

FACULTY OF SCIENCES  
B.Sc. I Yr. SEMESTER -I  
FISHERIES SYLLABUS  
THEORY/MODULE/PAPER - I  
~~ECOLOGY AND BIOLOGY OF FISHES - I~~

*Introduction to Fisheries Science & Ecology  
of Water Bodies.* 60 Hrs  
(4 Hrs/week)

**UNIT - I**

**1.0 Introduction to Fishery Science 10 Hours**

- 1.1 Introduction, definition, scope and importance of fisheries.
- 1.2 Classification of fisheries.

**UNIT - II**

**2.0 Introduction to Fishery Science 15 Hours**

- 2.1 History of fisheries.
- 2.2 Prospects and perspectives of fisheries in India.
- 2.3 Present status of fisheries in India.

**UNIT - III**

**3.0 Ecology of Water Bodies 17 Hours**

- 3.1 Ecology of lentic and lotic ecosystems – Reservoirs, Ponds, Rivers and Estuaries.
- 3.2 Ecosystem energetics and productivity – Energy flow, Trophic levels, Pyramids, biogeochemical cycles, eutrophication.

**UNIT - IV**

**4.0 Ecology of Water Bodies 18 Hours**

- 4.1 Physico-chemical characters of water and soil of freshwater and brackish water systems.
- 4.2 Population dynamics – Population characteristics. Dynamics of fish populations.  
Significance of plankton in aquaculture.
- 4.3 Aquatic pollution and its effect on fisheries.

@@@@

*Sadia Begum*  
Dr. SADIABEGUM  
BOS  
Fisheries, TU, NRB

FACULTY OF SCIENCES  
B.Sc. I Yr. SEMESTER – II  
FISHERIES SYLLABUS  
THEORY MODULE/PAPER II  
~~ECOLOGY AND BIOLOGY OF FISHES -II~~

✓  
*Biology of fishes*

60 Hrs  
(4 Hrs/week)

UNIT - I

1.0 Biology of Fishes

15 Hours

- 1.1 Exoskeletal and endoskeletal systems – Body form, fins and locomotion, skin, scales, endoskeletal systems.
- 1.2 Digestive, Respiratory, Swim Bladder, Circulatory Systems.

UNIT - II

2.0 Biology of Fishes

15 Hours

- 2.1 Nervous and Sensory systems.
- 2.2 Endocrine, Excretory systems, Osmoregulation and Reproductive System and Development.

UNIT - III

3.0 Biology of Fishes

15 Hours

- 3.1 Specialised organs – Electric organs, Sound producing organs, Bioluminescence and Poisonous glands.
- 3.2 Sex determination, Courtship and Parental care.
- 3.3 Fecundity, GSI, Sex ratio and Condition Factor.

UNIT - IV

4.0 Biology of Fishes

15 Hours

- 4.1 Spawning and its Periodicity.
- 4.2 Feeding Biology
- 4.3 Growth – Age determination, growth, morphometry and Meristic characters.

@@@@@

*Sadia Begum*  
Dr. SADIA BEGUM

B.O.S  
Fisheries, TU, N2B

FACULTY OF SCIENCES  
B.Sc. II Yr. SEMESTER-III  
FISHERIES THEORY SYLLABUS  
MODULE – III  
FISH PHYSIOLOGY

60 Hrs (4 hrs/week)

**UNIT- I:     Digestion in Fishes**

**15 Hours**

- 1.1 Digestive System: Digestive glands, their secretions and digestive enzymes.
- 1.2 Digestion, absorption and assimilation of Carbohydrates, Proteins and Lipids.
- 1.3 Role of hormones in the regulation of digestion.
- 1.4 Factors affecting digestion and absorption.

**UNIT- II:     Respiration and Circulation in Fishes**

**15 Hours**

- 2.1 Definition and types of respiration - External and Internal respiration.
- 2.2 Mechanism of gaseous exchange; Countercurrent Principle, water flow across the gills and respiratory pumps.
- 2.3 Circulation: Blood circulation and Coronary system in fish.
- 2.4 Composition and functions of blood, Role of blood in transport of gases ( $O_2$  and  $CO_2$ ).

