

**Rajarshi Shahu Mahavidyalaya,  
(Autonomous)  
Latur.**

# **S Y L L A B U S**

**B.Sc. Third Year**

**Subject: Fishery Science**

**Semester Pattern**

**W.e.f. June 2015**

# **RAJARSHI SHAHU MAHAVIDYALAYA, (AUTONOMOUS) LATUR.**

**Course Structure  
B.Sc. Third Year**

**Fifth Semester**

**Subject: FISHERY SCIENCE**

**W.e.f. June 2015**

- ❖ **Paper IX: Fish Microbiology, Pathology and Immunology**  
(Course Code: U-FIS-577)
  
- ❖ **Paper X: Fish Genetics, Biodiversity and conservation, Fisheries act and Regulation**  
(Course Code: U-FIS-578)
  
- ❖ **Lab Course VII**  
(Course Code: U – FIS-579)
  
- ❖ **Lab Course VIII**  
(Course Code: U – FIS-580)

**RAJARSHI SHAHU MAHAVIDYALAYA, (AUTONOMOUS) LATUR.**

**Course Structure**

**B.Sc. T.Y. (Fifth Semester)**

W.e.f. June 2015

**Subject: FISHERY SCIENCE**

**Paper IX: Fish Microbiology, Pathology and Immunology**

**Course Code: U-FIS-577**

**Marks – 50**

**Hours 45**

**Credits – 2**

**Objectives**

- The course is designed to give a basic understanding on the fundamental aspects of microbiology to diseases caused by various groups of microorganisms.
- The students will be introduced to the microbial world, the structure and significance of bacteria, fungi, algae, protozoa and viruses.
- On completion of the course the students are expected to have a clear understanding on microscopy, sterilization, disinfection, bacterial cultivation techniques, their growth dynamics, metabolic processes, to meet these needs focus will be given on microbial instrumentation their structure handling and principle.
- The students are also introduced to the beneficial and harmful manifestations of microorganisms especially of bacteria and their role in microbial mineralization and disease processes.
- In addition, basic aspects of immunology and Compounds that modulate the immune system in fish are also introduced to the students.

(All these are to be accomplished through formal lectures, class room discussions and the students will be assessed by examinations.)

**Course outcome:**

- Gain a heightened understanding of the various microbiological diseases caused by various groups of microorganisms.
- Have an increased understanding of understanding on microscopy, sterilization, disinfection, bacterial cultivation techniques, their growth dynamics, metabolic processes,
- Have an increased understanding of Innate and adaptive immunity in teleost fish
- Have an increased understanding of Changes during fish spoilage – Rigor mortis.

**Unit – I**

**Microbiology**

**07**

- 1) General account of harmful and useful micro-organisms in fresh water and marine water.
- 2) Fish spoilage - Causes of fish spoilage – Bacterial, enzymatic and chemical spoilage.
- 3) Changes during fish spoilage – Rigor mortis.

- 4) Chemical test for freshness.
- 5) Organoleptic test for freshness.
- 6) Sources of contamination of fish.

### **Unit – II**

#### **Microbiological tools and techniques.**

**08**

- 1) Hot air oven
- 2) Autoclave
- 3) Incubator
- 4) Centrifuge machine
- 5) Colorimeter
- 6) pH meter
- 7) Colony counters
- 8) Microscopes
- 9) Safety in Laboratory

### **Unit – III**

#### **Fish Pathology**

**10**

**(Disease causing organism, symptoms and preventives Measures).**

- 1) Fungal Diseases: Gill rot, Branchiomycosis.
  - 2) Bacterial Diseases: Dropsy and fin rot
  - 3) Protozoan Diseases: White spot and costiasis.
  - 4) Helminth diseases: Gyrodactylosis and Dactylogyrosis.
  - 5) Crustacean Diseases: Lerniasis and argulosis.
- Viral Diseases: WSSV, SVCV

6)

### **Unit – IV**

#### **Innate and adaptive immunity in teleost fish**

**20**

1. Introduction
2. Ontogeny of the immune system
3. Lymphoid organs
  - 3.1. Thymus
  - 3.2. Kidney
  - 3.3. Spleen
4. Cells involved in immune response
5. Nonspecific immunity

