

SYLLABUS

**AQUACULTURE MANAGEMENT &
TECHNOLOGY**
[2 YEARS M. Sc. COURSE]
(FOUR SEMESTER)
w. e. f. 2006 - 2007



VIDYASAGAR UNIVERSITY
MIDNAPORE – 721 102
WEST BENGAL

FIRST SEMESTER

THEORETICAL PAPER

PAPER – AMT 1001 (50 MARKS)

[Freshwater Fisheries resource diversity]

(University Examination 40 Marks + Internal Assessment 10 Marks)

1. Inland fisheries

Inland fishery resources, major river systems of India and their fisheries. Origin, distribution, classification and ecology of lakes and their fisheries, canal fisheries.

2. Reservoir fisheries

Fisheries of large, medium and small reservoirs of India. measures to increase their production and economic management of reservoirs.

3. Coldwater fisheries

Important coldwater fisheries of India. mahaseer and trout fisheries, their importance in sport.

4. Shellfish resources

Commercially important shellfish resources of freshwater, brackish water, marine water and mangrove ecosystem.

5. Invasive species

Invasive species of different ecosystems. Effect of invasive species on the indigenous fishery resources. Possible future impact and management practices.

PAPER – AMT 1002 (50 MARKS)

[Saline water fisheries resource diversity,

Conservation, management and remote sensing technology]

(University Examination 40 Marks + Internal Assessment 10 Marks)

1. Brackish water fisheries

Brackish water fishery resources, estuaries of India and their fisheries, backwaters and their fisheries; Brackish water lakes with special reference to Chilka and Pulicot.

2. Marine fisheries

Coastal capture fisheries – inshore, offshore and deep sea fisheries of Indian seas. Sardine, Indian Mackerel, Bombay duck, tuna, pomfret, prawn, lobster, crab and molluscan fisheries and other economic aquatic resources

3. Fisheries management and conservation

Anthropogenic activities and their effect on fisheries, threatened fish species of India, measures for management and conservation.

4. Remote sensing

Application of remote sensing in conservation & management of fish faunal diversity and exploitation of capture fisheries resource.

5. Ethics & Issues

Pollution and their impacts on aquatic resources. Social impacts, human diseases and possible preventive measures.

PAPER – AMT 1003 (50 MARKS)

[Taxonomy and Biology of Finfish and Shellfish]

(University Examination 40 Marks + Internal Assessment 10 Marks)

1. Taxonomy and distribution

Taxonomy, classification and distribution of freshwater and marine fishes, crustaceans and mollusks. General account of agnathans fishes, bony fishes, cartilaginous fishes, chimaera and dipnoi.

2. Biorhythms

Circadian and circannual rhythms, lunar and tidal rhythms. Ecological significance of biorhythms. Migration in fishes and prawns.

3. Population dynamics

Population structure, density, fluctuation. Estimation of fish populations.

4. Biology of Commercially important fishes and shellfishes.

Important groups of teleostean, crustaceans & molluscs having commercial fishery importance of world and India, food and feeding habits, food in relation to age, determination of age and growth – length frequency, commercially important of gastropods, bivalves and cephalopods of India.

5. Ecology and behaviour of fishes

Fish and its environment, intra-specific relationships in fish, food webs in relation to fish, impact of biotic and abiotic factor on fish production, fish migration. Concepts of ethology of fishes, fish behaviour in fish, behaviour responses to fishing.

PAPER – AMT 1004 (50 MARKS)

[Physiology of finfish and shellfishes]

(University Examination 40 Marks + Internal Assessment 10 Marks)

1. Digestive System

Structure, function and physiology of digestive system and associated glands; food and feeding habits of fishes and prawns. Qualitative and quantitative estimation of gut contents

2. Nutrition physiology

Growth and energy utilization, ATP production, Glycolysis, TCA cycle, protein and fat metabolism

3. Respiratory system

Structure and function of respiratory and accessory respiratory organs in fishes; respiration in prawns.

