INPUTS:

1. Non-luminous bacterial disease
2. Larval mycosis fungal disease
3. Cotton shrimp disease.
4. Hepatopancreatic microsporidiosis
5. Biofilms and its impact on health management.

PRESCRIBED BOOK(S): 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 husbandray and medicine. Pergamon Press. Oxford

REFERENCES:

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

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AQUACULTURE TECHNOLOGY SEMESTER-IV, (2024-2025)

Course No.: 10 (Minor IV) - **Shrimp Health Management**

Credits: 1 Hrs. /Wk.: 2

PRACTICALS:

1. Enumeration of Bacteria by TPC Method
2. Observation of gross pathology and external lesions of fish and prawn with reference to the common diseases in aquaculture
3. Examination of pathological changes in gut lumen, hepatopncreas, lymphoid organ, muscles and nerves of prawn and shrimp
4. Collection, processing and analysis of data for epidemiological investigations of viral diseases
5. Bacterial pathogens – isolation, culture and characterization
6. Antibiograms – preparation and evaluation
7. Molecular and immunological techniques; Biochemical tests; PCR; ELISA; Agglutination test; Challenge tests; Purification of virus for development of vaccines (Demonstration at institutes/labs)
8. Estimation of dose, calculation of concentration, methods of administration of various chemotherapeutics to fish and shell fish
9. Estimation of antibiotics used in aquaculture practices.
10. Estimation of probiotics used in aquaculture.

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AQUACULTURE TECHNOLOGY SEMESTER: V PAPER-6A (2024-2025)

Course 6A: SOIL AND WATER QUALITY MANAGEMENT

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. Elsevier Sci. 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 (2024-2025)

Course 6A: SOIL AND WATER QUALITY MANAGEMENT LAB

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 (2024-2025)

ORNAMENTAL FISH CULTURE

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. andSanthanan, 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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Jagannaickpur, Kakinada, East Godavari, AP – 533002

AQUACULTURE TECHNOLOGY SEMESTER: V PAPER-VIIA (2024-2025)

ORNAMENTAL FISH CULTURE LAB

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.

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