

# ORNAMENTAL FISH FARMING

(Based on Bharathidasan University Syllabus)



Compiled by  
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This note is written in simple and easy English to facilitate students studying Zoology as a main subject and as allied subject under the Bharathidasan University syllabus.

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I hope this notes will be committed to the intellectual life of the students.

Notes released by the Author based on Bharathidasan university syllabus

- 1. Invertebrata –I***
- 2. Invertebrata –II***
- 3. Chordate***
- 4. Biology of Invertebrates and Chordates (Allied)***
- 5. Commercial Zoology (Allied)***
- 6. Ornamental Fish Farming (NME)***
- 7. Public Health and Hygiene - English***
- 8. Public Health and Hygiene - Tamil***
- 9. Invertebrate I and Invertebrate II - (Practical Manual)***
- 10. Biology of Invertebrates and Chordates and Commercial Zoology (Allied- Practical Manual)***
- 11. Chordata and Cell and Molecular Biology (Practical Manual)***

**Dr K. DASS., M.Sc., B.Ed., M.Sc (Psy)., M.Phil., Ph.D.**



**NON-MAJOR ELECTIVE II**  
**ORNAMENTAL FISH FARMING**

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I hope the book will be committed to the intellectual life of the students.

**NON-MAJOR ELECTIVE II**  
**ORNAMENTAL FISH FARMING**  
**CONTENT**

<b>UNIT</b>	<b>TOPIC</b>	<b>PAGE</b>
<b>I</b>	Importance and scope of ornamental fish culture - Economics.	<b>01</b>
	Commercial value and potential trends in ornamental fish farming in world.	<b>01</b>
	Commercial value and potential trends in ornamental fish farming in India	<b>02</b>
	Budget required for setting up an Aquarium Fish Farm as a Cottage Industry.	<b>03</b>
<b>II</b>	Important freshwater and marine ornamental fishes	<b>04</b>
	Indigenous and exotic species	<b>04</b>
	Guppy	<b>04</b>
	Sword tail	<b>05</b>
	Gold fish	<b>06</b>
	Angel fish	<b>07</b>
	Anemone fish	<b>08</b>
	Butterfly fish	<b>09</b>
	Zebra fish	<b>10</b>
	Koi	<b>11</b>
	Tetra	<b>12</b>
	Molly	<b>13</b>
	Glass fish	<b>14</b>
	Cichlids	<b>15</b>
	Hippocampus	<b>16</b>
	Scat fishes	<b>17</b>
<b>III</b>	Mass production of fancy fishes: Preparations for breeding	<b>18</b>
	Induced breeding	<b>19</b>
	Food and feeding – Preparation and composition of formulated fish feeds.	<b>22</b>
	Live feeds: Artemia	<b>24</b>
	Live feeds: Tubifex.	<b>26</b>
	Live fish transport- Fish handling, packing and forwarding techniques.	<b>27</b>
	Requirements for an aquarium	<b>29</b>

<b>IV</b>	Aquarium design, Construction and preparation: size, shape, substrate	<b>30</b>
	Ornamental aquatic plants	<b>31</b>
	Construction and functions of Bio filters	<b>32</b>
	Accessories for fish tanks – hood	<b>32</b>
	Aerators	<b>32</b>
	Light	<b>32</b>
	Nets	<b>33</b>
<b>V</b>	General Aquarium maintenance – Maintenance of water quality	<b>33</b>
	Disease management : Common bacterial	<b>35</b>
	Viral Disease	<b>36</b>
	Fungal Disease	<b>36</b>
	Protozoan Disease	<b>37</b>
	Crustacean infections (Parasitic disease)	<b>38</b>
	Question bank	<b>40</b>
	Model question	<b>52</b>



UNIT –IIMPORTANCE AND SCOPE OF ORNAMENTAL FISH CULTURE**Important and scope of ornamental fish culture**

1. It is a *hobby* giving pleasure to everyone.
2. It *relaxes our mind* when feel tired.
3. This hobby is said to *reduce blood pressure*.
4. Children gain *knowledge and skills*.
5. It develops attachment with nature and responsibility towards the welfare of other living beings.
6. It creates self *employment opportunities*.
7. Aquarium fish can get about *100 times more price* than the food fish
8. Ancillary activities such as culture of ornamental fishes, breeding, *export*, supply of accessory apparatus *viz*; filters, aerators, plants, feeds etc., also provide indirect employment.

**Fish Keeping Industry**

- Fish keeping has been started as a *hobby* in the beginning. But nowadays it has become a popular industry worldwide.

**Ornamental fish farming in World Market**

- The fish keeping hobby is a multi-million dollar industry, throughout the world. *United States* is considered as the largest market in the world, followed by *Europe and Japan*.
- In 1994, 56% of U.S. households had pets, and 10.6% owned ornamental freshwater or saltwater fish, with an average of 8.8 fish per household.
- In 1993, the retail value of the fish hobby in the United States was \$910 million.
- From 1989 to 1992, almost 79% of all U.S. ornamental fish imports arrived from *Southeast Asia and Japan*.
- *Singapore, Thailand, Philippines, Hong Kong, and Indonesia* were the top five exporting nations.
- South America was the second largest exporting region, accounting for 14% of the total annual value. *Colombia, Brazil and Peru* were the major suppliers. The remaining 7% of ornamental fish imports came from other regions of the world.

- Approximately 201 million fish worth \$44.7 million were imported into the United States in 1992. These fish comprised 1,539 different species; 730 freshwater species, and 809 saltwater species.
- The freshwater fish accounted for approximately 96% of the total volume and 80% of the total import value. Of the total of all trade, only 32 species had import values over \$10,000. These top species were all of freshwater origin and accounted for 58% of the total imported value of the fish.
- The top imported species are the *guppy*, *neon tetra*, *platy*, *betta*, *Chinese algae eater* and *goldfish*.
- In many developing countries, local villagers collect specimens for the aquarium trade as their prime means of income.

## Ornamental fish farming in Indian Market

- India, despite its vast coastal zone and with abundant sources of freshwater, is still far behind as far as ornamental fish trade is concerned. The demand for good quality tropical fish is increasingly high. But the availability of ornamental fishes in the market does not meet the required level.
- More than 100 varieties of indigenous ornamental fish species are known in Indian freshwaters. The indigenous barbs *Puntius sp.* and *Botia sp.* are known for their fancy fin, colour pattern and flashing appearance and they fetch high price in the world market.
- India's contribution to global aquarium trade is worth more than 10 crore rupees annually. Tamil Nadu, with its year round warm climate and sustained live food sources is conducive for ornamental fish breeding. At present, only metropolitan cities like Calcutta, Mumbai and Chennai have emerged as the major ornamental fish breeding centers in the country.
- About 150 popular varieties of ornamental fishes such as *clown fishes*, *damsel*, *marine angel*, *moorish idol*, *surgeon fishes*, *fangs* and *butterfly fishes* are reported from Andaman and Nicobar Islands, Lakshadweep, Gulf of Mannar and Palk bay. The Thoothukudi coastal waters are also rich in ornamental fish due to the coral reefs.
- The Indian marine ornamental fish trade is benefited by wild collection. This is because these fishes cannot be easily bred in captivity.
- India is utilizing the natural ornamental fish sources along her coast, particularly in the *Gulf of Kutch*, *South Cochi*, *Cape Comorin* and *Rameswaram*. If the valuable

ornamental resources are taken up for proper use, it is possible to increase the present level of export to about 110 crore rupees.

