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<td>AQ 323 Fish Farm Design and Construction</td>
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<td>Genetics and Reproduction of Ornamental Fish</td>
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<td>FBG 421 Hatchery Management</td>
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<td>AQ 411 Prevention and Control of Fish Diseases</td>
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<td>AQ 421 Fish Feed Technology</td>
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<td>AQ 423 Integrated Aquafarming</td>
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<td>FM 421 Oceanography and Marine Biology</td>
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<td>FM 413 Fisheries Research Planning and Evaluation</td>
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<td>FM 422 Oceanography and Marine Biology</td>
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<td>FT 411 Quality Control of Fishery Products</td>
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<td>AgExt 427 Agricultural Extension</td>
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<td>AQ 413 Ornamental Fish Culture</td>
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<td>FBG 423 Principles of Molecular Biology and Biotechnology</td>
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<td>FM 415 Aquatic Pollution and Toxicology</td>
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- Odd and Even numbers of the courses are Theory and Practical, respectively
- For Theory one credit = One contact hour
- For Practical one credit = Two contact hours

**SYLLABUS FOR B.Sc. Fisheries (Hons.)**

**Level - I, Semester - I**

**Department of Fisheries Biology and Genetics**

**Course No. FBG 111**

**Course Title: Fisheries Zoology**

**Credit: 3**

1. Introduction: Course goals, objectives and outcomes
2. General survey and classification of animals up to sub-class level with special emphasis on groups having fisheries importance.
3. Adaptation of animals to aquatic life with special reference to temperature, salinity, current, depth, light etc.
4. Economic significance of the following groups of animals: Protozoans, Porifera, Coelenterates, Rotifers, Nematodes, Oligochaetes, Mollusks, Crustaceans, Aquatic insects, Echinoderms, Frogs, Aquatic reptiles, Fishing birds and Cetaceans.
5. Functional morphology and life history of the following aquatic animals: Paramecium, Aurelia, Pila, Lamellidens, Loligo, Macrobrachium, Scylla, Rana, Chitra, Crocodylus.

**Course No. FBG 112**

**Course Title: Fisheries Zoology**

**Credit: 1.5**

Students shall maintain a record of everything done in the practical and field sessions in a Practical Note Book to be signed and checked by teacher(s) concerned.

Viva voce test will form an essential part of the Practical Examinations.

1. Collection and preservation of aquatic animals.
2. Characterization and identification of the collected specimens.
3. Study of external morphology of fresh and preserved specimens.
4. Study of anatomy of different organ systems of representative invertebrates and chordates.

**Text books and references:**

1. Introduction: Definition and aim of aquaculture, history of aquaculture, present status and scope of aquaculture in Bangladesh. Problems and prospects of aquaculture.
3. Fish ponds: Site selection. Classification and characteristics of an ideal fishpond. Pond construction-area, shape, pond dike, bottom, contour etc.
4. Water quality in aquaculture: Physical and chemical properties of water, primary productivity, phytoplankton, zooplankton and benthos.
5. Selection of species for stocking: Biological characteristics of aquacultural species. Economic and market considerations.
7. Sources of fish seed: Natural sources of fish seeds. Artificial reproduction by environmental manipulation. Induced reproduction.

Text books and references:
4. Study of food web in a lentic habitat.
5. Study of stream as a lotic ecosystem.
6. Study of food web in a lotic habitat.
7. Study of species diversity indices in freshwater habitat.
8. Identification of aquatic weeds and their types.
9. Field visit to coastal mangrove and marine ecosystem and their community composition.

Text books and references:

Department of Fisheries Technology
Course No. FT 111
Course Title: Fish Harvesting-I
Credit: 3.0

1. Introduction to the history of Fishing. Fishing principle. Relationship between fish harvesting and fisheries management.
6. Fish harvesting in aquaculture system: Seine nets, traps, gill nets, hooks and lines, lift nets, cast nets, pond draining and others.
7. Fish aggregating devices (FAD). Electrofishing, chemical fishing and other methods of stupefying fish.

Text books and references:

Department of Biochemistry
Course No. BCHEM 115
Course Title: Biochemistry-I
Credit: 3

Carbohydrates: Classification, biological function and structural features. Cell wall polysaccharides.

**Proteins:** Classification, Amino acids and their classification. Reactions in protein chemistry. Organisation levels. Denaturation.