4. Circulatory and excretory systems

Structure and function of circulatory system, blood and its functions. Osmoregulation in fishes and prawns.

5. Endocrine system

Structure and function of endocrine glands of fishes. Neuroendocrine system of prawns. Role of hormones in relation to reproduction in fishes and prawns.

6. Reproductive system

Structure and function of reproductive system of fishes and prawns. Gametogenesis, ovulation and fertilization. Gonadosomatic index. Embryonic development of fishes and prawns.

7. Other organ systems

Nervous system, sound producing organs and sense organs. Bioluminescence.

PRACTICAL PAPER

PAPER – AMT 1005 (50 MARKS)

(University Examination 40 Marks + Internal Assessment 10 Marks)

1. Identification of Indian common fish faunal resources from cold water, warm water, brackish water, marine water and ornamental fishes.
2. Preparation of Taxonomic key and analysis of Phena.
3. Fish food organisms (Natural): Phytoplankton and zooplankton of Midnapore and adjoining areas.
4. Digestive and circulatory system of at least 3 different species (different family).
5. Internal ear and nervous system of at least 3 different species (different family).
6. Urino-genetal system of at least 3 different species (different family).
7. Length-weight relationship,
8. Morphometry study of fishes
9. Gonadosomatic index.
10. Population estimation etc.
11. Application of Remote Sensing & GIS in resource exploitation
12. Submission of laboratory note book.
13. Field note book (Visit on cold water fish farm or ornamental fish breeding and rearing).
14. Viva-voce

PAPER – AMT 1006 (50 MARKS)
(University Examination 40 Marks + Internal Assessment 10 Marks)

1. Gut content analysis of herbivorous fish & carnivorous fish.
2. Histological tissue preparation and straining
3. Gastrosomatic index of at least five fishes.
4. Accessory respiratory organ of *Channa (Ophiocephalus)*, *Anabas*, *Clarias*, *Heteropneustes* etc.
5. Identification of freshwater & brackish water/marine water prawns, Mussels and Oysters.
6. Identification of eggs, spawn, fry and fingerlings of cultivable fishes of India.
7. Laboratory note book.
8. Viva- voce.

SECOND SEMESTER

THEORETICAL PAPER

PAPER – AMT 2001 (50 MARKS)
[Aquaculture Management]
(University Examination 40 Marks + Internal Assessment 10 Marks)

1. Principles of aquaculture

Definition, history and scope of aquaculture, constraints and recent advances in aquaculture, criteria for selection of species.

2. Aqua farm engineering

Selection of site, designing, layout and construction of aqua farms, soil properties, water supply and drainage systems. Design and construction of aqua – hatcheries, aeration in aquaculture types and design, equipments, automatic feeders.

3. Freshwater culture

Carp culture, mono and poly culture extensive, semi-intensive and intensive culture; practices in integrated fish culture: sew age-fed fish culture; culture of prawns, catfishes, murrels, coldwater fishes. Pearl culture.

4. Brackish water culture

Brackish water culture in India, cultivable species, seed production. Traditional prawn culture system of India; Extensive, modified extensive and semi intensive shrimp culture.

5. Mariculture

Mariculture in India, cultivable species of fish, crustacean and molluscs; seed production. Propagation of sea weeds of commercial importance.

PAPER – AMT 2002 (50 MARKS)

[Fish Nutrition, Informatics and Ornamental fish]

(University Examination 40 Marks + Internal Assessment 10 Marks)

1. Nutrition of cultivated fishes

Qualitative and quantitative nutritional requirements of commercially important finfish and shellfish; factors altering energy requirements; digestive enzymes; feed utilization.

2. Biochemistry of finfish and shellfishes

Moisture, proximate composition, protein, lipid, carbohydrate, fibre, calcium, phosphorus, energy value etc.

3. Feed formulation and technology

Types of feeds, feed ingredients and their selection, formulation and preparation of feed, feed mills-types and mechanism, feed attractants and preservatives, effect of processing on nutritional quality. Addition of probiotics and probiotics in formulated feeds.

