

**SKILL ENHANCEMENT COURSES (SEC)  
INDEX  
DEPARTMENT OF ZOOLOGY  
B.Sc. (Hons.) Zoology**

<b>S.No.</b>	<b>Course Title</b>	<b>Semester</b>	<b>Syllabus Page</b>
<b>1</b>	<b>Aquaculture Entrepreneurship</b>	<b>II</b>	<b>1-4</b>
<b>2</b>	<b>Ornamental Fish Culture</b>	<b>III</b>	<b>5-7</b>
<b>3</b>	<b>Formulation of Fish Feed</b>	<b>IV</b>	<b>8-10</b>
<b>4</b>	<b>Fish Breeding and Larviculture</b>	<b>V</b>	<b>11-13</b>

## Aquaculture Entrepreneurship

### CREDIT DISTRIBUTION, ELIGIBILITY AND PRE-REQUISITES OF THE COURSE

Course title & Code	Credits	Credit distribution of the course			Eligibility criteria	Pre-requisite of the course (if any)
		Lecture	Tutorial	Practical/ Practice		
Aquaculture Entrepreneurship	2	0	NIL	2	Class XII	NIL

### Learning Objectives

The Learning Objectives of this course are as follows:

- To give first-hand training on traditional and technology-based Aquaculture.
- To understand the importance of different types of ponds required for aquaculture.
- To understand the requirement of advanced technology for sustainable development of aquaculture in India.
- To gain experience in the management of optimum water quality in the fish production systems.
- To enhance the quality of aquacrops and increase the production.

### Learning Outcomes

By the end of the course, the students will be able to:

- Identify the useful aquaculture systems for sustainable aquaculture development.
- Recognize the suitable and economically important aquacultural species.
- Understand the importance of aquaculture in nutrition security, poverty elevation and employment generation.

### Skill development and job opportunities

After completion of this course students may be

- Employed in various aquaculture related business including prawn and fish farms.
- Fully equipped to start own entrepreneurships in **fish farming**.

## SYLLABUS:

### Unit I: Pond-based Traditional Aquaculture

20 Hours

Introduction to indigenous pond-based fish culture systems and identification of economically important cultivable finfishes and shellfishes. The impact of aquatic organisms in the production of aquacrops.

#### Practical Exercises:

1. Designing (layout) and drawing of a self-sustainable Aquaculture farm showing different ponds.
2. Selection and identification of cultivable finfishes and shellfishes (prawns, mussels, crabs).
3. Collection and identification of various freshwater aquatic plants. Understanding of the role of different aquatic plants in aquaculture.
4. Identification of harmful aquatic insects and their remedial measures.
5. The study of diurnal fluctuations of major water quality parameters (*viz.*, temperature, pH, dissolved oxygen, ammonia etc.) in a pond.

### Unit II: Recirculating Aquaculture System (RAS)

20 Hours

Application of advance technology like, Recirculating Aquaculture System (RAS) for the sustainable development of Aquaculture in India.

#### Practical Exercises:

1. Designing of a land-based Recirculating Aquaculture System (RAS).
2. Evaluation of various types of filters like, mechanical, chemical and biological filters in the maintenance of water quality in the RAS.
3. The study of role of flow rate and duration of circulation in the maintenance of water quality in the RAS.
4. The monitoring of temperature, pH, dissolved oxygen, ammonia, nitrite, nitrate, phosphate etc. at different hours of water circulation.
5. Culture of various fishes and prawns in the RAS.
6. Visit to a Recirculating Aquaculture System.

### Unit III: Aquaponics System

20 Hours

Application of Aquaponics System to grow multiple crops simultaneously and thereby, increases the production of aquacrops in per unit area in a sustainable manner. Thus, enhances the earning of Fish farmers.

### Practical Exercises:

1. Designing of an Aquaponics System.
2. Evaluation of role of various types of edible (lettuce, tomato, water spinach etc.) and ornamental plants in the maintenance of ammonia levels in the fish culture units.
4. Identification of microorganisms functioning in the Aquaponics System.
5. Culture of various fishes and prawns in the Aquaponics System.
6. The monitoring of temperature, pH, dissolved oxygen, ammonia, nitrite, nitrate, phosphate etc. in the fish culture units.
7. Visit to an Aquaponics System.

### Recommended Books:

AOAC, Association of Official Analytical Chemists. 2019. Official Methods of Analysis. Washington, DC: Association of Official Analytical Chemists Inc.

APHA, American Public Health Association. 2017. Standard Methods for the Examination of Water and Wastewater. 23rd ed. Washington DC, USA: American Public Health Association, American Water Works Association, Water Environment Federation.