**UNIT- III:     Neuro-Endocrine System and Sensory organs**

**15 Hours**

- 3.1 Nervous system: CNS, PNS, and ANS, Neuron structure, Action potential and transmission of nerve impulse.
- 3.2 Synapse and neurotransmitters.
- 3.3 Neuro-endocrine system in Crustaceans and its role in the regulation of reproduction.
- 3.4 Sensory organs: Structure and function of chemo-, photo- and phonoreceptors, lateral line sense organs.

**UNIT- IV:     Excretion, Osmoregulation and Reproduction in Fishes**

**15 Hours**

- 4.1 Excretion: Nephron structure, Mechanism of excretion of nitrogenous wastes.
- 4.2 Osmoregulation: Mechanism of osmotic and ionic regulation.
- 4.3 Reproduction: Development of gonads, oogenesis and spermatogenesis.
- 4.4 Hormonal control of reproduction in fishes.

@@@@@

FACULTY OF SCIENCES  
B.Sc. II Yr. SEMESTER-III  
FISHERIES PRACTICAL SYLLABUS  
MODULE – III  
FISH PHYSIOLOGY

Marks: 50

1. Removal of fish pituitary gland and preparation of pituitary extract.
2. Estimation of primary productivity in freshwater bodies.
3. Enumeration and biomass estimation of freshwater zooplankton.
4. Enumeration and biomass estimation of benthos from lakes, ponds, streams and canals.
5. Study of inland capture fishes:
  - Cat fishes – any three
  - Clupeids - any three
  - Other Miscellaneous fishes - any three.



FACULTY OF SCIENCES  
B.Sc. II Yr. SEMESTER-IV  
FISHERIES THEORY SYLLABUS  
MODULE – IV  
FISH NUTRITION *ay fish feed*

60 Hrs (1 hrs/week)

**UNIT- I: Nutrition and Fish Feed** **15 Hrs**

- 1.1 Nutritional requirements of cultivable fish.
- 1.2 Natural food: Importance in aquaculture; Fish food organisms – bacterioplankton, phytoplankton and zooplankton and their role in larval nutrition.
- 1.3 Supplementary feed: Types of feed – Wet feed, moist feed, dry feed, mashes, pelleted feed – floating and sinking pellets, microencapsulated diets.
- 1.4 Feed Additives: Binders, antioxidants, enzymes, pigments, growth promoters, feed stimulants.

**UNIT- II: Nutritional Biochemistry** **15 Hrs**

- 2.1 Principles of fish nutrition and terminologies. Feeding intensity.
- 2.2 Classification of nutrients – Nutrient quality and evaluation of carbohydrates, proteins and lipids.
- 2.3 Digestive enzymes and feed digestibility.
- 2.4 Factors affecting digestibility. Nutritional deficiency diseases.

**UNIT- III: Nutritional Bioenergetics** **15 Hrs**

- 3.1 Energy requirements of fishes, protein to energy ratio, digestible energy.
- 3.2 Nitrogen balance Index, Protein sparing effect, High energy feed, Isocaloric diets.
- 3.3 Metabolic rate – Energy budgets; Energy efficiency of fish production.
- 3.4 Protein efficiency ratio, Net protein utilization and Biological Value.

**UNIT- IV: Feed Manufacture, Feeding Strategies and Feed Evaluation** **15 Hrs**

- 4.1 Feed manufacture: Raw materials, balanced mixture of macro and micro nutrients, hygiene, adulteration.
- 4.2 Feeding Strategies: Surface, Mid, and Bottom Feeders, Euryphagous, Stenophagous, filter feeding, predators.
- 4.3 Feed storage: Mycotoxins and use of preservatives.
- 4.4 Feed evaluation: Feed conversion ratio and feed efficiency ratio.

