**CLUSTER PAPERS**

**zoology syllabus for CLUSTER ELECTIVE –VIII-B:**

**VI semester**

**AQUACULTURE**

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**Cluster Elective Paper: VIIi-B-1**

**PRINCIPLES OF AQUACULTURE**

**Periods:60 Max.Marks:100**

**ZOO Credits:3**

**Unit – I**

**1.1 Introduction / Basics of Aquaculture**

 1.1.1 Definition, Significance and History of Aquaculture

 1.1.2 Present status of Aquaculture – Global and National scenario

 1.1.3 Major cultivable species for aquaculture: freshwater, brackish water and marine.

 1.1.4 Criteria for the selection of species for culture

 **Unit – II**

**2.1 Types of Aquaculture**

 2.1.1 Freshwater, Brackishwater and Marine

 2.1.2 Concept of Monoculture, Polyculture,Composite culture, Monosex culture and

Integrated fish farming

**2.2Culture systems**

 2.2.1 Ponds, Raceways, Cages, Pens, Rafts and water recirculating systems

**2.3Culture practices**

 2.3.1Traditional, extensive, modified extensive, semi-intensive and intensive cultures of

fish and shrimp.

**Unit – III**

**3.1 Design and construction of aquafarms**

 3.1.1Criteria for the selection of site for freshwater and brackish water pond farms

 3.1.2 Design and construction of fish and shrimp farms

**3.2 Seed resources**

 3.2.1 Natural seed resources and Procurement of seed for stocking: Carp and shrimp

**3.3 Nutrition and feeds**

 3.3.1 Nutritional requirements of a cultivable fish and shellfish

3.3.2 Natural food and Artificial feeds and their importance in fish and shrimp culture

**Unit – IV**

**4.1Management of carp culture ponds**

4.1.1 Culture of Indian major carps: Pre-stocking management – Dewatering, drying, ploughing/desilting; Predators, weeds and algal blooms and their control, Liming and fertilization; Stocking management – Stocking density and stocking; Post-stocking management – Feeding, water quality, growth and health care; and Harvesting ofponds

**4.2Culture of giant freshwater prawn,** *Macrobrachium rosenbergii*

**Unit – V**

**5.1Culture of shrimp** (*Penaeus monodon* or *Litopenaeus vannamei*)

**5.2 Culture of pearl oysters**

**5.3 Culture of seaweeds-**species cultured, culture techniques, important by-products, prospects

**5.4 Culture of ornamental fishes –** Setting up and maintenance of aquarium; and breeding.

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2. Bose AN et al.1991. *Coastal aquaculture Engineering*. Oxford & IBH Publ.Co.Pvt.Ltd.
3. Chakraborty C & Sadhu AK. 2000. *Biology Hatchery and Culture Technology of Tiger Prawn and Giant Freshwater Prawn.* Daya Publ. House.
4. FAO. 2007. *Manual on Freshwater Prawn Farming*.
5. Huet J. 1986. *A text Book of Fish Culture*. Fishing News Books Ltd.
6. ICAR. 2006*. Hand Book of Fisheries and Aquaculture*. ICAR.
7. Ivar LO. 2007. *Aquaculture Engineering*. Daya Publ. House.
8. Jhingran V.G. 2007. *Fish and Fisheries of India*. Hindustan Publ. Corporation, India.
9. Landau M. 1992. *Introduction to Aquaculture*. John Wiley & Sons.
10. Lovell RT.1998. *Nutrition and Feeding of fishes*. Chapman & Hall.
11. Mcvey JP. 1983. *Handbook of Mariculture*. CRC Press.
12. MPEDA: *Handbooks on culture of carp, shrimp, etc*.
13. New MB. 2000. *Freshwater Prawn Farming*. CRC Publ.
14. Pillay TVR.1990. *Aquaculture- Principles and Practices*, Fishing News Books Ltd., London.
15. Pillay TVR & Kutty MN. 2005. *Aquaculture- Principles and Practices*. 2nd Ed. Blackwell
16. Rath RK. 2000. *Freshwater Aquaculture*. Scientific Publ.

14. Stickney RR. 1979. *Principles of Warmwater Fish Culture*, John Wiley & Sons

15. Wheaton FW. 1977. *Aquacultural Engineering*. John Wiley & Sons.

 **Cluster Elective Paper: VIIi-B-2**

**AQUACULTURE MANAGEMENT**

**Periods : 60 Max.Marks : 100**

**ZOO Credits:3**

**Unit – I**

**1.1Breeding and Hatchery Management**

1.1.1 Bundh Breeding and Induced breeding of carp by Hypophysation; and

use of synthetic hormones

 1.1.2Types of fish hatcheries; Hatchery management of Indian major carps

 1.1.3 Breeding and Hatchery management of *Penaeus monodon*/ *Litopenaeus vannamei*

1.1.4 Breeding and Hatchery management of giant freshwater prawn.

**Unit – II**

**2.1 Water quality Management**

 2.1.1Water quality and soil characteristics suitable for fish and shrimp culture

2.1.2 Identification of oxygen depletion problems and control mechanisms in culture ponds

2.1.3 Aeration: Principles of aeration and Emergency aeration

2.1.4 Liming materials, Organic manures and Inorganic fertilizers commonly used and

 their implications in fish ponds

**Unit – III**

**3.1 Feed Management**

 3.1.1Live Foods and their role in shrimp larval nutrition.