**Nucleic acids:** Composition, structural features and physicochemical functions.

**Text books and references:**

**Course No. BCHEM 116**
**Course Title:** Biochemistry-I
**Credit:** 1.5

Preparation of buffer solution and determination of pH.  
Colour tests of carbohydrates and proteins. Separation of sugars and amino acids by TLC.  
Isoelectric pH determination of proteins.  
Extraction of starch and glycogen.  
Estimation of fish protein by Kjeldahl method.  
Estimation of casein by Biuret method.  
Estimation of reducing sugars.  
Determination of saponification value, acid value and peroxide value of fish oils.  
Estimation of alpha-amylase.  
Protein fractionation by electrophoresis.

**Text books and references:**

**Department of Aquaculture**
**Course No. AQ 113**
**Course Title:** Geographical Information Systems (GIS) in Fisheries
**Credit:** 3

1. Introduction: Definition, history and components of GIS.  
2. Spatial data: Mapping concepts, features and properties, maps and their influence on the character of spatial data. Data types: point, line and polygon. Vector and raster data, advantages and disadvantages. Other sources of spatial data. Census and survey data, aerial photographs, satellite images. Field data sources. Surveying and GPS.  
3. Data input, verification, storage, and output: Methods of data input, editing, presentation, updating and storage.  
5. Multi criteria evaluation (MCE): Fish habitat suitability modelling (FHSM) for different fish species, mapping fish species and plankton distributions in lake, estuaries and sea using available information and satellite images. Detection of existing fish farming locations using satellite images.  
6. Use of GIS for aquaculture planning and development.  
7. Case Study: Fish habitat suitability modelling in different environmental conditions.

**Text books and references:**
13. GIS Journals:

Department of Fisheries Management

Course No. FM 113
Course Title: Fisheries Resources
Credit: 3

1. Physical resources of Bangladesh: (a) Waterbodies: Ponds and lakes, river, canals floodplain, beels, haors, baors, paddy fields, borrow pits and Bay of Bengal, their origin and morphology. (b) Institutional resources: Gos and NGOs, educational, research, training and extension. (c) Financial institutions: Banks, cooperatives, NGOs and other agencies.
2. Biological resources: Indigenous and exotic fish and non-piscine fisheries organisms, other aquatic living resources of commercial and economic importance.
3. Present status of water bodies, nature and extent of utilization, potentials for future management for sustainable development, sectoral policies and programmes for water-bodies belonging to different ministries and departments, current five-year development activities of the Ministry of Fisheries and Livestock.
4. Present status of seed production of fin fish, shell fish and non-conventional aquatic fauna from natural and artificial resources.
5. Impact of monsoon and flood, and flood control structures on inland capture fisheries resources.

Text books and references:
1. Ameen, M., 1987. Fisheries Resources and Opportunities in Freshwater Fish Culture in Bangladesh. PAT. NRD-11/DANIDA, Noakhali, Bangladesh. 244 pp.

Department of Languages

Course No. LAN 111
Course Title: English Language
Credit: 3

1. Textual study and comprehension of a few selective BBC talks.
2. Socio-linguistic rules to perform language function in English.
3. Basic grammatical structures:
i) Types and constructional forms of sentences; Sequence of tense; Voice; Verbs; verb patterns and verb modifiers; Syntax including transformation and combination of sentence and framing of WH-questions.  
ii) Nouns, determiners and adjectives; Adverbials; Prepositional phrases; Headword, Infinitive phrases; Participle phrases; Apositives.  
iii) Mechanics – Punctuation, Quotation marks, Capitalization, Numbers, Abbreviation Italics, Spelling (including most common mistakes).

4. Principles and methods of composition:  
i) Precis  
ii) Abstract or Summary  
iii) Paragraphs  
iv) Letters  
v) Short Essays  
vi) Reports

Text books and references:

Text books:

References:

Level - I, Semester - II
Department of Fisheries Biology and Genetics

Course No. FBG 121
Title: General Ichthyology  
Credit: 3

1. Introduction: Course goals, objectives and outcomes. History of Ichthyology  
2. Definition of fish. Important facts and figures about fishes. Classification of major groups of freshwater and marine fishes  
3. External morphology:  
   Body forms, shapes and sizes. Body coverings. Appendages and openings.  
   Skin, scales, skeleton, and fins. Derivatives of skin. Coloration in fishes and its significance  
4. Muscles and locomotion:  
   Types, and their roles in locomotion and movements of different body parts  
5. Anatomy of different internal organs:  
   Respiratory system: Structure of gills, accessory air-breathing organs.  
   Digestive system: Food, feeding habits and feeding adaptations; comparative study of the alimentary canal in different groups of fishes.  
   Circulatory system: Components of circulatory systems.  
   Excretory system: Excretory organs, types of kidneys.  
   Reproductive system: Types of reproduction, primary and secondary sexual characters.  
6. Swim bladder: Origin and role in buoyancy  
7. Integration systems in fishes:  
   Nervous systems- brain and cranial nerves; spinal cord and nerves  
   Receptors- types and functions  
   Endocrine system- types of endocrine glands, their location and function.  

Course No. FBG 122
Course Title: General Ichthyology  
Credit: 1.5

Students shall maintain a record of everything done in the practical and field sessions in a Practical Note Book to be signed and checked by teacher(s) concerned.

Viva voce test will form an essential part of the Practical Examinations.  
1. Identification of important marine and freshwater fishes.  
2. Study of different types of scales.  
3. Study of external morphology and internal anatomy of fishes.  
4. Comparative study of digestive systems of fishes with different food and feeding habits.
5. Major circulatory blood vessels.
6. Identification of important bones and preparation of bone album.
7. Study of brain and pituitary gland.

Text books and references:

Department of Fisheries Biology and Genetics

Course No. FBG 123
Course Title: Biodiversity and Fishery Systematics
Credit: 3

1. Introduction: Course goals, objectives and outcomes.
2. Basic information on biodiversity: Definition of species. Ecosystem and genetic diversity. The nature and value of biodiversity-economic and ecological.
3. Aquatic biodiversity study: Species biodiversity
   Ecosystem diversity -
   Country level: Inland – ponds, swamps, lakes, canals and rivers and Marine – Bay of Bengal, coast, off-shore and estuaries
   Global level: Hydrosphere (7 oceans), Lithosphere (lands – 5 continents) and Atmosphere (Air), Rhythms: Scalar rhythm (24 h diurnal), Lunar rhythm (monthly) and solar rhythm (annual), wave and current
4. Loss of the biodiversity: Causes; natural variation in time and space; Present situation, endangered aquatic species of Bangladesh.
5. Systematics - an overview.
6. Taxonomic characters: Morphometric, meristic, physiological, ecological, and ethological.
   Criteria for taxonomic categorization.
10. Recent developments in systematics.
Course No. FBG 124  
Course Title: Biodiversity and Fishery Systematics  
Credit: 1.5

Students shall maintain a record of everything done in the practical and field sessions in a Practical Note Book to be signed and checked by teacher(s) concerned.

Viva voce test will form an essential part of the Practical Examinations.
1. Collection and preservation of aquatic animals.
2. Characterization and identification of collected specimens.
3. Study of morphometric and meristic characters of fishes.
4. Study of biodiversity of selected and protected areas.

Text books and references:

Department of Aquaculture

Course No. AQ 121  
Course Title: Freshwater Aquaculture  
Credit: 3

1. Aquaculture system: Management approach, extensive (traditional), improved traditional, semi-intensive and intensive culture. Monoculture, polyculture, composite fish culture and integrated aquaculture.
2. Pond aquaculture: Site selection, pond construction, drying, liming, fertilization, productivity, stocking and post stock management.
4. Natural fish seed collection, seed production and transportation: Natural fish seed collection, bundh spawning, induced spawning, methods of packing and transport of fry and live fish, causes of mortality of fry and brood fish during transportation, use of anaesthetics, antiseptics and antibiotics in live fish transport.
5. Aquatic weeds: Common aquatic weeds and methods of their control. Preparation of compost with aquatic weeds, algal bloom and its control.
6. Culture of important freshwater species: Carp, prawn, catfish, tilapia, eel, snakes-heads and small indigenous species (SIS).
7. Cage and pen aquaculture: Site selection, design and construction of cages and pens, species selection, stocking, feeding and harvesting.
8. Impacts of aquaculture on environment.

Course No. AQ 122  
Course Title: Freshwater Aquaculture  
Credit: 1.5

Students shall maintain a record of everything done in the practical and field sessions in a practical notebook to be signed and checked by teacher(s) concerned. Viva voce test will form an essential part of the practical examination.