**Table 1: Budget required for setting up an Aquarium Fish Farm as a Cottage Industry**

<b>Capital cost (Rs.)</b>		
2 glass aquarium (2.5 x 2 x 1) m each with lids and fittings	2 x 1400	2800
3 cement cistern (5 x 3 x 2) m	3 x 1200	3600
3 aerator	3 x 200	600
Other equipments like hand net, buckets, pipes		1000
<b>Capital cost total</b>		<b>8000</b>
<b>Culture cost (Rs.)</b>		
200 hundreds female	200 x 3	600
50 male	50 x 5	250
Feed for one year		3600
Others		1000
<b>Culture cost total</b>		<b>5,450</b>
<b>Capital cost total</b>		<b>8,000</b>
Total		<b>13,450</b>
<b>Production:</b> Monthly production of 5,000 young, Yearly production of 60,000 young 40% male = 24,000 60% female = 36,000.		
24,000 male	24000 x 3	72,000
36,000 female	36000 x 2	72,000
Total sale		<b>1,44,000</b>
Annual profit = (1,44,000- 13,450) = <b>1,30,550</b> Monthly profit = <b>Rs. 10,879</b>		



UNIT II

IMPORTANT FRESHWATER AND MARINE ORNAMENTAL FISHES

**Indigenous and Exotic Species**

**Indigenous** : Originating or occurring *naturally in a particular place*.

**Exotic** : It comes from a *different country* or culture.

**GUPPY (*Poecilia reticulata*)**

Phylum	:	Chordata
Class	:	Pisces
Order	:	Teleostei
Family	:	Poeciliidae



- It is an *ornamental fish*.
- **Common Name** : Guppy Fish
- **Attainable Size** : 2.5 inches
- **Environment** : Fresh and brackish water
- **Origin:** South America, Venezuela, Trinidad, Northern Brazil and Ghana.
- **Company:** Can be kept in most community aquariums. Don't keep with aggressive fish.
- **Water: pH:** 7.0 to 8.5
- **Temperature:** 18 to 28°C
- **Aquarium:** Best kept with a lot of plants and free swimming space.
- **Feed:** Omnivorous
- **Breeding:** Live bearer. Females give birth to fry

SWORD TAIL (*Xiphophorus helleri*)

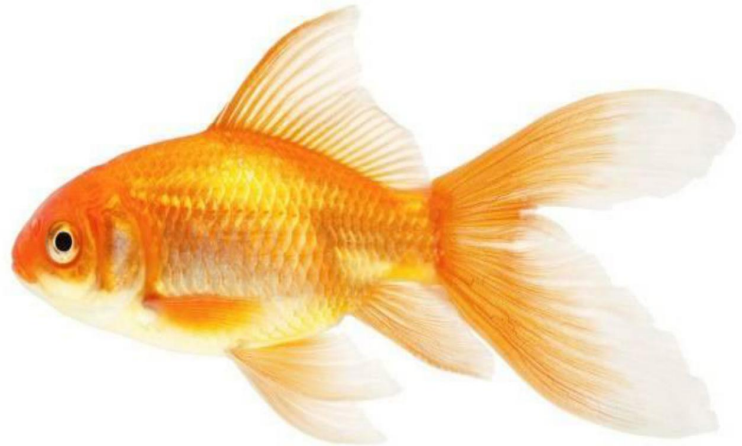
Phylum	:	Chordata
Class	:	Pisces
Order	:	Teleostei
Family	:	Poeciliidae



- It is an *ornamental fish*.
- **Environment:** freshwater fish.
- **Attainable Size:** 14 cm.
- **Water: pH:** 7 to 8
- The lower lobe of the caudal fin is elongated in the male.
- The anal fin of the male is sword-like and hence the name sword tail.
- The name 'sword tail' is not derived from the elongated tail fin. It is a misnomer.
- The colour patterns are red, green and black.
- **Feed:** Omnivore
- **Breeding:** Live bearer. (Females give birth to fry)

## GOLD FISH (*Carassius auratus*)

Phylum	:	Chordata
Class	:	Pisces
Order	:	Teleostei
Family	:	Cypriniformes

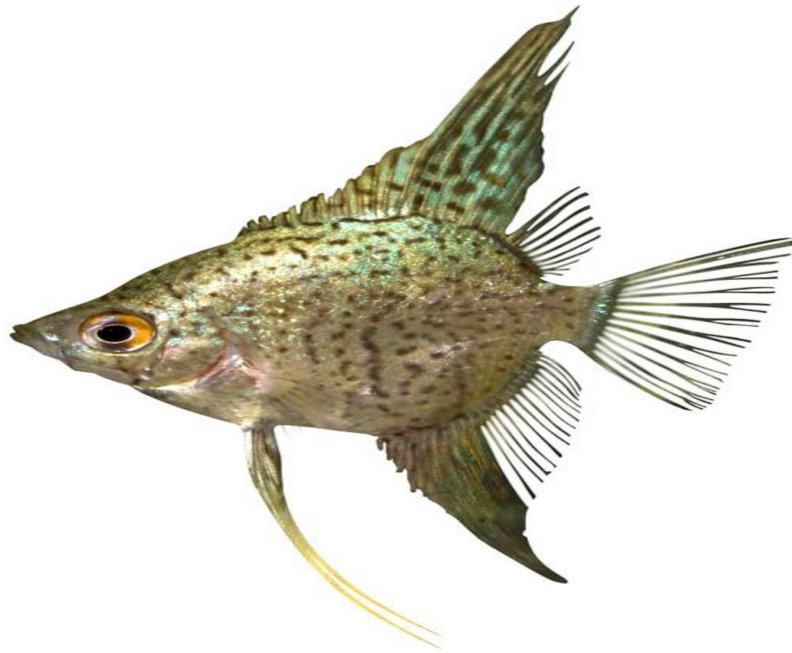


- Gold fish is an **ornamental fish**.
- **Scientific Name:** *Carassius auratus*
- **Common Name:** Gold Fish.
- **Attainable Size:** 59 cms.
- **Origin:** Central Asia, China and Japan.
- **Habitat:** Fresh water
- **Water pH:** 7.5 to 8.5,
- **Temperature:** 17 to 28°C
- **Company:** Can be kept with other large nonaggressive species if aquarium is large enough to accommodate.
- **Aquarium:** As it grows big, it requires a large aquarium. A well planted aquarium is preferred. It is a bottom dweller.
- **Feed:** Omnivorous, accept dry food, likes to eat small insects and also like vegetable food. Gold fish feeds on a large variety of food.
- **Breeding:** **Oviparous**
- It is **red or red white or black in** colour.
- It can live for **20** years.



ANGEL FISH (*Pterophyllum scalare*)

Phylum	:	Chordata
Class	:	Pisces
Order	:	Teleostei
Family	:	Cichlidae



- Angel fish is an **ornamental fish**.
  - It is a **freshwater** fish.
  - **Scientific name:** *Pterophyllum scalare*
  - **Common name:** Angel Fish
  - **Water: pH:** 6.5-6.9,
  - **Optimum temperature:** 24-28°C.
  - **Attainable Size:** 6 inches
  - **Origin:** It originates from South America
  - **Feed:** Omnivore.
  - **Breed:** lays eggs (**oviparous**).
  - A number of varieties are available. They are
- \* Silver \* Black lace \* Black \* Half black \* Veiltail \* Marble \* Golden \* Pearl scale.

ANEMONE FISH

Kingdom	:	Animalia
Phylum	:	Chordata
Class	:	Actinopterygii
Order	:	Perciformes
Family	:	Pomacentridae
Genus	:	Amphiprion



- Anemone fish is small, brightly coloured marine ornamental fish living among the tentacles of *sea anemone*.
- It is also called clown fish as it is very actively '**clowning**' around sea anemone.
- It is brightly coloured with three white bands around the body.
- It is small in size - 2 to 5 inches.
- It is a **warm water** fish living in coral reefs.
- It is **aggressive**.
- It leads a **symbiotic life with sea anemone**.
- The *mucous coat* of clown fish protects it from the sting of sea anemone.
- It is an **omnivorous**.
- Clown fish are sequential hermaphrodites.
- It lives in a colony. The colony consists of a mating couple and their offspring. All offspring are males.
- It is a territorial fish. It defends its anemone from other clown fish.
- On sexual maturity, one male changes into female.
- When the female dies, one dominant male change into female. So the colony has only one female.
- Female lays eggs in rock nests. (**Oviparous**).
- Male fertilizes and guards the eggs.
- The eggs are hatched into males in 6 to 10 days.
- They can live for 3 to 5 years in the aquarium and for 10 years in the wild.

**BUTTERFLY FISH**

Kingdom	:	Animalia
Phylum	:	Chordata
Class	:	Actinopterygii
Order	:	Perciformes
Family	:	Pomacentridae
Genus	:	Chaetodontidae



- They are found mostly on the reefs of the *Atlantic, Indian and Pacific* oceans.
- There are approximately **120 species in 10 genera**.
- Butterfly fish looks like smaller versions of angelfish (Pomacanthidae) but unlike these lack preopercle spines at the gill covers
- Butterfly fishes are fairly small, mostly from **12 to 22 cm in length**. The largest species grow up **to 30 cm**.
- Many bear shades of **black, white, blue, red, orange and yellow**. Some species are dull in colour.



**ZEBRA FISH** (*Danio rerio*)

Kingdom	:	Animalia
Phylum	:	Chordata
Class	:	Pisces
Order	:	Teleostei
Family	:	Cyprinidae



- It is an **ornamental fish**.
- **Habitat:** freshwater fish.
- It is native of streams of **Himalayas**. It commonly inhabits streams, canals, ditches, ponds and paddy fields.
- It has five horizontal blue stripes on the side of body similar to zebra horse.
- Males are torpedo-shaped and have gold stripes between the blue stripes.
- Females have a larger whitish belly and have silver stripes instead of gold.
- **Attainable Size:** 3.8 cm.
- **Lifespan:** 5 years.
- **Breed:** It lays eggs (**oviparous**).