4. Processing of feeds and Feeding of Fish

Processing and feed dispensing, Feeding mechanism and types, feeding behavior of cultivable fishes, feeding strategies and feed allocation

5. Live food culture

Natural food and their importance, methods of collection, maintenance and rearing of fish food organisms, different media used for maintaining culture; culture of phytoplankton, protozoan, rotifers, annelids and crustaceans.

6. Ornamental fish

Aquarium ornamental fishes, their breeding and culture, common aquarium plants and their multiplication. Ornamental objects, aerators and filters used in aquaria. Aquarium feeds and maintenance.

PAPER – AMT 2003 (50 MARKS)

[Fish breeding and Hatchery management]

(University Examination 40 Marks + Internal Assessment 10 Marks)

1. Brooder management

Selection of brooder, nutrition, gonadal changes, hormonal regulation.

2. Fish breeding

Induced breeding, hypophysation, different ovulating agents, hatchery and bundh breeding, multiple breeding, natural collection of seed, transportation of brood fish and seed.

3. Hatchery management

Types of hatchery, management practices for fin fish (Indian Major Carps, Siluroid fishes, prawn and shrimps, crab hatchery etc.)

4. Fish cytogenetics

Principles of genetics; techniques in cytogenetics, evolution of fish karyotypes. Sex linked genes and sex limited phenotypes, quantitative phenotypes, pleiotropy. Recent trends genetic mutations; types of mutations, mutagens.

5. Genetic improvement

Need for genetic improvement inheritance, inbreeding and cross breeding; Selection methods, basis of selection and its effects.

6. Hybridization

Types of hybridization, naturally occurring and artificially produced cyprinid hybrids. Cultural traits of hybrids.

PAPER – AMT 2004 (50 MARKS)
[Aquaculture Biotechnology]
(University Examination 40 Marks + Internal Assessment 10 Marks)

1. Genetic manipulation

Sex-reversal and sex control; role of steroids in sex reversal, chromosomal manipulation, polyploidy, androgenesis and gynogenesis; cryopreservation of gametes.

2. Genetic engineering

General principles of genetic engineering, recombinant DNA and gene cloning methods, restriction/modification enzymes, PCR, sequencing, DNA fingerprinting, recombinant vaccines, transgenic fish.

3. Biotechnology in aquaculture

Molecular expression of Key enzymes of metabolic importance, transplantation immunology. Hormonal manipulation in advancing maturity and reproduction, Biotechnology in aquaculture product development, biofertilization, biofermentation and biofilters.

4. Fish cell and tissue culture

General principles of cell and tissue culture, culture of primary cells, secondary culture (sub-culture) and cell lines. Fish cell culture; development of cell lines and their applications.

5. Fish stock improvement

Practical application of Biotechnology in aquaculture and Fisheries Management

PRACTICAL PAPER

PAPER – AMT 2005 (50 MARKS)
(University Examination 40 Marks + Internal Assessment 10 Marks)

1. Estimation of pH, lime requirement of fishpond, dissolved oxygen, free CO₂, estimation of alkalinity, and estimation of NH₃.
2. Aquarium design and aqua farm & hatchery design and estimation of cost effectiveness.

3. Culture of live food (phytoplankton, zooplankton, rotifers).
4. Aquaculture informatics-database development etc.
5. Application of remote sensing technology in resource exploitation and management.
6. Formulation and preparation of artificial fish food for Indian major carps & Prawns.

Visit to fish farming/ center and documentation of dominant finfish and shellfish

7. Laboratory Note Book.
8. Viva- voce.

PAPER – AMT 2006 (50 MARKS)
(University Examination 40 Marks + Internal Assessment 10 Marks)

- 1) Induced breeding of Indian major carps and other fishes.
- 2) Hybridization of species and genus level, egg production and fecundity estimation.
- 3) Isolation of protein, DNA and RNA.
- 4) PCR analysis and heterozygosity analysis.
- 5) Probiotics development and utilization trial.
- 6) Primary cell culture.
- 7) Laboratory Note Book.
- 8) Viva- voce.