1. Identification of common aquatic weeds and algae of aquaculture.
2. Identification of seeds of important aquacultural fish and shrimp species.
3. Preparation, fertilization and management of a nursery pond.
4. Preparation, liming, fertilization and management of a stocking pond.
5. Use of anaesthetics in handling of fish.
6. Transportation of fry, fingerlings and live fish.
7. Case study: Visit to hatchery and fish farms and preparation of case study report.
Text books and references:

Department of Fisheries Technology

Course No. FT 121
Course Title: Fish Harvesting-II
Credit: 3.0

2. Different types of fishing: Fishing machinery, industrial fishing, successful fishing and unsuccessful fishing, responsible fishing, sports fishing and ice fishing. Modern fishing gears and fishing crafts. Sinkers, floats, buoys in marine fishing. Fish responses to fishing gears.
3. Choice of netting material for bottom trawl, gill net and trammel net at sea.

Course No. FT 122
Course Title: Fish Harvesting-II
Credit: 1.5

Students shall maintain a record of everything done in the practical and field sessions in a Practical Note Book to be signed and checked by teacher(s) concerned.

1. Acquaintance with different types of fishing gears: Wounding gears, traps and nets. Identification, description, operation and significance.
2. Acquaintance with different types of fishing crafts used in Bangladesh: Identification, carrying capacities and significance.
4. Identification of different types of natural and synthetic fibers used in fishing.
5. Practice on net making and mending.
6. Exercise on different techniques of net preservation.
7. Field visit to a fish landing center.
8. Field visit to the river Brahmputra to see different fishing operation.
9. Exercise on fish harvesting using seine net and caste net in a University fish pond.

Text books and references:

5. Different published manuals, papers, reports etc. on related topics in fish harvesting.

Department of Rural Sociology
Course No. RS 121
Course Title: Rural Sociology
Credit: 3

1. Introduction: Definition of Sociology and Rural Sociology, Origin and Development of Rural Sociology; Scope of Rural Sociology, Importance of Rural Sociology, Role of the Rural Sociologists in Agricultural Development.
2. Methods and Techniques of Social Research: Scientific research methods, importance, value judgement and ethical issues, types, research process, sampling, mode of data collection and analysis of social data.
3. Culture: Meaning, importance and function, elements, cultural universals and variability, ethnocentrism and relativism.
4. Social Differentiation, Stratification and Rural Power Structure: Nature and sources of social differentiation, importance and consequences, form of Stratification, class and caste, class system of rural Bangladesh, Nature of Rural Power Structure, kinship and rural elites, power structure and development activities.
7. Rural Poverty, Rural Development and GO and NGO Activities: Meaning and nature of rural poverty, rural development models, GO and NGO activities.
9. Rural women and gender issues: Women and development, gender discrimination, aspects of gender inequality, important issues and techniques of development of women in Bangladesh.
10. Rural social policy and planning: Meaning and contribution of rural sociology in social policy, objectives of rural social planning, pre-requisite, limitations and obstacles of effective social planning, application of social planning.

Text books and references:

Text books:


References:

5. Etienne, G. 1998. Rural Change in South Asia-India, Pakistan, Bangladesh. UPL, Dhaka.
1. Introduction: Definition, history and heritage of wetlands, hydrological context, importance of wetland for Bangladesh.
3. Ecology of wetlands: Geomorphological characteristics and forest status; habitat for migratory birds; fisheries organisms (freshwater and marine).
4. Socio-economic aspects of wetlands: Human settlements, role in bio-diversity conservation, wetland crops, navigation and communication media, source of food and medicinal plants, biomass production and role in cottage industries, coral reef formation, eco-tourism and flood control.
5. Developmental activities and threats: Impact of development activities, disappearing and pollution of wetlands, land use conflicts and reclamation, role in endangering bio-diversity.
7. Future strategies for resource management, sustainable development and public awareness, and international collaboration.
8. Wetland management: Restoration, rehabilitation and management of wetlands.
9. Role of organizations in the conservation of wetlands: National management policy, role of the Ministry of Environment and Forest, Ministry of Livestock and Fisheries, Department of Fisheries (DoF), Bangladesh Fisheries Research Institute (BFRI), Bangladesh Fisheries Development Corporation (BFDC), Bangladesh Water Development Board (BWDB), Space Research and Remote Sensing Organization (SPARRSO); Non-government Organizations (national and international).