@@@@@

*Sadia Begum*

Dr. SADIA BEGUM

BOS

Fisheries, TU, N2B

**B.sc. FISHERIES BIOLOGY SYLLABUS UNDER CBCS**

**(With effect from 2016-2017)**

**V-SEMESTER**

**PAPER V-FISH PATHOLOGY(Theory)**

**UNIT I – Viral and Bacterial diseases**

**Max .Marks:75**

- 1.1 viral hemorrhagic septicemia. clinical symptoms , pathology and control measures.
- 1.2 Koi Herpesvirus clinical symptoms, pathology and control measures.
- 1.3 Infections haematopoietic necrosis virus clinical ,pathology and control measures.
- 1.4 Aquabrinavirus and betadona virus clinical symptoms ,pathology and control measures.
- 1.5 Gil ,Tail Rot and Fin Rot Dropsy and Red pest diseases –clinical symptoms, Pathology ,prevention and control measures.

**UNIT II-Fungal, protozoan, and Helminthes diseases.**

- 2.1 columnris- Mouth fungus clinical symptoms Pathology Prevention and control measures
- 2.2 epizootic ulcerative syndrome ( EUS),clinical symptoms and treatment of EUS.
- 2.3 clinical symptoms, Pathology ,Prevention and control measures of Lagenidium diseases(Larva Mycosis ) and Brown gill diseases.
- 2.4 Velvet, Rust –Gold Dust Diseases-clinical symptoms, and control measures.
- 2.5 Brooklynellosis , Hexamita and Costia Clinical Symptoms, Pathology and control measures.

**UNIT-III Crustacean, Nutritional and Ecological diseases.**

- 3.1 ichthyophthiriasis, Enterococcidiasis, whirling disease and Nodular disease. Clinical Symptoms , Pathology and control measures
- 3.2 Gyrodactylosis, Dactylogyrosis, Argulosis and Lernaeosis diseases-clinical symptoms, pathology and control measures.
- 3.3 Diseases of vitamin deficiency and Fatty liver degeneration.
- 3.3 Carbohydrates, proteins and lipid deficiency diseases in fish.
- 3.4 Gas bubble diseases and lack of oxygen –clinical symptoms ,pathology and control measures .
- 3.5 Environmental stress on outbreaks of infections diseases of fishes.

## REFERENCE BOOKS

1. Cheng TC. 1964. *The Biology of Animal Parasites*. W.B. Saunders Company, Philadelphia, Pennsylvania, USA.
2. Conroy CA and Herman RL. 1968. *Text book of Fish Diseases*. TFH (Great Britain) Ltd, England.
3. Lightner DV. 1996. *A Handbook of Shrimp Pathology and Diagnostic Procedures for Diseases of Cultured Penaeid Shrimp*. World Aquaculture Society, Louisiana, USA.
4. Reichenbach KH. 1965. *Fish Pathology*. TFH (Gt. Britain) Ltd, England.
5. Ribelin WE and Migaki G. 1975. *The Pathology of Fishes*. The Univ. of Wisconsin Press Ltd, Great Russel Street, London, UK.
6. Shuzo Egusa. 1978. *Infectious Diseases of Fish*. Oxonian Press Pvt. Ltd. New Delhi.
7. Van Duijn, C. 1973. *Diseases of Fishes*. Cox and Wyman Ltd. London.

## Practicals-30 Marks

1. Isolation and maintenance of bacteria from fishes and water.
2. Examination of moribund fish for viral and bacteria diseases; Sampling techniques,
3. Microbial identification Enumeration of bacteria on fish by TPC method
4. Histopathological observation of diseases fish organs.
5. Identification of various finfish / shellfish disease
6. Parasite in fishes, protozoan, helminths, crustaceans
7. Prophylaxis for the prevention of outbreak of fish disease
8. Processing and study of the arthropods and their larval stages, staining and study of the protozoans Fixation and staining of protozoa, examination of biopsy material, examination of tissue sections for parasites.