**KOI (Cyprinus carpio)**

Kingdom	:	Animalia
Phylum	:	Chordata
Class	:	Pisces
Order	:	Teleostei
Family	:	Cyprinidae



- **Common Name:** Koi Carp
- **Attainable Size:** 48 inches
- **Environment:** Fresh and brackish Water
- **Company:** Can be kept with most large nonaggressive species
- **Water : pH:** 7.0 -7.5, Temperature: 30 -32°C
- **Aquarium:** Requires a very large aquarium with a lot of space to swim on the surface. Areas with plants are appreciated if your aquarium can support both plants and open area.
- **Feed:** All kinds of food. Breeding: Females are rounder in spawning condition. Move eggs to a separate aquarium since parents eat them.
- They have different colours - white, black, red, yellow, blue, cream, etc.

TETRA FISH

- **Habitat and Distribution:** Asia, Pakistan, India, Bangladesh, Myanmar, Thailand and Malaysia.
- **Feeding: Omnivores**, meaning that they feed on both living animal and plant foods.
- **Breed: oviparous.**
- Tetra fish have well developed teeth that vary according to the gender.
- They are fast swimmers, very active and prefer grouping in schools by species.
- Most have scales with metallic shine.
- Colours are grouped in stripes, dots or spots. Very rarely they cover the whole body.
- The shape of the body is not typical for the whole family, and varies significantly from one Gender to another.
- Their behaviour varies from absolutely peaceful to aggressive.
- Whenever possible they will be supplied with some live food, such as mosquito larvae, water fleas( Daphnia), well-purged and washed tubifex and eventually scraped raw meat, frozen and frozen beef heart with the vegetable grater or boiled chicken liver and stepped on.

**MOLLY (*Poecilia*)**

Kingdom	:	Animalia
Phylum	:	Chordata
Class	:	Pisces
Order	:	Teleostei
Family	:	Poeciliidae



- Molly is an ornamental fish.
- It belongs to the family of swordtails and guppies.
- ***Habitat*** :Brackish water fish
- A table spoon of salt is added to the tank for better performance of molly.
- ***Feed*** : Omnivore
- ***Life span***: 5 years.
- ***Breed***: Live-bearer giving birth to young ones.

GLASS FISH (*Parambassis ranga*)

- **Common name :** Indian Glassy Fish, Indian Glassy Perch, Indian X-Ray Fish, Siamese Glassfish, and sometimes as the Malaysian Glassy Fish, the Glass Fish is one of the more fascinating species of aquarium fish.
- Fish have a laterally compressed body
- This is a fish whose transparency allows us to see without problems its skeleton and its internal organs.
- They are often sold injected with fluorescent colours, like blue, yellow, green, purple among others.
- **Size:** 3 inches
- **Water pH :** 6.5 - 7.5
- **Optimum Temperature:** 68° - 86°
- **Origin:** Southern Asia from Pakistan to Malaysia
- **Breed:** To induce spawning they need slightly brackish water conditions with elevated temperatures. They may place eggs on plant leaves. Raising the fry is another story all together.



CICHLID (*Pseudotropheus crabro*)



- Cichlid, any of more than 1,300 species of fishes of the family Cichlidae (order Perciformes), many of which are popular aquarium fishes.
- Cichlids are primarily freshwater fishes and are found in tropical America, mainland Africa and Madagascar, India and southern Asia.
- Depending on the species, cichlids range from vegetarian to carnivorous.
- The majority of species are African, appearing in great diversity in the major African lakes.
- Cichlids are rather deep-bodied and have one nostril (rather than the usual two) on each side of the head.
- The lateral line is discontinuous, and there are three or more anal spines.
- They generally have rounded tails and, though sizable for aquarium fishes, usually do not grow longer than about 30 cm (12 inches).

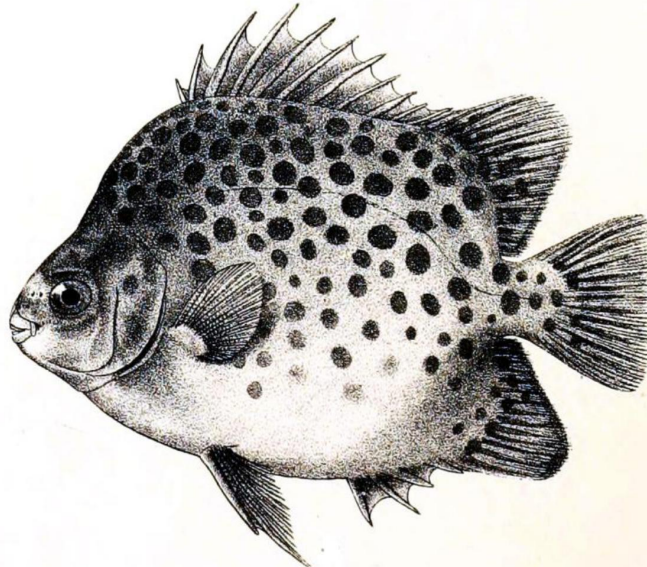


**SEAHORSE (*Hippocampus*)**

Kingdom	:	Animalia
Phylum	:	Chordata
Class	:	Actinopterygii
Order	:	Syngnathiformes
Family	:	Syngnathidae
Genus	:	Hippocampus
Common	:	Seahorse
Scientific	:	Hippocampus

- **The seahorse** is a small species of vertebrate that is found in the tropical shallows and temperate waters around the world.
- The sea horse is also commonly found around coral reefs where there is plenty of food and places for the seahorse to hide.
- **Origin:** Worldwide
- **Diet:** Omnivore
- **Size :** 2.5cm - 30cm (0.9in - 12in)
- **Habitat :** Fresh, Brackish, Salt
- **Optimum pH Level:** 7.9 - 8.4
- **Lifespan:** 2 - 6 years
- **Conservation Status:** Endangered



SPOTTED SCAT (*Scatophagus argus*)

- **The Spotted Scat** is an extremely attractive fish with a silvery or bronze case and covered with spots.
- **Feed:** Omnivorous species. In the wild they feed on a variety of plant matter along with worms, crustaceans, and insects.
- **Lifespan:** 20 years.
- With two colour versions of the Spotted Scat, the Red Scat and the Green Scat, this fish has a lot to offer. The Green Scat is the type most commonly seen.
- The Ruby Scat or Red Scat is a red subspecies.
- A few of the other names they are known by include *Argus Fish*, *Common Scat*, and *Leopard Scat*.
- These are all big, attractively patterned, and very durable fish. Almost every brackish aquarium will include at least one these types.
- The Spotted Scat is a bit larger brackish fish than either of those other two, typically reaching 6 - 8 inches (15-20 cm) in the aquarium.
- **IUCN Red List:** LC - Least Concern

UNIT IIIMASS PRODUCTION OF FANCY FISHES**Community of Aquarium Fishes**

- An aquarium containing many types of fishes is called *community aquarium*. The fishes of different types living together in a community aquarium are called *community aquarium fishes*.

The fishes for community aquarium should possess the following characteristics:

1. They should be *compatible*.
2. They should be *cooperative*.
3. They should not be *aggressive*.
4. They should not have *territorial habit*.
5. They should not be *predatory*.
6. Very large fishes should not be included.
7. *Slow-eaters* should not be included.
8. Fishes with different feeding habits should be included. They are
  - *Surface feeders*
  - *Column feeders*
  - *Bottom feeders*
  - *Scavengers*
- The *scavengers* eat away the left over feed and the debris.
- The community aquarium should have sufficient hiding sites (covers) such as rocks, caves, plants, wood, etc
- The following fishes can be kept in community tanks:
  - *Angel fish*
  - *Tetras*
  - *Rasboras*
  - *Danios*
  - *Rainbow fishes*
  - *Gourami*
  - *Cat fishes*

*The following fishes should not be included in community tanks:*

- *Red tailed black shark*
- *Snake heads*
- *Leaf fishes*
- *Bucktooth tetras*
- *Tinfoil barbs*
- *Iridescent sharks*
- *Large cat fishes*
- *Thread fin rainbow fish*
- *Pipe fishes*

Making fish to spawn by artificial methods is called induced breeding.

### **Induced breeding**

1. *Hypophysation*
2. *Ovaprim injection*

#### **1. Hypophysation**

- *Hypophysation* is a technique of induced breeding in fishes by injecting *pituitary gland extract*.
- In hypophysation, the pituitary gland extract is injected into the fish. The gland induces the fish to breed.
- When the pituitary gland of the same species is used, the hypophysation is called ***homoplastic***.
- Induced breeding is practiced in a wide variety of ornamental fishes.  
Eg. *Gold fish, Koi, etc.*

#### **Principle of Hypophysation**

- Environmental factors stimulate the hypothalamus of the brain.
  - The hypothalamus secretes a hormone called releasing hormone.
  - The releasing hormone stimulates the pituitary gland to secrete gonadotrophic hormones.
  - The gonadotrophic hormones stimulate the gonads.
  - The gonads in turn, secrete sex hormones.
  - The sex hormones produce the gametes, secondary sex characters, sexual behaviour, etc.
- This principle is applied in hypophysation.