- 5.1. Physical barriers
- 5.2. Nonspecific cellular cytotoxicity
- 5.3. Antimicrobial peptides
- 5.4. Phagocytosis
- 5.5. Complement
- 5.6. Tumor necrosis factor (TNF)
- 5.7. Interferon (INF)
- 5.8. Interleukins (IL)
- 5.9. Others cytokines and chemokines
  - 5.10. Protease inhibitors
  - 5.11. Lysozyme
  - 5.12. Natural antibodies
  - 5.13. Pentraxins
  - 5.14. Transferrin
6. Specific immunity
  - 6.1. Antibodies
  - 6.2. Immunological memory
  - 6.3. Cellular cytotoxicity
  - 6.4. Cytokines involved in adaptive immunity
7. Environmental effect on immune response
8. Compounds that modulate the immune system in fish
  - 8.1. Nucleotides
  - 8.2. Glucans
  - 8.3. Probiotics

### **Books and References Recommended for Paper-IX**

1. Robinson, R.K. (1985) Microbiology of Frozen Foods. Elsevier Applied Science Publishers.
2. Devadasan, K., Mukundan, M.K., Antony, P.D. and Jos Joseph (1994) Nutrients and Bioactive substances in Aquatic Organisms. SOFT(I)
3. James Muil Leitch (1965) International Congress of Food Science and Technology – Biological and Microbiological Aspects of food. Gordon and Breach Science Publishers.
4. Slanetz, L.W., Chichester, C.O., Gaufin, A.R. and Ordal, N.J. (1963) Microbiological Quality of Foods. Academic Press, New York.
5. Bonnell, A.D. (1994) Quality Assurance in Seafood Processing. Chapman and Hall, USA.
6. Zeuthen, P., Cheftel, J.C., Eriksson, C., Gormley, T.R., Linko, P. and Paullis, K. (1990) Processing and Quality of Foods. Vol. 2 Food Biotechnology. Elsevier Science Publishers Ltd.
7. Heid, J.L. and Maynard A. Joslyn, B.S. (1981) Fundamentals of Food Processing Operations : Ingredients, Methods and Packaging. The AVI Publishing Co. Inc., USA.
8. T.S. Gopalakrishna Iyer, Kandoran M.K., Mary Thomas and Mathew P.T. (2000) Quality Assurance in Seafood Processing. SOFT(I).
9. Hersch Doerfer S.M (Ed.) (1967) Quality Control in Food Industry. Academic Press Inc. London.

**RAJARSHI SHAHU MAHAVIDYALAYA, (AUTONOMOUS) LATUR.**  
**Course Structure**

**B.Sc. T.Y. (Fifth Semester)**  
W.e.f. June 2015

**Subject: FISHERY SCIENCE**

**Paper X: Fish Genetics, Biodiversity and conservation, Fisheries act and Regulation**

**Course Code: U-FIS-578**

**Marks – 50**

**Hours 45**

**Credits – 2**

**Objectives**

- Enable students to understand basic concept Principles of Fish Genetics and Biotechnology
- Enable students to understand principal and techniques of Chromosomal engineering
- Enable students to understand Biodiversity and conservation fishes in India.
- Enable students to understand Indian Fisheries Act strategies for exploitation of deep sea & Shore fisheries.

**Course outcome**

- Have an increased understanding of Principles of Fish Genetics and Biotechnology.
- Have an increased understanding of Chromosomal engineering.
- Have greater insight into how genes transfer from one generation to other.
- Understand what is the mechanisms of Production of Monosex super male and female by hormonal and sex reversal technique.
- Have an increased understanding of fish biodiversity and its importance
- Have an increased understanding of various fishing act.