THIRD SEMESTER

THEORETICAL PAPER

PAPER – AMT 3001 (50 MARKS)
[Aquatic Biology]
(University Examination 40 Marks + Internal Assessment 10 Marks)

1. Aquatic ecosystems

Definition, principles and scope of ecology in relation to aquatic ecosystem. Abiotic and biotic factors.

2. Freshwater ecology

Physico-chemical characteristics of freshwater, classification of freshwater bodies, thermal stratification, freshwater communities, adaptations.

3. Estuarine and coastal ecology

Characteristics of estuaries, classification, horizontal stratification, estuarine communities adaptations. Major estuaries of India. Coastal resource and management.

4. Marine ecology

Physico-chemical characteristics of marine environment, classification, thermal stratification, marine communities.

5. Productivity

Primary productivity, gross and net productivity. Plankton and their role in aquatic ecosystem in relation to fisheries; qualitative and quantitative analysis of plankton. Biomass, food webs, energy flow.

PAPER – AMT 3002 (50 MARKS)

[Microbiology and Public Health Fishery]

(University Examination 40 Marks + Internal Assessment 10 Marks)

1. Scope of Microbiology

Introduction and scope of microbiology of aquatic ecosystem. Influence of physical, chemical and biological factors on aquatic microorganism. Role of microbes in regeneration of nutrients – conversion of carbon, nitrogen and other elements .

2. Benthos and macro vegetation

Classification and identification of major types and their role in aquatic production. Methods of collection, preservation and identification of dominant types from different water habitats.

3. Aquatic microbiology

Types of microbes, bacteria, fungi and viruses. Isolation and culture techniques, identification of bacteria and fungi and maintaining their cultures. Microbiology in relation to fish and prawn production.

4. Aquatic pollution

Sources of pollution, Biological and Chemical Oxygen Demand. Aquatic contaminants and their biodegradation, impact of pollution on fish health and fisheries.

5. Public Health fishery

Biological factors of water-self purification. Technical means of controlling microbial population in water. Public health fishes. Treatment of domestic and industrial sewage for fish culture. Sewage fed fisheries in India.

PAPER – AMT 3003 (50 MARKS)

[Finfish and shell fish pathology]

(University Examination 40 Marks + Internal Assessment 10 Marks)

1. Disease diagnosis

Principles of disease diagnosis in finfish and shell fish, epidemiological and clinical diagnosis, postmortem examination, microbiological, histopathological and haematological methods.

2. Non – infections diseases

Nutritional and environmental diseases including neoplasia, their symptoms, cure and control.

3. Parasitic diseases

Diseases caused by protozoa and metazoa (crustaceans, helminthes), their symptoms, cure and control.

4. Microbial diseases

Diseases caused by bacteria, fungi and viruses, their prophylactic and therapeutic measures.

5. Diseases of shellfish

Current status of parasitic, microbial, and environmental diseases of shellfish.

PAPER – AMT 3004 (50 MARKS)

[Immunology, vaccination and diagnostic equipments]
(University Examination 40 Marks + Internal Assessment 10 Marks)

1. Fish immunology

Introduction to immunology, non-specific and specific immunity, cellular and molecular interaction in immune response. Antigens and antigenicity, theory of antibody formation; structure, type and function of immunoglobins.

2. Fish vaccination

General principles of fish vaccination, optimizing factors for vaccination, strategies for fish vaccination and vaccine production. Vaccine against selected species of bacteria.

3. Aquaculture Medicine

Traditional aquaculture medicines, commercially available aquaculture medicine in India like- Probiotic, sanitizers, oxigenators, immunostimulant, vitamin, minerals etc. Use of zeolite, dolomite and LSP. In aquaculture rules and regulation for use of aquaculture medicine.