**Procedure of Hypophysation**

Hypophysation involves the following steps:

1. *Collection of pituitary gland*
2. *Preparation of pituitary extract*
3. *Selection of breeders*
4. *Injection of pituitary extract*
5. *Breeding*
6. *Hatching*

**1. Collection of Pituitary Gland**

- The first step in hypophysation is the collection of pituitary gland. The gland is collected from *mature fishes* or any *other vertebrates*.

**2. Preparation of Pituitary Extract**

- The glands are macerated in a tissue homogenizer with a little distilled water.
- The homogenate is diluted with distilled water.
- The preparation is centrifuged at about 1000 rpm for 5 minutes.
- The supernatant is the pituitary extract. It is preserved in glycol

**3. Selection of Breeders**

- Mature males and females are selected and stocked for hypophysation
- Two males and one female form one unit for hypophysation.

**4. Injection of Pituitary Extract**

- The selected males and females are kept on a table on a cotton cushion.
- The extract is injected intramuscularly at the base of the pectoral fin or pelvic fin or caudal fin.
- About 0.5 to 2ml of extract is given for breeders weighing upto 10 kg.
- The female is given two doses, namely
  1. *A preparatory dose and*
  2. *A resolving dose.*
- About 4 hours interval is given between the two doses.
- The male is given only one dose.

**5. Breeding**

- After injection of the pituitary extract, the breeders are introduced into a breeding tank.
- They breed in six hours. After spawning, the breeders are transferred to rearing tanks.



## 6. Hatching

- In ten hours, the eggs are fertilized.
- The eggs are hatched.

## Ovaprim

- Ovaprim is a synthetic injection used for induced breeding in fishes.
- It is a substitute for pituitary extract
- It is a liquid peptide and is ready for injection.
- Ovaprim contains two components, namely:
  1. *Gn RH-Gonadotropin releasing hormone*
  2. *Domperidone (Dopamine inhibitor)*
- When ovaprim is injected into the muscle or body cavity of fish, it induces maturation. Male can produce sperms and female can produce eggs.
- Males need one injection and females need two injections.
- The Gn RH elicits the release of gonadotropins from the pituitary gland.
- The dopamine inhibitor serves to remove any other inhibition of Gn RH release and effect.
- The eggs are released in 4 hours after injection.

## Stripping

- Stripping is the collection of eggs and sperms (milt) manually by pressing the abdomen of brood fishes.
- Stripping is a method of collection of eggs and milt (sperms) from the fishes.
- Sexually mature males and females are identified.
- Two males and one female are transferred to a breeding tank.
- Optimum conditions are maintained. Continuous aeration is provided.
- They are given ovaprim injections.
- The female is given two doses and the male is given a single dose.
- They will spawn 4 hours after the second injection
- Stripping process is started on the 3rd hour after the second dose of injection
- The female is captured.
- It is anaesthetised with the anaesthetics **MS-222**.
- The water is **wiped** off with a soft towel.
- The head of the fish is held on one hand with the tail down

- With the help of the other hand, a gentle pressure is applied on the abdomen, moving towards the vent
- A stream of eggs flows from the vent
- The stream of egg is collected into a clean dry bowl.
- Then males are captured and stripped one by one in the same way.
- The milt is collected in the same bowl containing eggs
- After stripping, the breeders are released into the tank
- The sperms fertilize the eggs
- The fertilized eggs are transferred to a nursery tank for further development.

## Principles of Feed Formulation

1. The feed must be a balanced diet.
2. The feed should produce optimum growth rate.
3. The feed should contain all the essential amino acids and essential fatty acids. Fish meal is a good source of essential amino acids and essential fatty acids. Hence fish meal should be compulsorily included in the feed.
4. Ingredients of plant origin and animal origin should be included.
5. The feed must be in low cost but in good quality.
6. Certain vitamins and minerals may be excluded as the fish may get them from natural feed sources.
7. The feed must be acceptable by the fish.
8. The typical adult feed should contain more protein but less carbohydrate. In the case of fry, the fats should be less.
9. It should contain all the nutrients essential for life activities. The following nutrients should be included in the artificial feed:

•**Carbohydrates** •**Proteins** •**Fats** •**Vitamins** •**Minerals** •**Additives** *binders* •**Preservatives**  
 •**Chemoattractants**

10. The feed should contain **carbohydrate**. It is the **source of energy**. The energy value of carbohydrate is 4kcal/gram.

*The following are the sources for carbohydrate (energy source)*

1. Rice bran
2. Tapioca flour
3. Wheat bran
4. Corn bran
5. Sorghum, etc.

11. **Proteins are the body builders.** An ideal feed should contain 40% protein. The energy value of protein is 4.5kcal/g. The ingredients containing protein are the following:

• **Fish meal • Silk worm pupae • Blood meal • Prawn waste • Clam meat • Slaughter house waste • Ground nut oil cake • Cotton seed cake • Coconut oil cake • Gingelly oil cake • Linseed cake • Sunflower cake**

12. The fish feed must contain **fats**. The fats are the **energy producers**. They contain more energy than that of carbohydrate and protein. The energy value of fats is 9kcal/g.

The following are the fat source of fish feed:

- **Vegetable oils**      • **Fish oils**

13. The feed must contain **Vitamins**. The following vitamins are essential for fish.

1. Vitamin A
2. Vitamin B
3. Vitamin C
4. Vitamin D
5. Vitamin E
6. Vitamin K

14. The **minerals** are essential for vital activities of fish. The fish feed should contain the following minerals in trace amount:

• **Calcium • Sodium • Potassium • Phosphorus • Magnesium • Copper • Iron • Zinc • Cobalt**

15. The **additives** are added to make the **feed stable**. When additives are added the feed will **not dissolve and disappear in the water**. They bind the feed ingredients. So they are also called **binders**. Eg. Tapioca flour, Rice flour, agar, etc.

16. **Preservatives** are added to prevent the decay of the feed.

17. **Chemo attractants** are added to add flavour and taste to the fish feed.

18. The ingredients are selected according to their availability and cost.

19. The ingredients are ground well and mixed thoroughly.

20. They are made into *pellets, dried and stocked*.

The following is a typical artificial feed formula:

<i>Tapioca flour</i>	-	9 kg
<i>Rice bran</i>	-	27 kg
<i>Fish meal</i>	-	23 kg
<i>Ground oil cake</i>	-	14 kg
<i>Silk worm pupae</i>	-	26 kg

### ***Preparation of Dry Pelleted***

#### **Feed at Home**

1. Take the needed ingredients in appropriate proportion.

*The ingredients are fish meal, soyameal, carbohydrate sources such as cereals, vitamins, minerals, chemoattractants, binders, antimicrobial agents, an- tioxidants, etc.*

2. Mix all the ingredients with adequate water and make into dough.

3. Cook the dough in a pressure cooker or by steaming. Take care to avoid overcooking which will degrade the quality of the food.

4. Make the feed into pellets by passing through a machine called pelletizer.

5. Pellets are either air dried or dried in shade without affecting the prescribed moisture content.

6. The dried pellets are stored in air tight containers.

### **Preparation of Crumbles and Granules**

In this feed preparation, the cooked feed is not pelletized but made into small granules or crumbles with hand and then dried in shade.

#### **Feeding Methods**

The ornamental fishes may be

<i>Herbivores</i>	-	<i>Plant eaters</i>
<i>Carnivores</i>	-	<i>Meat eaters</i>
<i>Omnivores</i>	-	<i>Eat both plants and meat</i>

\* Ornamental fishes are in *captivity*. So they cannot select their food. The aquarist should provide the suitable food.