**Unit- I**

**Principles of Fish Genetics and Biotechnology**

1. Fish Genetic (Germ Plasm) Resources
2. Chromosomes and Genes.
3. Karyotyping
4. Cryopreservation of gametes (Gene banking)
5. Sex determination
6. Monosex culture
7. Sterile fish

## **Unit -II**

### **Hybridization**

1. Hybridization in Indian Carps
2. Intra Specific and Intergenric hybrids
3. Natural Hybridization
4. Important hybrids
5. Inbreeding, cross breeding and selective breeding
6. Application of hybridization in fisheries 20

### **Chromosomal engineering**

1. Genome
2. Gynogenesis
3. Androgenesis
4. Polyploidy (Triploids or Broiler fish)
5. Production of Monosex super male and female by hormonal and sex reversal technique.

## **Unit -III**

Biodiversity and conservation fishes in India.

Endangered fishes of India and world.

## **Unit -IV**

- 1) Indian Exclusive economic zone (EEZ).
- 2) Indian Fisheries Act strategies for exploitation of deep sea & Shore fisheries.
- 3) Organization setup of fisheries sector of states, central level



### **Books and References Recommended for Paper-X**

1. Marine Biotechnology (Vol 1, 2 and 3)- 1999 -Fingerman et al., Science Publishers Inc, USA.
2. Fish Genetics: Theory and Practice:BY Boris Gomsly **Publisher:** VDM Verlag Dr. Müller (March 24, 2011)
3. Aquaculture and Biotechnology – 1999- Karunasagar et al., - Oxford and IBH, New Delhi
4. Fisheries Biotechnology – 2004 – Lakra et al., - Narendra Publishing House
5. Biotechnology and Genetics in Fisheries and Aquaculture -2003 – A.R. Beaumont and K. Hoare – Blackwell Science.
6. Fish in Research – Academic Press, London
7. Immunodetection methods in aquaculture.2001– Adams, A
8. Progress in reproductive endocrinology- 1999 – K.G. Adiyodi
9. Aquaculture and fisheries biotechnology, a genetic approach – 2003- R.A. Dunham
10. Aquaculture and Biotechnology – 2003- Karunasagar, I
11. Reproductive biotechnology in finfish aquaculture – 2002- Lee, C.S.

**RAJARSHI SHAHU MAHAVIDYALAYA, (AUTONOMOUS) LATUR.**

**Course Structure**

**B.Sc. T.Y. (Fifth Semester)**

W.e.f. June 2015

**Subject: FISHERY SCIENCE**

**Lab Course VII (Course Code: U – FIS-579)**

**(Based on Paper IX – Paper IX: Fish Microbiology, Pathology and Immunology)**

**Marks – 50**

**Hours 30**

**Credits – 2**

**Objectives**

- The laboratory practical course is designed to give a basic understanding on the fundamental aspects of microbiology to diseases caused by various groups of microorganisms.
- Enable students to understand the microbial world, the structure and significance of bacteria, fungi, algae, protozoa etc
- Enable students to understand the beneficial and harmful manifestations of microorganisms
- In addition, basic aspects of immunology and Compounds that modulate the immune system in fish are also introduced to the students.

**Course outcome:**

At the end of this course, students should be able to

- Students enable to understand the various microbiological diseases caused by various groups of microorganisms.
- Students enable to understand to handle microscopy and learn the techniques of sterilization, disinfection, bacterial cultivation techniques, their growth dynamics, metabolic processes.
- Students enable to understand Staining techniques viz- monochrome staining and gram staining.
- Students enable to Isolate of microorganisms from water.
- Students enable to Inhibit and destruct microorganisms by heat.
- Students enable to understand Titration of plaque-forming Bacteriophage
- Students enable to understand Blood analysis of fishes and Treatment of fishes by using different methods

**1) Study of Basic Microbiological Tools (structure and use)**

- a. Hot air oven
- b. Autoclave
- c. Incubator

- d. Centrifuge machine
  - e. Colorimeter
  - f. PH meter
  - g. Colony counter
  - h. Compound microscope
- 2) Study of disease causing agents in fishes.
  - 3) Isolation of microorganisms (Bacteria and fungi) from fish (Streak plate method)
  - 4) Staining - monochrome staining and gram staining.
  - 5) Identification of fresh fishes and spoiled fishes.
  - 6) Isolation of microorganisms from water
  - 7) Environmental distribution of bacteria
  - 8) Inhibition and destruction of microorganisms by heat.
  - 9) Bacterial exoenzymes.
  - 10) Measurements of bacteria
  - 11) Titration of plaque-forming Bacteriophage.
  - 12) Treatment of fishes by using different methods
  - 13) Blood analysis of fishes.