4. Fish disease and human health

Aquatic pathogens in relation to human health. Concepts and principles of aquatic animal health certification.

5. Diagnostic equipments

Structure, principles and application of microscopes, Spectrophotometer, centrifuge, chromatography, electrophoresis apparatus, ELISA reader, PCR (polymerase chain reaction).

PRACTICAL PAPER

PAPER – AMT 3006 (50 MARKS)

(University Examination 40 Marks + Internal Assessment 10 Marks)

- 1) Measurement of BOD and COD of different waters.
- 2) Productivity estimation and analysis of food webs and energy flow.
- 3) Identification of macro vegetation from different aquatic ecosystem.
- 4) Isolation and culture of aquatic microbes.
- 5) Plate culture, subculture of microbes, streak plate method, spread plate method, pour plate method.
- 6) Gut flora culture of fish species.
- 7) Gram strain preparation and staining methods.
- 8) Isolation of fungal pathogen and staining.
- 9) Laboratory Note Book.
- 10) Viva- voce.

PAPER – AMT 3006 (50 MARKS)

(University Examination 40 Marks + Internal Assessment 10 Marks)

- 1) Disease diagnosis through post-mortem examination.
- 2) Isolation and culture of fish disease producing microbes.
- 3) Histopathology and haematology (submission of slides).
- 4) Fish blood grouping and immunity study through macrophage analysis.
- 5) Use of disease diagnostics instruments (Phase contrast microscope, UV spectrophotometer, cold centrifuge, electrophoresis apparatus, ELISA reader, PCR etc.).
- 6) Laboratory Note Book.
- 7) Viva- voce.

FOURTH SEMESTER

THEORETICAL PAPER

PAPER – AMT 4001 (50 MARKS)

[Fisheries Technology, harbour engineering]
(University Examination 40 Marks + Internal Assessment 10 Marks)

1. Crafts

Traditional and mechanical vessels. Craft design, material, construction and maintenance. Prevention of fouling and wood borers. Equipment for fish finding, navigation and deck gears. Outboard motors and their operations.

2. Gears

Different types of gear materials – twines, ropes. Design and fabrication of fishing gears. Principles and operations of different gears like shore seine, gill net, trawl net, line fishing, fishing traps, jigging, purse seine and electric fishing. Mesh size regulation and turtle exclusion device (TED). Gear preservation.

3. Packaging technology

Effect of different fibres on the quality of fresh and processed products, aeration, microbial contamination and transport safety. Types of different bags, cartoons, coloration, labeling, consumer acceptance.

4. Fish processing and By-products

Types of processing and canning, Commercially important by-products of fish and shellfish like fish meal, fish oil, isinglass, fin rays, chitosan etc.

5. Diversified and value added products

Different value added products like fish fingers, flakes, soup powder, breaded and battered products and mince products.

PAPER – AMT 4002 (50 MARKS)

[Food safety and Quality assurance]
(University Examination 40 Marks + Internal Assessment 10 Marks)

1. Fish handling and ice storage

Handling and transportation of fresh fish. Freshness test by organoleptic method. Different methods of production of ice, storage and calculation of requirement of ice. Stages of fish in ice.

2. Freezing and frozen products

Different types of freezing methods like air-blast freezing, plate freezing and cryogenics. Freezing curve, flow chart, grading, packing and storage of frozen products. Drip loss and thawing of frozen fish.

3. Biochemical aspects

Proximate composition of fish. Estimation of total nitrogen, lipid, moisture and ash content in fish. Rigor mortis changes, fresh-ness test. Protein denaturation, volatile nitrogen, lipid oxidation and rancidity.

4. Microflora of fishery products

Microbes causing food spoilage. Pathogenic organisms like *Vibrio cholerae*, *Salmonella*, *Staphylococcus aureus* etc. Microbial analysis of food products, isolation and identification of different microbes. Spoilage microorganism of fish and fishery products. Study of psychrophilic and mesophilic. Microbes of processed fish and products.