They are given two types of feed, namely

**1. Live feed.**

**2. Artificial feed.**

\* **Live feed** are living organisms. The following constitute live feed:

- *Tubifex*- *Annelid* • *Earthworms* • *Larvae of Artemia* • *Infusorians* - *Protozoa*. • *Daphnia*
- *Cyclops* • *Meal worms* • *Blood worms* • *White worms* • *Microworms* • *Mosquito larvae, etc.*

\* **Artificial fish feed** is the prepared food. It is prepared by mixing the following ingredients:

<i>Tapioca flour</i>	-	9 kg
<i>Rice bran</i>	-	27 kg
<i>Fish meal</i>	-	23 kg
<i>Ground oil cake</i>	-	14 kg
<i>Silk worm pupae</i>	-	26 kg

## Live Feed

- Live feed refers to living organisms used as feed for ornamental fishes.
- Live food contains all the nutrients such as
  - **Proteins** • **Lipids** • **Carbohydrates** • **Vitamins** • **Minerals** • **Amino acids** • **Fatty acids**
- Live foods are easily digestible.
- Live feed is a supplementary feed
- It is a natural food.
- It consists of phytoplankton, zooplankton and other aquatic organisms.
- It provides vigorous growth, efficient breeding and survival
- They provide bright and brilliant colouration.
- They stimulate larval feeding response.
- They will not pollute the tank.
- Fish enjoy hunting live feed, So they gain psychological benefit.
- Some live feed organisms work as scavengers in the tank. Eg. *Gammarus pulex*
- As the fish fry are tiny, the microscopic feed organisms form a convenient feed.
- The following are the feed organisms used in aquarium:
  - *Infusorians* - *Protozoa*
  - *Tubifex* - *Annelid worm*
  - *Daphnia*
  - *Cyclops*
  - *Earthworms*
  - *Artemia larva*
  - *Meal worms*



## Culture of Artemia

- Artemia are commonly known as sea monkey or brine shrimp. They inhabit salt pan waters of more than 200‰ salt content.
- Their cyst can be stored for many years.
- For laboratory hatching, the dried cysts are allowed to float on surface of filtered normal sea water.
- The cysts hatch in 24-48 hours depending on the ambient temperature.
- Prior to hatching, encapsulated cysts may be treated with 5% sodium hypochlorite or potassium hypochlorite which helps in the removal of the chorion in 5-10 seconds.
- Eggs can also be incubated in a solution made 2 teaspoons of common salt mixed in 1 litre of fresh water.
- For mass culture of *Artemia*, about 250gm of cysts are sprinkled in 100 litre of 30-35‰ seawater.
- Temperature must be maintained at 26-30°C.
- Vigorous aeration is necessary to hasten the hatching.
- The hatched *naupli* are attracted, using a light source and collected with a fine meshed net.
- They can be transferred to container of fish or prawn larvae as a live food.
- They can also be stored in freeze dried form. For continuous supply of eggs, young brine shrimps may be fed from 3d day onwards with yeast and unicellular algae.
- Adult brine shrimp also be developed in cement tanks containing 60 ppt. of salt water and organic manure. The food particles supplied should be less than 60 micron size.

## Culture of Tubifex

- Tubifex is an oligochaete Annelid.
- It is a fish feed organism.
- It is a live feed for fish fry and fingerlings.
- It is cultured in intensive method.
- It is cultured on flat trays or cement tanks.
- The culture medium is prepared by mixing sewage with sheep or pig or horse manure.
- The medium is inoculated with Tubifex.
- The Tubifex grows in red masses.
- In 15 days, it is ready for harvest.

**Method of Packaging Ornamental Fish for Export of live fish**

**Preparing fish for export**

- A few days before export, weak and diseased or dead fishes are removed.
- The active live fishes are then separated into clean water tanks according to species.
- Subsequently, the fishes are not fed for several days.
- Very small fish are stopped from feeding 12 to 24 hours before trans-shipment while for middle sized fish, it is 48 hours and larger fish should not be fed for 3 days before shipment.
- Thereafter, fish should be carefully transferred into TPB with oxygenated water for transport with minimal disturbance.

**The packaging process**

- Ornamental fish are packed in transparent polythene bags (thickness not less than 0.1mm) filled to 1/5 of its volume.
- The polythene to be chosen for the live fish export should satisfy the needs like,
  - ☐ *High oxygen retain ability*
  - ☐ *Tensile strength*
  - ☐ *Tearing strength*
- The TPB are filled with five parts oxygen to one part water. After filling with water and putting fish according to species, the upper part of the polythene bag is compressed to drive out air and then inflated with oxygen.
- The top of the bag is bent and tied with two or three rubber bands, then placed in Styrofoam boxes. The molded Styrofoam (thermo cool) boxes, seems to have revolutionized packing.
- Today the most acceptable packing material all over the world is either a complete molded Styrofoam box or a carton lined with Styrofoam of minimum 15 mm thickness.

**The following aspects of packaging process and transportation of ornamental fishes have been dealt with below**

1. *Density*
2. *Temperature*
3. *Dissolved gases*
4. *Anesthetics*

**1. Density**

- As an appropriate guide 2 kg of fish can be placed in 20 liters of water inside a polythene bag, with large oxygen filled space above it, and at 10°C, can be carried for 5 hours without the need for further oxygenation

**2. Temperature:**

- Temperature influences the activity and the oxygen consumption of the fish, as well as the oxygen carrying capacity of the water.
- High temperature especially may also be directly lethal to fish. Frozen blocks or Ice packs are advisable during transportation.

**3. Dissolved Gases**

- Fish are provided with well aerated water with an air space above it.

**4. Anesthetics (Anti-Biotics)**

- Increased physical activity during transport can adversely affect the health of the fish in several ways.
- First is physical damage by the abrasion with the packing container, second is by a physiological reaction to a physical activity and other environmental factors such as low dissolved oxygen.
- Such reaction is manifested in high blood lactate levels, which can cause serious debilitation or death.
- The level of physical activity of the transported fish must be kept to the minimum.
- Some antibiotics are employed to reduce the damage done on the fish such as *tetracycline* and *nitrofurazone*.
- The *tetracycline* about four-five tablets per one hundred and forty liters of water (140L), while the *nitrofurazone* is given one spoon full per one hundred liters (100L).

**UNIT –IV****AQUARIUM DESIGN, CONSTRUCTION AND PREPARATION****Requirements for an Aquarium**

- Aquarium is a tank with colourful fishes and plants maintained for human recreation.
- An aquarium requires the following components:

1. *Fish tank*
2. *Water*
3. *Ornamental fishes*
4. *Aquarium plants*
5. *Substrate*
6. *Aerators*
7. *Filters*
8. *Thermometer*
9. *Heater*
10. *Nets*
11. *Artificial feed*
12. *Live feed*
13. *Light*
14. *Air stone*
15. *Scrapers*
16. *Feeding cups*
17. *Siphon tube*
18. *Breeding traps*

**Aquarium Tanks**

- Aquarium tanks are made of glass panes with or without frames.
- Aquarium can be made from materials like concrete, wood, fiberglass, metal framed glass panels, extruded acrylic and all glass.

**Aquarium Size and Volume**

- An aquarium can range from small glass bowl containing less than a litre of water to large public aquaria which can house entire ecosystems such as kelp forests
- Larger aquaria are typically recommended due to their resistance to rapid fluctuations of temperature and pH, allowing for greater system stability.

- Practical limitations of a large aquarium are the weight and internal water pressure. Hence the maximum size advisable for a home aquarium is around 1 cubic meter in volume. Some Aquarists, however, have constructed aquaria of up to many thousands of litres.
- Reef aquaria, having a small water volume under 100 litres, are termed nano reefs.
- Public aquaria, designed for exhibition of large species or environments, can be dramatically larger than any home aquarium. The Georgia Aquarium, for example, features an individual aquarium of 6,300,000 US gallons (23,800 m<sup>3</sup>).

## Construction of an Aquarium Tank

1. The construction of a glass aquarium tank requires the following materials:
  - *Glass plates - 5 numbers*
  - *Silicone gel*
  - *Squeezing gun*
  - *Adhesive tape*
  - *Thermocol sheet*
  - *Rubbing alcohol (or) acetone*
  - *Containers*
2. The glass plates are cut in correct size.
3. The side glass plates should be just shorter than the final measurement for correct fitting. The difference in size should be twice the thickness of the glass. For example, if the thickness of the glass is 4 mm, the side plate should be 8 mm shorter.
4. Spread the thermocol on a smooth ground.
5. Place the bottom glass plate in the centre of thermocol.
6. Place the other 4 glass plates around the bottom plate as in the figure.
7. Clean the surfaces and edges of the glass plates with alcohol.
8. Apply silicone gel using a squeezing gun along the edges of the centre plate and the back plate.
11. Keep a heavy object on the backside of the vertical glass plate to held it in position.
12. Like this, paste the side glasses one by one and lastly the front glass.
13. Apply adhesive tapes on the corners.
14. Leave it as such for 1 day
15. On the next day, the excess of silicone gel can be removed with a knife.
16. The tank may be filled with water.