Textbooks and references:

Department of Fisheries Technology

Course No. FT 123
Course Title: Principles of Fish Handling and Preservation
Credit: 3.0

1. Introduction: Physical structure of fish, general principles and methods of food preservation with special emphasis on finfish and shellfishes.
2. Fish as food: Major component of fish flesh, nutritive value and chemical composition of fish. Post-mortem changes in fish and nature of spoilage:
3. Commercial handling of fish and shellfish: Good practices of handling of raw material, handling of fish on board fishing vessel and shore plant, temporary and bulk preservation and transportation
4. Chilling of fish: Principles of chilling, chilling of fish with ice and other methods, types of ice and icemakers, storage of ice, chilling of fish at sea, distribution and retailing of chilled fish
5. Freezing: Principles of fish freezing, freezing methods and equipment, glazing and stowage.
6. Fish working premises: Layout and design, equipment, staff hygiene, sanitation and cleaning
7. Packaging of fresh fish: Modern packaging materials, wholesale packaging, traditional packaging, retail packaging and airfreight packaging

Textbooks and references:
4. FAO Fisheries Reports 1975. Ice in Fisheries. Food and Agriculture Organization of the United Nations, No. 59
7. Madakia, H. 1985. Fish handling, ASEAN-CIDA-SEAFDEC Regional Training Course in Fish Handling and Processing, Samutprakarn: 6-30 March 1985

Department of Computer Science & Mathematics

Course No. CSM 127
Course Title: Computer Science
Credit: 2

Computer basics: history and development, computer types on size and use, impact of computer on society and technology; computer systems, hardware and software, computer peripherals, i/o devices and storage media; systems software, language software, and applications software; program and algorithm; information coding, number systems and their internal representation; simple application and applet development using Java; introduction to HTML and java script in applet development; familiarity with word processing, database, spread sheet, and statistical packages; development of presentation materials using Microsoft Power Print.

Course No. CSM 128
Course Title: Computer Science
Credit: 1

Computer operations on DOS and windows environment; simple application and applet development; creation of document with figure, picture, column and table; financial book keeping and analysis using spread sheet; data storage and retrieval using Microsoft Access; simple statistical analysis using SPSS; preparation of presentation materials using Microsoft Power Point; file management.

Text books and references:

Level - II, Semester - I

Department of Fisheries Biology and Genetics

Course No. FBG 211
Course Title: Embryology
Credit: 3

1. Introduction: Course goals, objectives and outcomes.
2. Phylogenetic and ontogenetic development.
3. The origin and structure of gametes.
5. Parthenogenesis: Natural and artificial parthenogenesis and their impact; gynogenesis, androgenesis.
6. Cleavage: Pattern of cleavage, cleavage in different animals; blastulation.
7. Gastrulation: Fate of cells; gastrulation in different animals and formation of organ rudiments.
8. Organization of early embryo, epigenesis, nucleic acid and protein synthesis.
10. Differentiation and growth mechanism of cell reproduction.

Text books and references:
Department of Aquaculture

Course No. AQ 211
Course Title: Coastal Aquaculture
Credit: 3

1. Introduction: History of coastal aquaculture, global, regional and national importance of coastal aquaculture.
2. Site selection: General consideration: physico-chemical properties of soil and water.
3. Farming techniques: Shallow water (finfish and shrimp), intertidal zone (oyster), deep water (rafts and cages).
4. Larval rearing of marine finfishes, shrimp and prawn and other marine organisms.
5. Culture of finfishes: Seabass (*Lates calcarifer*), milkfish, mullets, yellowtail, grouper and salmon.
6. Culture of crustaceans: Crabs, shrimp and prawn and lobsters.
7. Culture of marine mollusks and seaweeds: Mussels; clams; oysters (including pearl oyster); abalone; scallops; seaweeds.
9. Mangrove forest and aquaculture: Mangrove ecosystem, energy flow in mangrove swamps, impact of deforestation and management of mangroves for sustainable aquaculture and fisheries.

Course No. AQ 212
Course Title: Coastal Aquaculture
Credit: 1.5

Students shall maintain a record of everything done in the practical and field sessions in a practical note book to be signed and checked by teacher(s) concerned. Viva voce test will form an essential part of the practical examination.