Chakrabarti, R. and Sharma, J. G. 2008. Aquahouse. New Dimension of Sustainable Aquaculture. DIPAS, Indian Council of Agricultural Research, New Delhi, India.

Holt, G. J. 2021. Larval Fish Nutrition. Willey-Blackwell, UK.

ICAR, Indian Council of Agricultural Research. 2013. Handbook of Fisheries and Aquaculture. Directorate of Knowledge Management in Agriculture, Indian Council of Agricultural Research, New Delhi, India.

Pillay, T. V. R. 2005. Aquaculture. Principles and Practices. Blackwell Publishing, New Delhi, India.

### Examination scheme and mode:

Total Marks: 100

Internal Assessment (Practical): 25 marks

End Semester Practical Exam\* : 75 marks

The Internal Assessment for the course may include Class participation, Assignments, Class tests, Projects, Field Work, Presentations, amongst others as decided by the faculty.  
For End Semester Practical Exam External to be appointed by the parent Department.

## Ornamental Fish Culture: Opportunity and Scope

### CREDIT DISTRIBUTION, ELIGIBILITY AND PRE-REQUISITES OF THE COURSE

Course title & Code	Credits	Credit distribution of the course			Eligibility criteria	Pre-requisite of the course (if any)
		Lecture	Tutorial	Practical/ Practice		
Ornamental Fish Culture: Opportunity and Scope	2	0	NIL	2	Class XII	NIL

### Learning Objectives

The Learning Objectives of this course are as follows:

- To give first-hand training on Aquarium preparation and decoration.
- To gain hands-on training on breeding and culture of various Ornamental fishes.
- To gain experience in the management of optimum water quality in the fish aquarium.
- To gather knowledge on the nutritional requirements of the cultivable species.

### Learning Outcomes

By the end of the course, the students will be able to:

- Prepare and decorate ornamental fish aquarium.
- Identify the suitable and economically important Ornamental fish species.
- Initiate entrepreneurship on Aquarium making and Ornamental fish production.

### Skill development and job opportunities

After completion of this course students will be

- Fully equipped to start own entrepreneurship in **aquarium making and its decoration.**
- Aware about the requirements to start their own **Ornamental fish industry.**

## SYLLABUS:

### Unit I: Preparation of Aquarium and Its Decoration

20 Hours

Preparation of glass aquaria of various shapes and their decoration using locally available materials. The impact of aquatic plants in the maintenance of healthy environment in the aquarium.

#### Practical Exercises:

1. Construction of glass aquaria of various shapes (rectangular, square, round etc.).
2. Identification and culture of useful aquatic plants for the decoration of fish aquarium.
3. Decoration of aquarium with plants and locally available materials.

### Unit II: Breeding of Ornamental Fishes and Culture of Plants

20 Hours

Identification of economically important cultivable Ornamental plants and fishes for culture.

#### Practical Exercises:

1. Identification of economically important Ornamental fishes and their breeding.
2. Culture of young larvae and feeding them live food.
3. Regular monitoring of water quality parameters viz. temperature, pH, conductivity, dissolved oxygen, ammonia etc. in the fish aquarium.
4. Culture of zooplankton (rotifers, cladocerans, copepods etc.) using organic manures for the feeding of fish larvae.
5. Production of plants for the decoration of aquarium.

### Unit III: Production of Marketable Ornamental Fishes

20 Hours

Culture of compatible fishes together and feeding them with live food and prepared diets. Keep them ready for local market.

#### Practical Exercises:

1. Maintenance of aquarium.
2. Feeding of ornamental fishes with various natural foods and prepared diets.
3. Evaluation of their growth rate and colour development.
4. Development of marketing strategy for the produced ornamental fishes in well decorated aquaria.

5. Visit to any Aquarium Facility.

### Recommended Books:

AOAC, Association of Official Analytical Chemists. 2019. Official Methods of Analysis. Washington, DC: Association of Official Analytical Chemists Inc.

APHA, American Public Health Association. 2017. Standard Methods for the Examination of Water and Wastewater. 23rd ed. Washington DC, USA: American Public Health Association, American Water Works Association, Water Environment Federation.

Chakrabarti, R. and Sharma, J. G. 2008. Aquahouse. New Dimension of Sustainable Aquaculture. DIPAS, Indian Council of Agricultural Research, New Delhi, India.

Holt, G. J. 2021. Larval Fish Nutrition. Willey-Blackwell, UK.

ICAR, Indian Council of Agricultural Research. 2013. Handbook of Fisheries and Aquaculture. Directorate of Knowledge Management in Agriculture, Indian Council of Agricultural Research, New Delhi, India.