**Types of Substrate****Gravel**

- For freshwater aquaria, gravel is the most common substrate.
- To prevent damage to fish, gravel should not be sharp.
- Aquarium gravel can be as pea-sized or as fine as 1-2 mm.
- It is available in a number of colours and may be coloured or dyed.
- Gravel must be chemically inert. It is commonly composed of quartz or other lime free minerals.
- If the gravel is rough or sharp, it is not suitable for bottom-dwelling fish that may dig the substratum

**Calcium Carbonate Substrates**

- Shell grit, crushed limestone, crushed marble, crushed coral skeletons, coral sand are also used as substrates.
- Calcium carbonate is the primary component of these substrates.
- It increases water hardness and pH. Hence these are used most often for hard water species like cichlids
- Lime free gravels are much preferable for fresh water aquarium fish, particularly river species, which are adapted to soft water

**Peat or decomposed plant matter**

- Peat, or decomposed plant matter, is used most commonly in soft water systems.
- It is soft in texture and therefore suitable for demersal (bottom-dwelling) species.

**Sand**

- Sand is often recommended for use with certain species, such as the river stingrays, which bury themselves in the fine substrate.

**Ornamental Aquarium Plants**

1. Visual impact to the aquarium.
2. Shelter and territorial boundaries to the fishes.
3. Leaves of long plants trailing over the water surface provide shade and a refuge for young fishes.
4. At breeding times plants may be used as a spawning site.
5. They act as basic building materials for bubble nesting fishes
6. Some aquarium plants form food for vegetarian fishes.

7. Carbon dioxide produced by fishes is absorbed by plants; thus they control the carbon dioxide in the aquarium.
8. Photosynthetic activity of plants provides a source of oxygen for fishes.
9. Nitrates formed at the end of denitrifying action by bacteria may be taken up by the plants.
10. Live aquarium plants will prevent algal infestation by competing with algae for nutrients.
11. They will provide weaker fish with suitable hiding spots.

**Biological Filtration**

- Biological filtration is the removal of wastes from the aquarium using bacteria and plants.
- Biological filtration deals with the growing of the good bacteria in the filter.
- The good bacteria are convert ammonia to nitrite and then convert nitrite into nitrate.
- Thus establishment of bacteria is essential for the success of a tropical aquarium.

**Ammonia -> Nitrite -> Nitrate**

**Accessories for Fish Tanks****Hood**

- The part that covers the part that typically covers the lighting fixture is the hood. It may also incorporate a plastic lid to cover the top of the aquarium.
- The single hood that covers the aquarium and houses a light usually is less expensive than a separate lid and lighting unit.

**Aerator**

- Aerator is an electrical device generating air.
- It consists of a motor and a pump.
- It works like a compressor.
- It produces air. The air is passed into the aquarium.
- This dissolves air in aquarium water. Hence the aquarium water is oxygenated. Fish get sufficient O<sub>2</sub>.
- The turbulence removes CO<sub>2</sub>, from the water.
- Air bubbles add attraction to the aquarium.

**Light**

- Lighting makes an aquarium more attractive. It is also an essential stimulus to the plants and fishes.
- Aquarium plants need light to photosynthesis-a process by which they remove CO<sub>2</sub> from water.

- Light can be easily provided by means of lamps mounted in the aquarium cover usually referred to as hood or reflector.
- Tungsten lamps, fluorescent tubes or a combination of the two can be used.
- The aquarium should be lit for at least 10 hours each day.

**Nets**

- Nets of various sizes are needed in an aquarium. Nets may be used for a variety of tasks
  1. To skim debris from a tank
  2. To catch fish of various sizes
  3. To scoop up a meal of freshly hatched brine shrimp.

The following points should be considered while choosing a net:

- Net material should not cause scale damage.
- Mesh size should be selected in such a way that it should not allow the fish to go through or get caught in.
- The net material should be soft (silk or muslin cloth) and flexible.
- It must have easy to use handles.

**UNIT- V****AQUARIUM MAINTENANCE****Water Quality Management in Aquarium**

- Water is the home of the fish. The fish lives, feeds, breathe breeds and defaecates in the aquarium water. So water quality management is vital for the fish.
- If the water is not properly managed, the water becomes toxic and kills the fishes.

**Water quality is managed in the following ways:**

- \* The optimum pH for aquarium is 7 to 8. It is alkaline.
- \* The organic wastes released by the fishes make the water acidic. The acidic water is made alkaline by the addition of slaked lime, Calcium hydroxide.
- \* Sodium bicarbonate and tries stabilizes the pH for one or two weeks.
- \* Aquarium fishes prefer soft water. A hardness range of 100 to 300 ppm is suitable.

**The hard water is made into soft water by the Following methods:**

1. Boiling the water. It decomposes bicarbonates into CO<sub>2</sub>, and insoluble monocarbonates.
2. Passing the water through zeolite (sodium aluminium silicate). It absorbs lime and magnesium from the water.

3. By the addition of sodium carbonate, soluble calcium and magnesium salts are precipitated as insoluble  $\text{CaCO}_3$  and  $\text{MgCO}_3$ . They are removed by distillation.

4. Chlorine from chlorinated water is removed by two methods

1. *Strong aeration.*
2. *Addition of dechlorinating additives*
3. *Heating*
4. *Exposing to sunlight.*

5. The optimum  $\text{O}_2$  level of aquarium water is 5ppm. The  $\text{O}_2$  level is enhanced by the following methods.

1. *Aeration*
2. *Agitation*
3. *Sprinkling of water.*

6. The optimum level of  $\text{CO}_2$  is 60 mg/l.  $\text{CO}_2$  level increases due to respiration. Aquarium plants absorb  $\text{CO}_2$ .  $\text{CO}_2$  is identified by phenolphthalein indicator.

7. As the fishes are ammonotelic, they excrete ammonia. More than 1mg/l of ammonia is toxic.

8. The optimum temperature for aquarium water is 23 to 28°C (73 to 82°F).

9. Anaerobic condition in the aquarium bed, converts sulphate into hydrogen sulphide ( $\text{H}_2\text{S}$ ). 0.01 to 0.5 mg/l is known to be lethal to fishes.  $\text{H}_2\text{S}$  can be reduced by the following methods:

1. *Aeration-adding  $\text{O}_2$*
2.  *$\text{O}_2$  reacts with  $\text{H}_2\text{S}$  and produces sulphate ions*
3. *Water change*
4. *Application of lime*
5. *Increasing pH*

**Diseases can be classified into the following types**

1. *Bacterial*
2. *Viral*
3. *Fungal*
4. *Protozoan*
5. *Parasitic diseases*
6. *Deficiency diseases*

**1. Bacterial disease****Fin Rot**

**Causative Organism:** *Aeromonas*, *Pseudomonas* or *Vibrio* (Gram negative organism)

**Description**

- Fin rot is one of the most common and most preventable, diseases in aquarium fish.
- It is caused by several types of bacteria and often occurs concurrently with other diseases.
- It can usually be cured, but if left untreated, it can kill the diseased fish and infect all the others in the tank.

**Symptoms**

- Fin edges turn white
- Fins fray
- Bases of fins inflamed
- Entire fin may rot away
- Degeneration of the tissues between individual rays of the fin.
- As the disease advances, the area may become red and inflamed, with bloody patches appearing as more of the fin is eaten away.

**Causes**

- Stress
- Poor water quality.
- Overcrowding the tank
- Feeding outdated food
- Overfeeding

**Treatment**

- Water change
- Treat with antibiotics like chloramphenicol, oxytetracycline, and tetracycline.
- Removal of food debris.
- Addition of aquarium salt.

**Prevention**

- Maintain good water quality
- Keep proper water parameters
- Feed fresh food of high quality in small amounts
- Avoid stale foods



## 2. Viral Diseases

### Carp Pox

- This results in epidermal hyperplasia.
- It is thought to be due to a herpes virus. It is present as discrete candle like lesions.
- It is an epidemic occurring in spring but disappearing in late summer.
- The disease has also been attributed to avitaminosis and calcium deficiency.

### Prevention

- Keeping good sanitary condition
- Avoiding over crowding

### Spring Viraemia of Carp (SVC)

- SVC is the most important viral disease of ornamental carp. It is caused by *Rhabdovirus carpio*.

### Symptoms

1. Lethargy
2. Darkening of the skin
3. Respiratory distress
4. Loss of balance
5. Abdominal distension (dropsy)
6. Exophthalmia
7. Peritoneal haemorrhage of gills and skin

### Control

1. Isolation of infected school of fishes
2. Provide food soaked in a solution of methylene blue
3. Antibiotics such as terramycin, chloromycetin/ chloroamphenicol have proved effective against this disease.

## 3. Fungal Diseases

- Various fungal diseases are seen in aquarium fish. Most fungal diseases are associated with poor environmental conditions, malnutrition or other primary diseases.

### Saprolegniasis

- Saprolegniasis is a fungal disease.
- It is also called water mould disease or *dermatotycosis*.
- It is caused by the fungus *Saprolegnia parasitica*.