 3.1.2 Supplementary feeds: Principal foods in artificial diets; Types of feeds; Feed

 additives and Preservatives; role of probiotics.

 3.1.3 Feed formulation and manufacturing; Feed storage

 3.1.4 Feeding strategies: Feeding devices, feeding schedules and ration size; Feed

 evaluation- feed conversion efficiencies and ratios

**Unit – IV**

**4.1 Disease Management**

4.1.1 Principles of disease diagnosis and health management;

 4.1.2 Prophylaxis, Hygiene and Therapy of fish diseases

 4.1.3 Specific and non-specific defense systems in fish; Fish immunization and

 vaccination

 4.1.4Etiology, Symptoms, prophylaxis and therapy of common fish diseases in fish ponds

4.1.5Etiology, Symptoms, prophylaxis and therapy of common shrimp diseases in shrimp ponds

**Unit – V**

**5.1 Economics and Marketing**

5.1.1 Principles of aquaculture economics – Capital costs, variable costs, cost-benefit analysis

5.1.2Fish marketing methods in India; Basic concepts in demand and price analysis

**5.2 Fisheries Extension**

5.1.3 Fisheries Training and Education in India; Role of extension in community development.

**5.3 Fish Genetics**

5.1.4 Genetic improvement of fish stocks – Hybridization of fish.

5.1.5 Gynogenesis, Androgenesis, Polyploidy, Transgenic fish, Cryopreservation of gametes, Production of monosex and sterile fishes and their significance in aquaculture.

**REFERENCE BOOKS**

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. Chakraborty C & Sadhu AK. 2000. *Biology Hatchery and Culture Technology of Tiger Prawn and Giant*

*Freshwater Prawn*. Daya Publ. House

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6. Ian C. 1984. *Marketing in Fisheries and Aquaculture*. Fishing News Books.

7. ICAR. 2006. *Handbook of Fisheries and Aquaculture*. ICAR.

8. Jhingran VG. 2007. *Fish and Fisheries of India.* Hindustan Publishing Corporation, India.

9. Jhingran VG & Pullin RSV. 1985. *Hatchery Manual for the Common, Chinese and Indian Major Carps*.

ICLARM, Philippines.

10. Kumar D. 1996. *Aquaculture Extension Services Review: India.* FAO Fisheries CircularNo. 906, Rome.

11. Lavens P & Sorgeloos P. 1996*. Manual on the Production and Use of Live Food for Aquaculture.* FAO

Fisheries Tech. Paper 361, FAO.

12. MPEDA. 1993. *Handbook on Aqua Farming - Live Feed. Micro Algal Culture.* MPEDA Publication

13. New MB. 1987. *Feed and Feeding of Fish and Shrimp. A Manual on the Preparation and Preservation of*

*Compound Feeds for Shrimp and Fish in Aquaculture.* FAO – ADCP/REP/87/26

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ICAR

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Publ.

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Daya Publ.

**Cluster Elective Paper: VIIi-B-3**

**POSTHARVEST TECHNOLOGY**

**Periods : 60 Max.Marks : 100**

**ZOO Credits:3**

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**Unit – I**

**1.1 Handling and Principles of fish Preservation**

1.1.1 Handling of fresh fish, storage and transport of fresh fish, post mortem changes (rigor

mortis and spoilage), spoilage in marine fish and freshwater fish.

 1.1.2 Principles of preservation– cleaning, lowering of temperature, rising of temperature,

denudation, use of salt, use of fish preservatives, exposure to lowradiation of gamma rays.

  **Unit – II**

**2.1 Methods of fish Preservation**

 2.1.1 Traditional methods - sun drying, salt curing, pickling and smoking.

 2.1.2 Advanced methods – chilling or icing, refrigerated sea water, freezing, canning,

Irradiation and Accelerated Freeze drying (AFD).

**Unit – III**

**3.1 Processing and preservation of fish and fish by-products**

 3.1.1Fish products – fish minced meat, fish meal, fish oil, fish liquid (ensilage), fish

protein concentrate, fish chowder, fish cake, fish sauce, fish salads, fish powder, pet

food from trash fish, fish manure.