Pillay, T. V. R. 2005. Aquaculture. Principles and Practices. Blackwell Publishing, New Delhi, India.

Swain, S. K., Sarangi, N. and Ayyapan, S. 2010. Ornamental Fish Farming. DIPAS, Indian Council of Agricultural Research, New Delhi, India.

### Examination scheme and mode:

Total Marks: 100

Internal Assessment (Practical): 25

marksEnd Semester Practical Exam\* :

75 marks

The Internal Assessment for the course may include Class participation, Assignments, Classtests, Projects, Field Work, Presentations, amongst others as decided by the faculty. For End Semester Practical Exam External to be appointed by the parent Department.



## Formulation of Fish Feed

### CREDIT DISTRIBUTION, ELIGIBILITY AND PRE-REQUISITES OF THE COURSE

Course title & Code	Credits	Credit distribution of the course			Eligibility criteria	Pre-requisite of the course (if any)
		Lecture	Tutorial	Practical/ Practice		
Formulation of Fish Feed	2	0	NIL	2	Class XII	NIL

### Learning Objectives

The Learning Objectives of this course are as follows:

- To give first-hand training on identification of various indigenous ingredients for formulation of fish feed.
- To gather knowledge on the nutritional requirements of the cultivable species.
- To gain knowledge on the impact of formulated feeds on fish growth.
- To enhance the quality of aquacrops and increase the production.

### Learning Outcomes

By the end of the course, the students will be able to:

- Identify the useful ingredients for fish feed formulation.
- Learn to prepare fish feed using locally available ingredients.
- Start the Fish feed production industry.
- Initiate entrepreneurship on Fish feed production.

### Skill development and job opportunities

After completion of this course students may be

- Employed in various aquaculture related business including prawn and fish farms.
- Fully equipped to start own fish feed production industry.

## **SYLLABUS:**

### **Unit I: Selection of ingredients**

**20 Hours**

Identification of various types of non-conventional ingredients for fish feed formulation. Evaluation of their nutritional quality. Preparation of fish feed and feeding of the prepared feeds to the cultivable fishes and prawns. The study of impact of the prepared feeds on the performances of fishes and prawns.

#### **Practical Exercises:**

1. Identification of various types of locally available ingredients (*viz.* macrophytes, oil-cakes, plants etc.) for fish feed formulation.
2. Evaluation of the nutritional values (*viz.* protein, lipid, carbohydrates, ash, amino acids, fatty acids) of these ingredients.
3. Assay of presence of anti-nutritional factors (*viz.* tannin, saponin, phytic acid, oxalic acid etc.) in these ingredient

### **Unit II: Formulation of Fish Feed**

**20 Hours**

Preparation of fish feed using traditional method and computerized soft ware. Evaluation of quality of prepared feed for the cultivable species.

#### **Practical Exercises:**

1. Formulation of fish feed using "Pearson Square" method.
2. Formulation of fish feed using computerized soft ware.
3. The assay of biochemical composition of formulated feed: protein, lipid, carbohydrate, ash, amino acids, fatty acids.

### **Unit III: Feeding of Fish**

**20 Hours**

The feeding of the prepared feeds to the cultivable fishes and prawns. The study of impact of the prepared feeds on the performances of fishes and prawns. Evaluation of nutritional value of fishes for human consumption.

#### **Practical Exercises:**

1. The feeding of the prepared feeds to the cultivable fishes and prawns.
2. Evaluation of impact of the prepared feeds on the survival, growth and production of fishes and prawns.
3. Assessment of Feed Conversion Ratio (FCR) and Feed Conversion Efficiency (FCE) of the feed.

4. Assay of nutritional value of the produced fishes/ prawns for human consumption.
5. Evaluation of impact of prepared feed on the water quality of the culture system
  
6. Visit to a Fish feed preparation facility/ industry.

### Recommended Books:

AOAC, Association of Official Analytical Chemists. 2017. Official Methods of Analysis. Washington, DC: Association of Official Analytical Chemists Inc.

APHA, American Public Health Association. 2017. Standard Methods for the Examination of Water and Wastewater. 23rd ed. Washington DC, USA: American Public Health Association, American Water Works Association, Water Environment Federation.

Chakrabarti, R. and Sharma, J. G. 2008. Aquahouse. New Dimension of Sustainable Aquaculture. DIPAS, Indian Council of Agricultural Research, New Delhi, India.

Holt, G. J. 2021. Larval Fish Nutrition. Willey-Blackwell, UK.

ICAR, Indian Council of Agricultural Research. 2013. Handbook of Fisheries and Aquaculture. Directorate of Knowledge Management in Agriculture, Indian Council of Agricultural Research, New Delhi, India.