- The fungus is a coenocytic mycelium without a cell wall.
- On a dead fish, the mould can spread and cover the entire body in 12 to 24 hours.
- It is a skin disease.
- The fish secretes a great deal of mucous. Tufts of cotton wool-like structure appear on the skin.
- Ulcer develops on the skin. Haemorrhage occurs from the wound.
- The fish rubs the body against solid materials.
- Blindness occurs.
- Loss of appetite
- The fish moves slowly and eventually dies.

#### Treatment

- Disinfect the pond with quicklime.
- Dip treatment in 3 % common salt solution for 5 to 10 minutes.
- Dip treatment in potassium permanganate solution 1:1000.
- Dip treatment for three seconds in malachite green 1:1000.
- Apply malachite green ointment or sulfa-ointment.

#### 4. Protozoan Diseases

##### Ich

##### Causative Organism

- *Ichthyophthirius multifiliis*- a Protozoan parasite.
- Common Names: ***Ich, white spot***
- This is the most common disease. The parasite is a Protozoan. It is spherical in shape with cilia covering the surface.
- They burrow under the skin of the fish where they set up an irritation and spread, all over the body and fins.
- When they fully develop and mature, they leave off their host and individually form a cyst.
- The cyst will adhere to plants and rocks. The cyst capsule will burst and release thousands of tiny spores which re infects the fish.

### Symptoms

- Small white spots resembling sand
- Fish scratch against rocks and gravel
- In advanced stages fish become lethargic
- Redness or bloody streaks in advanced stages
- Infected fish scratch against rocks and gravel in an effort to get relief
- Fishes hold their fins and tail flat.

### Treatment

- Medicate for 10-14 days. Malachite green, methylene blue, quinine hydrochloride and meprazine hydrochloride are all effective
- Reduce medication when treating scale less fish
- Discontinue carbon filtration during treatment
- Perform water changes between treatments

### Prevention

- Quarantine new fish for two weeks
- Treat plants before adding to tank
- Maintain high water quality
- Provide fish with a nutritionally balanced diet

## 5. Parasitic Diseases

- Parasites live on or inside the ornamental fishes. Parasites can be classified into two groups, *ectoparasites* and *endoparasites*.

### Ectoparasites

- Ectoparasites are found on the external surfaces such as skin, fins and gills.
- In ornamental fishes, the common *endoparasites* are *blood parasites*, *intestinal worms* and *protozoan*.

### Crustacean Ectoparasites

#### *Argulosis*

- Argulosis is a parasitic disease caused by Argulus
- Argulus is a copepod crustacean.
- It is commonly called fish lice.

- Argulus is an ectoparasite.
- It is attached to the body with the help of suckers and hooks
- It sucks the blood and body fluids of the fish
- Anaemia is caused.
- Red patches appear on the body.
- The fish loses scales.
- Gills are damaged.
- Stunted growth.
- Mass mortality occurs.

**Treatment**

- Dip treatment in **lysol-water** solution 1:5000 for 10 seconds.
- Dip treatment in *potassium permanganate* 1:1000 for 40 seconds.
- Dip treatment in 1% common salt solution.
- *Casuarina poles* are planted in the culture pond. This will help the fish to rub the body against the poles to scrap away the parasite.

**Endoparasites**

- Endoparasites are found in the internal tissues and organs. Most of the endoparasitic diseases are caused by trematode, cestode and nematode worms.
- Worms protruding from the anus is another indication. Identification of sporozoan and protozoan endoparasites often requires microscopic examination of tissues

**Intestinal Parasites****Symptoms**

- Worms sticking out through the vent; emaciation of the body

**Cause**

- Different varieties of intestinal worms.

**Treatment**

- Anti helminthics are added to the daily diet. Add 1 tablespoon of aquarium salt for each 5 gallons of water to help fish with normal body fluid functions.
- Activated carbon if any is removed during treatment. Change 15 percent of the water daily to keep environmental conditions optimal.

**QUESTION BANK**

**UNIT- I**

**IMPORTANCE AND SCOPE OF ORNAMENTAL FISH CULTURE**

**I. Two mark questions**

1. Aquarium
2. Cichlid

**II. Five mark questions**

3. Give a short note on importance and scope of ornamental fish culture

**III. Ten mark questions**

4. Write about the Commercial value and potential trends in ornamental fish farming in the world and in India.
5. Mention the budgets required for setting up an aquarium fish farm as a Cottage Industry.

**UNIT – II**

**IMPORTANT FRESHWATER AND MARINE ORNAMENTAL FISHES**

**I. Two mark questions**

1. Exotic fish species
2. Feminization
3. Fertilization
4. Indigenous fish species
5. Protandray
6. Protogyny

**II. Five mark questions**

7. Write the systematic and biology of Guppy.
8. Write the systematic and characteristics of Sword tail.
9. Write the systematic and salient features of Gold fish.
10. Write the systematic and biology of Angel fish.



11. Write the systematic and characteristics of Blue morph.
12. Write the systematic and salient features of Anemone fish.
13. Write the systematic and salient features of Butterfly fish.
14. Write the systematic and salient features of Zebra fish.
15. Write the systematic and salient features of Koi.

**III. Ten mark questions**

16. Write the systematic and salient features of Tetra.
17. Write the systematic and salient features of Molly.
18. Write the systematic and salient features of Glass fish.
19. Write the systematic and salient features of Cichlids.
20. Write the systematic and salient features of Hippocampus.
21. Write the systematic and salient features of Scat fishes.

**UNIT – III****MASS PRODUCTION OF FANCY FISHES****I. Two mark questions**

1. Diurnal
2. Anesthetics
3. Artificial feed.
4. Blood worm
5. Breeding
6. Brood stock
7. Carnivores
8. Community aquarium.
9. Herbivores
10. Hermaphrodite
11. Induced breeding
12. Live bearer
13. Live feed
14. Metamorphosis
15. Mouth brooder

16. Nocturnal
17. Omnivores
18. Ovaoprim
19. Ovaprim injection
20. Pellets
21. Rotifers
22. Stripping
23. Tubifex
24. Hypophysation

**II. Five mark questions**

25. Write short note on pellets.
26. Mention the Principles of Feed Formulation
27. Write short note on *Hypophysation*
28. Give a short note on *Ovaprim injection*
29. Write short note on different types of feeds used in aquarium.

**III. Ten mark questions**

30. Describe the induced breeding methods in ornamental fish seed production.
31. Give a detailed account on preparation and composition of formulated fish feeds.
32. Describe types of artificial feeds.
33. Explain the importance of live feed for ornamental fish culture.
34. Explain – Egg laying ornamental fishes.
35. Give an account on live bearer ornament fishes.
36. Explain the procedure for the culture of tubifex.
37. Explain - Culture of rotifers,
38. Describe the methods of transportation of live fishes.

**UNIT IV**

**AQUARIUM DESIGN, CONSTRUCTION AND PREPARATION**

**I. Two mark questions**

1. Aerators
2. Air pump
3. Air stone
4. Biological filtration
5. Gravel
6. Hood
7. Sand
8. Light
9. Marine aquarium
10. Nets.
11. Substrate

**II. Five mark questions**

12. Describe the Types of Substrate
13. Give a shot note on Biological Filtration

**III. Ten mark questions**

14. Explain - Aquarium design, Construction and preparation.
15. Explain importance of aquarium plats.
16. Describe the types of filters used for aquarium.
17. Give an account on aerators and filters in home aquarium.

**UNIT - V**

**GENERAL AQUARIUM MAINTENANCE**

**I. Two mark questions**

1. Common bacterial disease
2. Crustacean infections
3. Disease management
4. Dropsy
5. Ectoparasite
6. Entoparasite
7. Feeding regimes.
8. Fungal
9. Gill rot
10. pH
11. Protozoan disease
12. Viral disease

**II. Five mark questions**

13. Discuss the biological factor, nutrient and water quality management.
14. Discuss the water quality management in a home aquarium.

**III. Ten mark questions**

15. Write an essay on parasitic diseases, causative agents, symptoms and their control measures.
16. Write an essay on bacterial diseases, causative agents, symptoms and their control measures.
17. Write an essay on viral diseases, causative agents, symptoms and their control measures.
18. Explain the causative organism, symptoms and their control measures of protozoan

**TWO MARK**

**UNIT-I**

**IMPORTANCE AND SCOPE OF ORNAMENTAL FISH CULTURE**

**I. Two mark questions**

**1. Aquarium**

Aquarium is a tank with colourful fishes and plants maintained for human recreation.