Sadia Begum



**B.sc. FISHERIES BIOLOGY SYLLABUS UNDER CBCS**  
**(With effect from 2016-2017)**  
**V-SEMESTER**  
**PAPER VI- WATER QUALITY MANAGEMENT (Theory)**

Max Marks:75

**UNIT-I Water quality, fertilizers and manures , liming and Dynamics of dissolved oxygen.**

- 1.1 Water quality: constituents of water quality parameters,-optimal levels and their management in fresh water fish.**
- 1.2 Fertilizers and manures : Different kinds of fertilizers and manures ,fertilizer grade source, rate and frequency of application; Ecological changes taking place after fertilizing.**
- 1.3 Bio fertilizers : Role of inorganic, organic and biofertilizers in aquaculture Practices; Utilization of bioactive compounds by micro organisms.**
- 1.4 Liming: properties of liming materials, lime requirements and application of liming materials to ponds, effects of liming on ecosystem.**
- 1.5 Dynamics of dissolved oxygen : Dial changes in dissolved oxygen concentration ,**
- 1.6 oxygen budget of culture ponds ; algal die – off, overturns,**
- 1.7 identification of oxygen problems.**

**UNIT-II Aeration, and Hatchery management**

- 2.1 Aeration : principles aeration ,emergency aeration, desertification and Practical considerations.**
- 2.2 Hatchery management: Fish hatchery protocols, seed rearing technology;**
- 2.3 Packaging and transport of seed ,,shrimp hatchery –Larval rearing; culture and use of different live feed; different chemicals and drugs used ; water quality and feed management.**
- 2.4 water discharge standards: effect treatment in hatcheries.**

**UNIT-III Aquatic weed management and pollution during aquaculture practices.**

- 3.1 Aquatic weed management: Common weeds and problems in culture ponds; Chemical, biological And mechanical control methods: Algal bloom Control.**
- 3.2 Chemical treatment; potassium permanganate, hydrogen peroxide, calcium hydroxide;**
- 3.3 Reduction of pH, control of turbidity, salinity ,hardness, Chlorides, water exchange, Chlorine removal; rotenone, formalin and malachite green;**
- 3.4 Methods of applying chemicals.**
- 3.5 Pollution in relation to aquaculture practices.**



## REFERENCE BOOKS

1. Adhikari S & Chatterjee DK. 2008. *Management of Tropical Freshwater Ponds*. Daya Publ.
2. Boyd CE and Tucker CS. 1992. *Water Quality and Pond Soil Analyses for Aquaculture*. Alabama Agricultural Experimental Station, Auburn University.
3. Boyd CE. 1979. *Water Quality in Warm Water Fish Ponds*. Auburn University Publ. Co.
4. Boyd, CE. 1982. *Water Quality Management for Pond Fish Culture*. Elsevier Sci.
5. Hephher B & Pruginin Y. 1981. *Commercial Fish Farming*. John-Willey & Sons Inc.
6. Jhingran VG. 1982. *Fish and Fisheries of India*. Hindustan Publishing Corporation, India.
7. Midlen & Redding TA. 1998. *Environmental Management for Aquaculture*. Kluwer.
8. Pillay TVR & Dill WMA. 1979. *Advances in Aquaculture*. Fishing News Books, Ltd. England.
9. Rajagopalsamy CBT & Ramadhas V. 2002. *Nutrient Dynamics in Freshwater Fish Culture System*. Daya Publ.
10. Sharma LL, Sharma SK, Saini VP & Sharma BK. 2008. *Management of Freshwater Ecosystems*. Agrotech Publ. Academy.
11. Stickney RR. 1979. *Principles of Warm water Aquaculture*. John-Willey & sons Inc.
12. Tucker C.S. 1985. *Channel Catfish Culture*. Elsevier.