**RAJARSHI SHAHU MAHAVIDYALAYA, (AUTONOMOUS) LATUR.**

**Course Structure**

**B.Sc. T.Y. (Fifth Semester)**

W.e.f. June 2015

**Subject: FISHERY SCIENCE**

**Lab Course VII (Course Code: U – FIS-580)**

**( Based on Paper X- Fish Genetics, Biodiversity and conservation, Fisheries act and Regulation)**

**Marks – 50**

**Hours 30**

**Credits – 2**

**Objectives**

- Enable students to understand basic Principles of Fish Genetics and Biotechnology
- Enable students to understand principal and techniques of Chromosomal engineering
- Enable students to understand Biodiversity and conservation fishes in India.
- Enable students to understand Indian Fisheries Act strategies for exploitation of deep sea & Shore fisheries.

**Course outcome:**

At the end of this course, students should be able to

- Students enable to understand Collection and observation of gametes from fresh water fishes locally available
- Students enable to understand erythrocyte measurements for polyploidy evaluation.
- Students enable to understand Cryopreservation techniques.
- Students enable to Determine of hybrids in different fishes.
- Students enable to understand the concept of Androgenesis and Gynogenesis so as they can produce broiler fishes.
- Students enable to understand endangered fishes of India. And world hence will be sure step up to conserve it.

1) Collection and observation of gametes from fresh water fishes

2) Polyploidy evaluation using erythrocyte measurements

- 3) Cryopreservation of gametes
- 4) Chromosome karyotyping
- 5) Sex determination in fin-fishes and shell-fishes
- 6) Determination of hybrids in major carps (Rohu - catla hybrid)
- 7) Study of Androgenesis and Gynogenesis.
- 8) Study of endangered fishes of India and world.
- 9) Identify and Describe Triploid and Broiler fish.

**RAJARSHI SHAHU MAHAVIDYALAYA,  
(AUTONOMOUS) LATUR.**

**Course Structure  
B.Sc. Third Year**

**Sixth Semester**

**Subject: FISHERY SCIENCE**

**W.e.f. June 2015-16**

**Revised Syllabus**

- ❖ **Paper XI: AQUACULTURE ENGINEERING AND TECHNOLOGY**  
**Course Code: U-FIS-677**
- ❖ **Paper XII: Fish Economics, Marketing, Fisheries Extension and Statistics**  
**Course Code: U-FIS-678**
- ❖ **Lab Course X**  
**(Course Code: U – FIS-680)**
- ❖ **Lab Course IX**  
**(Course Code: U-FIS-679)**

**Revised Syllabus**  
**RAJARSHI SHAHU MAHAVIDYALAYA, (AUTONOMOUS) LATUR.**  
**Course Structure**  
**B.Sc. T.Y. (Sixth Semester)**  
W.e.f. June 2016  
**Subject: FISHERY SCIENCE**

**Paper XI: Aquaculture Engineering and technology**

**(U-FIS-677)**

**Marks – 50**

**Hours 45**

**Credits – 2**

**OBJECTIVES**

1. Provide students with necessary skills for designing aquaculture system;
2. Enable students to design, construct and maintain fish farms;
3. Provide student with the requisite knowledge of pond construction engineering;
4. Enable students to design water pumps for different aquaculture systems;
5. Enable students to design and construct fish cages, tanks and other fish enclosure structures;
6. Provide students with opportunities to develop fish farm construction skills;
7. Provide students with skills to design aerators and filters for aquaculture systems
8. Provide students with the skills to design and construct water re -circulatory systems;
9. Enable students to manage waste in aquaculture production systems.