### Examination scheme and mode:

Total Marks: 100

Internal Assessment (Practical): 25 marks

End Semester Practical Exam\* : 75 marks

The Internal Assessment for the course may include Class participation, Assignments, Class tests, Projects, Field Work, Presentations, amongst others as decided by the faculty.

For End Semester Practical Exam External to be appointed by the parent Department.

## Fish Breeding and Larviculture

### CREDIT DISTRIBUTION, ELIGIBILITY AND PRE-REQUISITES OF THE COURSE

Course title & Code	Credits	Credit distribution of the course			Eligibility criteria	Pre-requisite of the course (if any)
		Lecture	Tutorial	Practical/ Practice		
Fish Breeding and Larviculture	2	0	NIL	2	Class XII	NIL

### Learning Objectives

The Learning Objectives of this course are as follows:

- To give first-hand training on various aspects of brood stock maintenance of carps and air breathing fishes.
- To understand the breeding techniques for carps and air breathing fishes.
- To understand the larviculture techniques for carps.
- To gain experience on the larviculture techniques of air breathing fishes.
- To gather knowledge in the management of optimum water quality for larviculture.
- To gather knowledge on the nutritional requirements of the cultivable species.
- To gain knowledge on the impact of live food in larviculture.

### Learning Outcomes

By the end of the course, the students will be able to:

- Produce seeds of carps and air breathing fishes.
- Start the Fish hatchery business.
- Start fish-food production.
- Initiate entrepreneurship in fish seeds production.

#### • Skill development and job opportunities

After completion of this course students may be

- Employed in various aquaculture related business including prawn and fish farms.
- Fully equipped to start own entrepreneurships in **fish farming**.

## **SYLLABUS:**

### **Unit I: Breeding of Economically Important Fishes**

**20 Hours**

Breeding of various fishes in the captivity and production of quality fish seeds for aquaculture.

#### **Practical Exercises:**

1. Management of brood stock units and breeding of carps.
2. Maintenance of brood stock units and breeding of air breathing fishes.
3. Estimation of major water quality parameters viz., temperature, pH, dissolved oxygen, conductivity etc. in the fish breeding units.

### **Unit II: Culture of Important Live Food Organisms**

**15 Hours**

Culture of various live food organisms using organic manures and feeding of different fish larvae produced.

#### **Practical Exercises:**

1. Culture of live food organisms viz., rotifers, cladocerans, copepods, chironomid larva etc. using organic manures (like cattle manure, poultry wastes and mustard oil-cake).
2. Evaluation of major water quality parameters viz., temperature, pH, dissolved oxygen, ammonia etc. in the live food culture units.
3. The enrichment of live food organisms (with vitamin C, DHA, EPA etc.) to enhance the nutritional value of the live food for fish larvae.

### **Unit II: Larviculture**

**25 Hours**

Culture of larvae of carps and air breathing fishes and production of healthy seeds for stocking ponds.

#### **Practical Exercises:**

1. Culture of fish larvae in the static water/ Recirculating Aquaculture Systems (RAS).
2. Measurement of water quality parameters (viz., temperature, pH, dissolved oxygen, ammonia etc.) in the larvae culture unit regularly.
3. Feeding of fish larvae with live food thrice daily.
4. The study of morphological and physiological changes in the larvae during ontogenic development.
5. Visit to a fish farm.

#### **Recommended Books:**

AOAC, Association of Official Analytical Chemists. 2017. Official Methods of Analysis. Washington, DC: Association of Official Analytical Chemists Inc.

APHA, American Public Health Association. 2017. Standard Methods for the Examination of Water and Wastewater. 23rd ed. Washington DC, USA: American Public Health Association, American Water Works Association, Water Environment Federation.

Chakrabarti, R. and Sharma, J. G. 2008. Aquahouse. New Dimension of Sustainable Aquaculture. DIPAS, Indian Council of Agricultural Research, New Delhi, India.

Holt, G. J. 2021. Larval Fish Nutrition. Willey-Blackwell, UK.

ICAR, Indian Council of Agricultural Research. 2013. Handbook of Fisheries and Aquaculture. Directorate of Knowledge Management in Agriculture, Indian Council of Agricultural Research, New Delhi, India.

Pillay, T. V. R. 2005. Aquaculture. Principles and Practices. Blackwell Publishing, New Delhi, India.

#### **Examination scheme and mode:**

Total Marks: 100

Internal Assessment(Practical): 25 marks

Semester Practical Exam\* : 75 marks

The Internal Assessment for the course may include Class participation, Assignments, Class tests, Projects, Field Work, Presentations, amongst others as decided by the faculty.

For End Semester Practical Exam External to be appointed by the parent Department.