## Practical-30 Marks

- 1 Types of Aerators.
- 2 Studies of fish breeding and gamete preservation. Method to identify quality seeds- stress test and microscopic examination.
- 3 Design and construction of fish hatcheries.
- 4 Freshwater fish identification – tagging – different types of tags.
- 5 Visit to nearest freshwater body; catching methods – catch data analysis on major freshwater resource – Estuaries - Reservoirs.
- 6 Types of weeds and treatment.

Jasdia Begu -

**B.sc. FISHERIES BIOLOGY SYLLABUS UNDER CBCS**  
**(With effect from 2016-2017)**  
**VI-SEMESTER**  
**PAPER VII- FISH PROCESSING TECHNOLOGY (Theory)**

**Max Marks:75**

**UNIT-I Process Bio chemistry and Microbiology**

- 1.1 Major and minor constituents of fish ,their distribution and function-moisture, Protein ,Lipids, Carbohydrates, vitamins and minerals .**
- 1.2 Post-mortem biochemical changes in fish – rigor mortis, autolysis ,auto-Oxidation and Their significance.**
- 1.3 Oxidative deterioration ; Toxins and toxic Substances in fish.**
- 1.4 Biochemical and microbial Spoilage of fish; Factors affecting Spoilage fish.**
- 1.5 Role of bacteria and moulds in fish Preservation**
- 1.6 Pathogenic Organisms encountered in fish Products, fecal indicator Organisms.**

**UNIT-II Handling and Fish Preservation**

- 2.1 Handling ,storage and transport of fresh fish , sanitary and Phyto- sanitary Requirements For maintenance of quality.**
- 2.2 Principles of fish Preservation; preservation of fish by curing ,drying . salting and Smoking; Chilling and freezing of fish; canning of fish and fish Products.**
- 2.3 Modern techniques employed in fish Preservation ; Accelerated Freeze Drying (AFD) ,Irradiation.**
- 2.4 Fishery by –Products and Waste utilization.**

**UNIT-III Quality Management and certification**

- 3.1 HACCP (Hazard Analysis and Critical Control Points) and Good Manufacturing Practices:**
- 3.2 HACCP Principles ,Practical aspects of planning and implementation,**
- 3.3 Verification ,validation and Audit.**
- 3.4 National and international Standards –ISO 9000 Series,2000 Series of Quality Assurance System codex Alimentarius Commission , Food Safety and Standards Act of India 2006.**



## REFERENCE BOOKS

1. Adcock D, Bradfield R, Halborg A & Ross C. 1995. *Marketing Principles and Practice*. Pitman Publ.
2. Allen, et al. (Eds). 1984. *Bio-Economics of Aquaculture*. Elsevier Publication
3. Chaston I. 1984. *Business Management in Fisheries and Aquaculture*, Fishing News Books.
4. Hephner B and Pruginin Y. 1989. *Commercial Fish Farming*. Wiley-Interscience.
5. Ian C. 1984. *Marketing in Fisheries and Aquaculture*. Fishing News Books.
6. Kumar D. 1996. *Aquaculture Extension Services Review: India*. FAO Fisheries Circular No. 906, Rome.
7. Meade JW. 1989. *Aquaculture Management* Van Nostrand, New York.
8. Pillay TVR. 1990. *Aquaculture Principles and Practices*. Fishing News Books Ltd. London
9. Ray GL. 2006. *Extension, Communication and Management*. 6th Ed. Kalyani Publ. Delhi.
10. Shang YC. 1990. *Aquaculture Economic Analysis - An Introduction*. World Aquaculture Society, USA.

## Practicals-30 Marks

1. Estimation of costs and returns of different aquaculture systems – planning and budgeting – linear programming production function analysis – cost function analysis – financial and farm business analysis – risk programming – case studies.
2. Visit to fish farms, prawn farms and hatcheries – discussion on socio economic issues in aquaculture development.
3. Data collection on cost and returns of different fishing methods (instead of economics of capture fisheries);
4. Structural Change in the seafood export of India-Estimation of DRC, NPC for selected groups of exports.