5. Quality assurance

Standards of sanitation and hygiene. Implementation of HACCP(Hazard Analysis and Critical Control Point) concept and food safety in fish industry. Various national and international standards on fishery products.

PAPER – AMT 4003 (50 MARKS)

[Fisheries Economics and Marketing]
(University Examination 40 Marks + Internal Assessment 10 Marks)

1. Principles of economics

Definition, subject matter and scope of economics. Law of diminishing returns, laws of increasing, constant and decreasing utility and returns. Law of equi-marginal returns. Importance of economics in aquaculture development.

2. Economy of fishermen

Fishermen populations, GDP from fisheries sector, foreign exchange earnings and employment potential of fishing industry.

3. Prospective of Aquaculture in Socio-Economic impact & Rural Development

Resource use and development, Socio-economic analysis, Socio-demographic profile, work contribution, household expenditure, income contribution, decision making, female headed household, impact of different age groups, socio-economic condition of fisherman.

4. Marketing

Markets and their kinds. Law of demand and supply, price determination, problems of fish marketing in India. exports of fish and fishery products, trends ;and problems therein. Role of MPEDA in exports of fish and fishery products.

5. Planning and extension

Fishery development plans and various schemes, with particular reference to Fish Farmer's Development Agencies, their achievements.

6. Fishery co-operatives

Functions, financial assistance, input supplies, marketing of fish. Socio-economic development. Role of fisheries corporations and Missionary Organizations in fisheries development.

PAPER – AMT 4004 (50 MARKS)

**[Fisheries Legislation, Statistics, Computer application
and Business Management]**

(University Examination 40 Marks + Internal Assessment 10 Marks)

1. Fisheries Legislation, Administration and development

Fisheries administration in Central and states, Fisheries legislation of Government of India and different States. Exclusive Economic Zone, Coastal Regulation Zone. Indian fisheries Act 1976, Coast guard Act 1978, Maritime Zones of India Act 1981, Related rules and Act, EEZ-1997 and recent developments.

2. Financial assistance

Financial assistance available to fishery sector from government, commercial banks, NABARD, Cooperatives and other institutional organizations.

3. Projects formulation and business management

Projects formulation, monitoring and evaluation, calculation of profitability.

4. Fisheries statistics

Scope and objectives of fisheries statistics; collection, presentation and interpretation of data; frequency distribution, charts and diagrams, histograms and frequency curves. Mean, mode, median, variance and standard error, concept of sample and population, characteristics of a sample, probability calculation, normal and binomial distribution. Test of significance based on t, X^2 and F, linear regression and correlation; analysis of variance. Fitting of curves (first degree), index numbers, census and sample survey, sampling techniques.

5. Computer application:

Basic principle of computer and its organization, software and hardware of computer and their functions, central processing unit and output devices in computer system. Introduction of various statistical packages and their use in fisheries data analysis, knowledge of different operating system with special reference to WINDOWS, role of bioinformatics in aquaculture.

PRACTICAL PAPER

PAPER – AMT 4005 (50 MARKS)

(University Examination 40 Marks + Internal Assessment 10 Marks)

1. Fish freezing and handling technology.
2. Production of value added products.
3. Production of important fish by-products.
4. Analysis of proximate composition of fish and processed products.

5. Microbial analysis of food products and identification of microbes causing food spoilage.
6. Visit to a coastal / mariculture farm and study the socio-economic status of the fisherman community.
7. Job training on fish processing Technology and fisheries business management.
8. Data analysis and & graph representation. MS – Office (Word, Excel, PowerPoint), Multimedia and Internet operation.
9. Field Note Book.
10. Laboratory Note Book.
11. Viva-voce.

PAPER – AMT 4006 (50 MARKS)
(University Examination 40 Marks + Internal Assessment 10 Marks)

1. Research (within same or other Institute/University)
2. Seminar (on any urgent issues of Aquaculture Management & Technology)
3. Viva-voce.