**Course outcome**

**Course outcome:**

At the end of this course, students should be able to

- Students enable to understand The farm: technical components in a system
- Students enable to understand Land-based hatchery and juvenile production farms and their structure.
- Students enable to understand Instrumentation and Monitoring.
- Students enable to understand to handle Instruments for measuring physical conditions
- Students enable to understand hydraulics and Water Transport system.
- Students enable to understand design and construct water re -circulatory systems in and around the aquaculture farms.

# UNIT-I

## **1. Aquaculture engineering**

### Introduction

1.1 Aquaculture engineering

1.2 Classification of aquaculture

1.3 The farm: technical components in a system

1.3.1 Land-based hatchery and juvenile production farm

1.3.2 On-growing sea cage farm

1.4 Future trends: increased importance of aquaculture engineering

## **2. Instrumentation and Monitoring**

1 Introduction

2 Construction of measuring instruments

3 Instruments for measuring water quality

3.1 Measuring temperature

3.2 Measuring oxygen content of the water

3.3 Measuring pH

3.4 Measuring conductivity and salinity

3.5 Measuring total gas pressure and nitrogen saturation

3.6 Other

## **4 Instruments for measuring physical conditions**

4.1 Measuring the water flow

4.2 Measuring water pressure



4.3 Measuring water level

5 Equipment for counting fish, measuring fish size and estimation of total biomass

5.1 Counting fish

5.2 Measuring fish size and total fish biomass

6 Monitoring systems

6.1 Sensors and measuring equipment

6.2 Monitoring center

6.3 Warning equipment

6.4 Regulation equipment

6.5 Maintenance and control

## UNIT-II

### **3. Water Transport**

#### **1 Introduction**

#### **2 Pipe and pipe parts**

.1 Pipes

2 Valves

3 Pipe parts – fittings

4 Pipe connections – jointing

5 Mooring of pipes

6 Ditches for pipes

#### **3 Water flow and head loss in channels and pipe systems**

3.1 Water flow

3.2 Head loss in pipelines

3.3 Head loss in single parts (fittings)

3.4 Pumps

3.4.1 Types of pump

3.4.2 Some definitions

3.4.3 Pumping of water requires energy

3.4.4 Centrifugal and propeller pumps

3.4.5 Pump performance curves and working point for centrifugal pumps

3.4.6 Change of water flow or pressure

3.4.7 Regulation of flow from selected pumps

## **UNIT-III**

### **4. Design and Construction of Aquaculture Facilities**

4.1 Introduction

4.2 Land-based hatchery, juvenile and on-growing production plant

4.2.1 General

4.2.2 Water intake and transfer

4.2.3 Water treatment department

4.2.4 Production rooms

4.2.5 Feed storage

4.2.6 Disinfection barrier

4.2.7 Other rooms

21.2.8 Outlet water treatment

4.2.9 Important equipment.

4.3 On-growing production, sea cage farms.

4.3.1 General.

4.3.2 Site selection.

4.3.3 The cages and the fixed equipment.

4.3.4 The base station.

4.3.5 Net handling.

4.3.6 Boat

## **UNIT-IV**

### **5. Recirculation and Water Re-use Systems**

5.1 Introduction

5.2 Advantages and disadvantages of re-use systems

5.2.1 Advantages

5.2.2 Disadvantages of re-use systems

5.3 Definitions

5.3.1 Degree of re-use

5.3.2 Water exchange in relation to amount of fish

5.3.3 Degree of purification

5.4 Theoretical models for construction of re-use systems

5.4.1 Mass flow in the system

5.4.2 Water requirements of the system

5.4.3 Connection between outlet concentration, degree of re-use and effectiveness of the water treatment system

5.5 Components in a re-use system

5.6 Design of a re-use system

## **Books and References Recommended for Paper-XI**

1. **Fundamentals of Aquacultural Engineering** Lawson, Thomas

Chapman ^ Hall. Inc. NY.

2. **Aquacultural Engineering.** (Dchapt 12, 13, 15). Wheaton, F.W. John Wiley & Sons, N.Y.

3. **Water supply Engineering** Santhosh Kumar Garg.

4. **Coastal Aquacultural Engineering** Bose et. al.