*Sadia Begum*



**B.sc. FISHERIES BIOLOGY SYLLABUS UNDER CBCS**  
**(With effect from 2016-2017)**  
**VI-SEMESTER**  
**PAPER VIII- FISHERIES ECONOMICS & EXTENSION (Theory)**

**Max Marks:75**

**UNIT –I-Economics- Production Cost benefit analysis and Economics of Unit Costs**

**1.1 The basis of Production ; Interrelationships of aquaculture system .**

**Production Economics; Basic economic Principles applied to fish Production;**

**1.2 Input-output relationships, maximum level of input, least-cost combination of inputs, Maximum level of output, combination of products , economics of size.**

**1.3 Cost- Benefit Analysis: Production costs , Variable costs, revenue, economic analysis; Partial budget analysis , cash flow analysis.**

**1.4 Economics of fish Production farm (Unit costs). Fresh Water fish farming in ponds – a Small scale business,**

**1.5 composite fish culture – large scale and Technical parameters that need to be considered.**

**UNIT –II Marketing economic and economic feasibility of investment analysis**

**2.1 Marketing Economics: Fish marketing Methods in India;**

**2.2 Basic concepts in demand and price analysis; demand , supply and fish prices, elasticity of demand (Price elasticity of demand , income elasticity of demand , cross elasticity of demand).**

**2.3 Economic feasibility of investment analysis ; Methods of feasibility analysis; the payback Period , average rate of return, discounting method,**

**2.4 Net present Value , Benefit- Cost Ratio, Internal Rate of Return.**

**UNIT \_III Fisheries extension .**

**3.1. Fisheries training and Education in India: Training Institutes, Universities , Research Organizations.**

**3.2 .Institutional funding to fisheries and aquaculture Sector.**

**3.3 .Socio-economic Conditions of fishermen and fish sector.**

**3.4 . Fishermen Co-operative Societies.**

## REFERENCE BOOKS

1. Balachandran KK. 2001. *Post-harvest Technology of Fish and Fish Products*. Daya Publ.
2. Bond, et al. 1971. *Fish Inspection and Quality Control*. Fishing News Books, England.
3. Clucas IJ. 1981. *Fish Handling, Preservation and Processing in the Tropics*. Parts I, II. FAO.
4. Gopakumar K. (Ed.). 2002. *Text Book of Fish Processing Technology*. ICAR.
5. Govindan, TK. 1985. *Fish Processing Technology*. Oxford-IBH.
6. Hall GM. (Ed). 1992. *Fish Processing Technology*. Blackie.
7. Huss HH, Jakobsen M & Liston J. 1991. *Quality Assurance in the Fish Industry*. Elsevier.
8. John DEV. 1985. *Food Safety and Toxicity*. CRC Press.
9. Krenzer R. 1971. *Fish Inspection and Quality Control*. Fishing News.
10. Larousse J & Brown BE. 1997. *Food Canning Technology*. Wiley VCH.
11. Nambudiri DD. 2006. *Technology of Fishery Products*. Fishing Chimes.
12. Regenssein JM & Regenssein CE. 1991. *Introduction to Fish Technology*. Van Nostrand Reinhold.
13. Rudolf K. 1969. *Freezing and Irradiation of Fish*. Fishing News (Books).
14. Sen DP. 2005. *Advances in Fish Processing Technology*. Allied Publ.

## PRACTICALS-30 Marks

1. Determination of moisture content in fish and fishery products
2. General description – freezing
3. Processing shrimp
5. Drying of fish
6. Organoleptic analysis of fish
7. Preparation of fishery byproducts
8. Preparation of shark fin rays, fish maws, chitin and fish wafer
9. Fish pickling and Value added fishery products, fish curry, cutlets, fish finger.
11. Filleting of fish, treatments, glazing, packaging, freezing, Processing of Prawns, Lobster, Squid, Cuttle Fish, Crab etc. in different styles. Packaging and Freezing, Freezing curve, determination of freezing point.

*Joshia Begu*