An aquarium requires the following components:

*1. Fish tank 2. Water 3. Ornamental fishes 4. Aquarium plants etc.,*

**2. Important and scope of ornamental fish culture**

1. It is a *hobby* giving pleasure to everyone.

2. It *relaxes our mind* when feel tired.

3. This hobby is said to *reduce blood pressure*.

4. Children gain *knowledge and skills*.

**3. Important species for aquarium.**

Guppy, tetra, Platy, Betta, Gold fish etc.,

**UNIT – II**

**IMPORTANT FRESHWATER AND MARINE ORNAMENTAL FISHES**

**I. Two mark questions**

**1. Exotic fish species**

It is comes from a *different country* or culture.

**2. Feminization**

Feminization is the changes of a male fish into a female fish.

**3. Fertilization**

Fusion of male and female gametes is known as fertilization

**4. Indigenous fish species**

Originating or occurring *naturally in a particular place*.



**5. Protandry**

The fish is born as male and later changes into female

**6. Protogyny**

The fish is born as female and later changes into male

**7. Hippocampus**

Hippocampus is also known as the common seahorse, estuary seahorse, yellow seahorse

**8. Butterfly fish**

The butterfly fish is a generally small sized species of marine fish, found in tropical and subtropical waters, primarily around coral reefs.

**9. Oviparous**

Animals reproduced by laying eggs

**10. Viviparous**

Animals reproduced by give birth (babies)

**11. Ovoviviparous**

Fishes retain the eggs inside their body, eggs are hatched inside the body and youngones are born.

**UNIT – III****MASS PRODUCTION OF FANCY FISHES****I. Two mark questions****1. Diurnal**

Diurnal is a form of animal behaviour activity in day time.

**2. Anesthetics**

A substance that makes you unconscious or makes specific body parts without sensation so that don't feel pain

**3. Artificial feed.**

Artificial feed refers to the feed preparation by mixing various food ingredients.

**4. Blood worm**

These are midge larvae naturally occurring in the bottom of stream and rivers. It is a fish feed. They can be high in protein

**5. Breeding**

Breeding refers to the production of youngones by sexual reproduction.

**6. Brood stock**

A fish or a fish pairs that is used for breeding

**7. Carnivores**

A carnivore is an animal that gets food from killing and eating other animal.

**8. Community aquarium.**

An aquarium containing many types of fishes is called *community aquarium*.

**9. Community aquarium fishes**

The fishes of different types living together in a community aquarium are called *community aquarium fishes*

**10. Herbivores**

A herbivores is an animal that gets food from plants.

**11. Hermaphrodite.**

An animal having both male and female sex organ is known as hermaphrodite

**12. Induced breeding**

It a process this process of making fish to spawn artificially.

**13. Live bearer**

The animal giving birth to young ones

**14. Live feed**

Living organism used as fish feed.

**15. Metamorphosis**

Metamorphosis is a biological process this process, a complete change of form from larva to adult.

**16. Mouth brooder**

Fish that hold eggs and fry in their mouths is called moth brooder. Ex. Cichlids

**17. Nocturnal**

Animals are take rests during the day and become active at night time.

**18. Omnivores**

Omnivores an animal that gets food from animals and plants.

**19. Ovaprim**

It is a drug used as an instead for pituitary extract in induced breeding.

**20. Pellets**

Pellets are formulated feed ingredients mixed, cooked and extruded in the form of noodles.

**21. Rotifers**

The rotifers commonly called wheel animals or wheel animalcules, make up a phylum (Rotifera) of microscopic and near-microscopic pseudocoelomate animal

**22. Stripping**

Stripping is the collection of eggs and sperms (milt) manually by pressing the abdomen of brood fishes.

**23. Tubifex**

Tubifex is a worm that is fed as an occasional treat to fish that is high in protein and other nutrient.

**24. Hypophysation**

It is a technique of induced breeding in fishes by injecting pituitary glands extract.

**25. Suction tube**

The tubes used for removing secretions from the nose, throat or ears. They are made of glass and are fitted to a suction pump

**UNIT IV****AQUARIUM DESIGN, CONSTRUCTION AND PREPARATION****I. Two mark questions****1. Aerators**

- Aerator is an electrical device generating air.
- It consists of a motor and a pump.
- It works like a compressor.
- It produces air. The air is passed into the aquarium.

**2. Air pump**

Air pump is a device used to force air into aquarium tubing. The tubing is placed into the aquarium to increase water agitation and for decorative purpose.

**3. Air stone**

An air stone is used in conjunction with an air pump and tubing.

**4. Biological filtration**

It is the process of removal of waste from the aquarium using bacterium.

**5. Gravel**

It is an aquarium substrate composed of quartz or other lime free minerals. It must be chemically inert.

**6. Hood**

The part that covers the part that typically covers the lighting fixture is called hood.

**7. Sand**

It is an aquarium substrate composed of quartz or other lime free minerals. It must be chemically inert.

**8. Light**

- It is illuminating the aquarium
- Lighting makes an aquarium more attractive. It is also an essential stimulus to the plants and fishes.
- Aquarium plants need light to photosynthesis-a process by which they remove CO<sub>2</sub> from water.

**9. Marine aquarium**

It is an aquarium tank containing saltwater fishes.

**10. Nets**

1. To skim debris from a tank
2. To catch fish of various sizes
3. To scoop up a meal of freshly hatched brine shrimp.

**11. Substrate**

It is placed at the bottom of the aquarium and it consist of gravel, sand or mud.

**12. What are the needs of ornamental fish farm**

Aquarium or fish tank

Pumps

Aeration Devices



Net or Seine Reels

Handling and Grading Equipment

Water testing equipment

### **UNIT - V**

### **GENERAL AQUARIUM MAINTENANCE**

#### **I. Two mark questions**

##### **1. Common bacterial disease**

Disease caused by bacteria is called bacterial disease. Ex: Columnaris, fin rot and Dropsy

##### **2. Crustacean infections**

Disease caused by Crustacea is called Crustacean disease. Ex. Argulosis, Lernaeasis, Gyrodactylosis,

##### **4. Dropsy**

It is bacterial disease, accumulation of yellow fluid inside the body cavity caused by *Pseudomonas punctata*

##### **5. Ectoparasite**

- Ectoparasites are found on the external surfaces such as skin, fins and gills.
- In ornamental fishes, the common *endoparasites* are *blood parasites*, *intestinal worms* and *protozoan*.

##### **6. Entoparasite**

- Endoparasites are found in the internal tissues and organs. Most of the endoparasitic diseases are caused by trematode, cestode and nematode worms.

##### **9. Gill rot**

It is a fungal disease caused by Branchiomyces.

##### **10. pH**

It is a measure of the acidity or alkalinity of water.

##### **11. Protozoan disease**

Disease caused by protozoan is called protozoan disease .Ex. Ich and Velvet disease,

##### **12. Viral disease**

Disease caused by Virus is called Viral disease Ex: Carp pox and Spring Viraemia

**S.NO: XXXX****Subject Code: 16SNMEZ02****B., SC DEGREE EXAMINATION****Part IV – Non Major Elective****ORNAMENTAL FISH FARMING****Time: Three Hours****Maximum: 75 marks****SECTION A- (10×2=20)***Answer ALL questions*

1. Aerator
2. Net
3. Dry feed
4. Live feed
5. Fish hatching
6. Argulus
7. Spawning
8. Live bearer
9. Gold fish
10. Fighter fish

**SECTION-B (5×5=25)***Answer ALL questions, choosing either (a) or (b)*

11. a). Write short note on the controlling methods of temperature in aquarium. **(OR)**  
b). Mention the equipments used in aquarium.
12. a). Write the culture technique of fish food organism. **(OR)**  
b). Write short note on different types of feeds used in aquarium.
13. a). Write the cleaning methods of aquarium. **(OR)**  
b). Write about the controlling procedures of algal growth in aquarium
14. a). Mention secondary sexual characters seen in ornamental fishes. **(OR)**  
b). Give an account on the nest builders of an aquarium
15. a). Name any five marine ornamental fish. **(OR)**  
b). Explain the general characters of marine ornamental fishes.

**SECTION-C (3×10=30)***Answer any THREE questions*

16. Write a detailed account on the types and important of aquarium.
17. Write about the balanced diet for aquarium fishes
18. Give a detailed account on different type of disease and its management in ornamental fishes.
19. Describe the induced breeding methods in ornamental fishes.
20. Describe the methods of transportation of live fishes.

தேடிச் சோறுனிதந் தின்று - பல

சின்னங் சிறுகதைகள் பேசி - மனம்

வாடித் துன்பமிக உழன்று - பிறர்

வாடப் பலசெயல்கல் செய்து - நரை

கூடிக் கிழப்பருவ மெய்தி - கொடுங்

கூற்றுக் கிரையெனப் பின்மாயும்,,,,,,