### **List of journals**

Aquacultural Engineering

Aquaculture and Fisheries Management

**RAJARSHI SHAHU MAHAVIDYALAYA, (AUTONOMOUS) LATUR.**

**Course Structure**

**B.Sc. T.Y. (Sixth Semester)**

**W.e.f. June 2015**

**Subject: FISHERY SCIENCE**

**Lab Course IX (Course Code: U-FIS-679)**

**Marks – 50**

**Hours 30**

**Credits –2**

**Objectives**

- Provide students with necessary skills for designing aquaculture system;
- Enable students to design, construct and maintain fish farms;
- Provide student with the requisite knowledge of pond construction engineering;
- Enable students to design water pumps for different aquaculture systems;
- Enable students to design and construct fish cages, tanks and other fish enclosure structures;
- Provide students with opportunities to develop fish farm construction skills;
- Provide students with skills to design aerators and filters for aquaculture systems
- Provide students with the skills to design and construct water re -circulatory systems;
- Enable students to manage waste in aquaculture production systems.

**Course outcome**

At the end of this course, students should be able to

- Students enable to understand Evaluation of potential site for aquaculture.
- Students enable to determine the Pace Value & the distance between two given points
- Students enable to find the bearing of different objects and to convert WCB to RB.
- Students enable to understand To measure and plot the distances of various field objects by radial method
- Students enable to analyze Soil for farm construction.
- Students enable to understand the Calculation of the Flow Rate for a Given Pipe Diameter, Pressure, & Length.
- Students enable to Estimate the horse power and selection of ideal pumps.

➤ Students enable to understand various aqua cultural accessories

1. Evaluation of potential site for aquaculture

2. **Chain surveying:** To determine the Pace Value & the distance between two given points.

3. **Compass Survey.** To find the bearing of different objects and to convert WCB to RB.

4. **Plane table and leveling.**

- To measure and plot the distances of various field objects by radial method.

5. **Simple Leveling:** To determine the level difference between the given points.

6. Soil analysis for farm construction.

7. Familiarization with various survey equipments.

8. Estimation of water requirements.

9. Calculate the Flow Rate for a Given Pipe Diameter, Pressure, & Length

10. Water purification methods.

11. Estimation of horse power and selection of ideal pumps.

12. Familiarization with various aqua cultural accessories.

13. Visits to different types of: Freshwater fish/prawn farms/Visits to different types of :

Estuarine fish / shrimp farms/Visits to different types of : Fresh water fish / prawn hatcheries.

/Visits to different types of : Marine fish /shrimp hatcheries

**RAJARSHI SHAHU MAHAVIDYALAYA, (AUTONOMOUS) LATUR.**

**Course Structure**  
**B.Sc. T.Y. (Sixth Semester)**  
W.e.f. June 2015  
**Subject: FISHERY SCIENCE**

**Paper XII: Fish Economics, Marketing, Fisheries Extension and Statistics**  
**Course Code : U-FIS-678**

**Marks – 50**

**Hours 45**

**Credits – 2**

**OBJECTIVES**

- Enable students to identify different marketing channels and intermediaries involved therein and their roles in fish marketing,
- Enable students to exchange and circulate information, ideas and practical experience on all matters relating to fisheries and their management.
- Enable students to learn structure of fish market to meet the local, specialist and overall needs of fisheries interests.
- Enable students to identify different marketing channels and intermediaries involved therein and their roles in fish marketing.
- Enable students to learn Extension

**Course outcome**

At the end of this course, students should be able to

- Students enable to understand Economic Terminology
- Students enable to understand Demand and Supply of Fish
- Students enable to understand Elasticity of Demand.
- Students enable to understand marketing channels and intermediaries involved.
- Students enable to understand Nature of fisheries extension
- Students enable to understand Collection and organization of data, Construction of frequency tables and the criteria governing formulations of good table.