 3.1.2 Fish by-products – fish glue, ising glass, chitosan, pearl essence, shark fins, fish

 leather and fish maws.

**3.2Seaweed Products**

3.2.1Preparation of agar, algin and carrageen. Use of seaweeds as food for humanconsumption, in diseasetreatment and preparation of therapeutic drugs.

**Unit – IV**

**4.1Sanitation and Quality control**

4.2.1 Sanitation in processing plants - Environmental hygiene and Personal hygiene in processing plants.

4.2.2 Quality Control of fish and fishery products – pre-processing control, control during processing and control after processing.

**4.2 Regulatory affairs in industries**

**Unit – V**

**5.1 Quality Assurance, Management and Certification**

5.1.1Seafood Quality Assurance and Systems: Good Manufacturing Practices (GMPs); Good Laboratory Practices (GLPs); Standard Operating Procedures (SOPs); Concept of Hazard Analysis and Critical Control Points (HACCP) in seafood safety.

5.1.2 National and International standards – ISO 9000: 2000 Series of Quality

 Assurance System, *Codex Alimentarius*.

**REFERENCE BOOKS**

1. Balachandran KK. 2001. *Post-harvest Technology of Fish and Fish Products*. Daya Publ.

2. Bond, et al. 1971. *Fish Inspection and Quality Control.* Fishing News Books, England.

3 Clucas IJ. 1981. *Fish Handling, Preservation and Processing in the Tropics*. Parts I, II. FAO.

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

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6. Hall GM. (Ed). 1992. *Fish Processing Technology*. Blackie.

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12. Regenssein JM & Regenssein CE.1991. *Introduction to Fish Technology*.VanNostrand Reinhold.

13. Rudolf K. 1969*. Freezing and Irradiation of Fish.* Fishing News (Books).

14. Sen DP. 2005. *Advances in Fish Processing Technology*. Allied Publ.

**zoology practiclsyllabusCLUSTER ELECTIVE PAPER: VIII-B**

**VI semester**

**AQUACULTURE**

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**PRACTICAL: I**

**Periods : 24 Max.Marks : 50**

**ZOO Credits:2**

**Cultivable fishes**

1. Identification and study of important cultivable and edible fishes - Any ten

2. Identification and study of important cultivable and edible crustaceans - Any five

3. Identification and study of common aquarium fishes – Any five

4. General description and recording biometric data of a given fish.

**Diseases**

1. Identification and study of fish and shrimp diseases - Using specimens / pictures

2.External examination of the diseased fish – diagnostic features and procedure.

3. Autopsy of fish – Examination of the internal organs.

4. Determination of dosages of chemicals and drugs for treating common diseases.

**Pond Management**

1. Water Quality -Determination of temperature, pH, salinity in the pond water sample;

Estimation of dissolved oxygen, free carbondioxide, total alkalinity, total

 hardness, phosphates and nitrites.

2. Soil analysis – Determination of soil texture, pH, conductivity, available nitrogen, available

phosphorus and organic carbon.

3. Identification and study of common zooplankton, aquatic insects and aquatic weeds – Each 5

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**PRACTICAL - II**

**Periods :24 Max.Marks : 50**

**ZOO Credits:2**

**Nutrition**

1. Identification and study of Live food organisms – Any five

2. Formulation and preparation of a balanced fish feed

3. Estimation of Proximate composition of aquaculture feeds – Proteins, carbohydrates, lipids,

moisture, ash content.

4. Gut content analysis to study artificial and natural food intake.

**Post harvest Technology**

1. Evaluation of fish/ fishery products for organoleptic, chemical and microbial quality.

2. Preparation of dried, cured and fermented fish products, examination of salt, protein, moisture in dried / cured products, examination of spoilage of dried / cured fish products, marinades, pickles, sauce.

3. Preparation of isinglass, collagen and chitosan from shrimp and crab shell. ?

4. Developing flow charts and exercises in identification of hazards – preparation of hazard

analysis worksheet, plan form and corrective action procedures in processing of fish.

**PRACTICAL - III**

**Project Work**

Visit to a fish breeding centre / fish farms and submit a project report

or

Visit to a feed manufacturing unit and submit a project report

or

Visit to a shrimp hatchery / shrimp farms and submit a project report

or

Visit to a shrimp processing unit and submit a project report

 **LEARNINGOUTCOMES:**

* Describe the state of the aqua culture and aquatic science profession and potential career opportunities
* Utilize the developed experticise in concepts theories and energizing methodologies to succeed in taking real world issue in aqua culture.
* Demonstrate advanced knowledge and competency in taxonomy and natural history of aqua flora and fauna of the north east.
* Demonist rate hands on experience in aquatic sampling inventory measurement techniques.