**Unit I**

**1. Fish Economics**

**Economic Terminology**

**10**

1. Scarcity
  2. Choice
  3. Scale of Preference
  4. Definitions in Economics
  5. Macro-Economic Tools
  6. Economic Systems
  7. Market Economy
  8. Disadvantages of market economy
  9. Planned economy
  10. Mixed economic systems
- 2. Functions of an economic system**  
Aquaculture economics

## Unit II

20

### **Demand and Supply of Fish**

#### **Introduction**

##### **a) Consumer Demand**

1. Demand Schedule
2. Demand Curve
3. Demand and quantity demanded
4. Factors affecting the demand for fish and fish products
5. Population size and distribution
6. Consumer income and distribution
7. Prices and availability of substitutes
8. Consumer tastes and preferences

##### **b) Elasticity of Demand**

1. Price elasticity of demand
2. Calculation of own Price elasticity of demand
3. Determinants of price elasticity
4. Income elasticity
5. Cross-price elasticity
6. Elasticity, total and marginal revenue
7. Producer supply
8. Elasticity of supply
  - a) Price elasticity supply
  - b) Calculating supply elasticities
  - c) Price flexibilities



- d) Short and long run supply curves
- 9. Competitive market equilibrium

### **C) Fish Marketing**

- 1. Introduction
- 2. Traditional and modern fish marketing
- 3. Fish trade on micro and macro levels
- 4. Selling procedure for fish in India
- 5. Cost marketing and differential prices
- 6. Strategic fish marketing
- 7. Intensive growth
- 8. Diversification of growth

## **Unit III**

**08**

### **Management and Extension**

- 1. Nature of fisheries extension
- 2. fisheries extension and traditional management
- 3. Extension and co-operative development
- 4. Role of co-operative development in fisheries
- 5. Fisheries extension system India problems.
- 6. Future of fisheries extension
- 7. Communication and flow of information
- 8. Techno Socio-economic problem of fishermen
- 9. Role of women in fisheries
- 10. Need of technical knowledge to fishermen

## **Unit IV**

**07**

### **Statistics**

- 1. Definition and scope of statistics
- 2. Collection and organization of data
- 3. Representation of data by graphs, charts and diagrams
- 4. Classification of data according to attributes and class intervals
- 5. Construction of frequency tables and the criteria governing formulations of good table
- 6. Methods of computing mean, median and mode of grouped and ungrouped data

### **Books and References Recommended for Paper-XII**

1. Srivastava and Vathsala (1984) Strategy for development of Inland fisheries resource of India. Concept Publishing Co. New Delhi
2. Panayotou, T. (1982) Management concepts for small scale fisheries Economic and Social aspects. Fisheries Tech. Tech. Pap. No. 228. Rome.
3. Cunningham, D and Whitmarsh, (1985) Fisheries economics, an introduction.
4. IRDC (1982) Aquaculture economic research in Asia.Singapore.
5. Anderson.L. (1977) The economics of fisheries management. John Hopkins.
6. Geoffrey Waugh. Fisheries Management – Theoretical developments and contemporary applications.
7. Ian Chaston. Managerial effectiveness in fisheries and aquaculture.
8. Colin Clark, W., Bioeconomic modeling and fisheries management.
9. Revin Crean and David Symes (Ed), Fisheries management in crisis.
10. Subba Rao, N., Fisheries development and management in India.
11. Ian Chaston, Business management in fisheries and aquaculture.
12. Rowena Lawson, Economics of fisheries development.
13. Pauly, D. and Murphy, G.I. (Ed), Theory and management of tropical fisheries.



- 1. Economics of pond culture and riverine fisheries**
- 2. Field level data collection, tabulation, analysis and Report writing**  
(Inland fishery catch from nearby villages)
- 3. Study of organizational structure and their role in fisheries viz.**
  - a) Fishermen co-operative society
  - b) FFDA (fish farmer's development Agency)
  - c) State and central Government organization i.e. ministry of fisheries.
  - d) Fish processing unit any four
- 4. Study of socio-economic conditions of fishermen from near By villages**
- 5. Preparation of extension material like pamphlets, leaflets and posters.**
- 6. Preparation of Radio talks**
- 7. Participation in Exhibitions**
- 8. Interview of fish farmers: A detailed project of the above cited areas should be submitted at the time of examination.**
- 9. Determination of mean, mode, median from given data.**
- 10. Graphical representation of given data.**
- 11. Determination of per hectare income.**