1. Designing of a coastal shrimp and fish farm.
2. Transportation of larvae and PL of shrimp.
3. Nursing of brackish water fish and shrimp fry.
4. Demonstration of culture techniques for oysters, mussels and clams.
5. Decapsulation and hatching of *Artemia* in laboratory condition.
6. Culture of algae, rotifer and cladocera in laboratory condition.
7. Case study: Visit to a shrimp hatchery and a coastal aquaculture farm and report writing.

Text books and references:

Department of Fisheries Management

Course No. FM 211
Course Title: Physico-chemical Limnology
Credit: 3

2. Rivers: Definition, types, origin, sources of water, rivers of Bangladesh, and rivers of the world.
3. The nature of water. The water molecule, physical and chemical characteristics of pure water.
5. Chemical characteristics of inland waters: Dissolved gases (oxygen, carbon dioxide and other gases). Dissolved solids (nitrogenous compounds, phosphorus, calcium and magnesium, sodium and potassium, iron, silicon, trace elements). Role of nutrients in primary production.
6. pH: definition, description, and effects on fishes and aquatic environment.
7. Biogeochemical cycles: definitions, biogeochemical cycles of nitrogen, phosphorus, calcium, carbon, silicon, sulfur, iron etc.
Course No. FM 212  
Course Title: Physico-chemical Limnology  
Credit: 1.5

Students shall be required to show a good knowledge of the topics included in the theoretical portion of the paper. They shall maintain a record of everything done in practical classes/field trips in a practical note book to be signed and checked by the teacher(s) concerned. Viva-voce test will form an essential part of the practical examination.

2. Recording of temperature, turbidity, colour, light penetration and water flow of water-bodies.
4. Procedures of removing turbidity by different methods.
5. Lime application: Determination of dose and application procedures.
6. Field visit to study water quality parameters of fish farm.

Text books and references:

Department of Fisheries Technology

Course No. FT 211  
Course Title: Fisheries Microbiology-I  
Credit: 3.0

1. Introduction: Scope, historical development, ecology and geographical distribution.
3. Molds and yeasts: General morphology, structural and reproductive characteristics, cultural characteristics, physiological characters, distinguishing characters of important genera and industrial importance.
4. Bacteria: Morphology and structure (cell wall, cell membrane, capsule, pilli, flagella, spores, cytoplasm, and nuclear material). Cultural and physiological characteristics. Description of important genera.
5. Viruses: General characteristics, classification, morphology and structure, viral reproduction.
6. Microbial growth and nutrition: Microbial growth curve, factors affecting microbial growth (water activity $a_w$, pH, temperature, redox-potential $E_n$, nutrient, microbial interactions, antimicrobial agents)
8. Antibiotic, antiseptics and disinfectants: Definition, types, characteristics, mode of action and economic importance.

Text books and references:

Department of Biochemistry

Course No. BCHEM 213  
Course Title: Biochemistry-II  
Credit: 2

Concept of free energy, entropy and enthalpy. Exergonic and endergonic reactions. ADP-ATP cycle. Bioluminescence.


**Protein Metabolism:** Food protein quality evaluation. Basic processes of amino acid catabolism. Nitrogen excretory products in aquatic animals. Fixation of nitrogen by aquatic plants.

**Lipid Metabolism:** Fatty acid oxidation. Biosynthesis of fatty acids and cholesterol. Interrelationship of fat, protein and carbohydrate metabolism.

**Nucleic acids:** Replication, transcription and translations- Biological functions of restriction enzymes. Concept of recombinant DNA and cloning.

**Hormones:** Characteristics and classification. Mode of action and biological functions of pituitary, hypthalamus, adrenal cortex and sex hormones.

**Text books and references:**

Department of Agricultural Statistics

**Course No. Stat 211**
**Course Title:** Statistics  
**Credit:** 3


Hypotheses, test of hypothesis, type 1 and type II errors and level of significance. Preliminary idea on t-test, F-test, chi-square test and their application. Testing hypothesis regarding population mean, equality of two means, population variance equality of two population variances, goodness of fit and independence of two attributes in contingency table and test of significance of correlation coefficient and regression coefficients(s).

Principles of experimental design. Field layout and analysis of variance in completely randomized design, randomized block design and Latin square design. Analysis of covariance in a completely randomized design and randomized block design.

**Course No. Stat 212**
**Course Title:** Statistics  
**Credit:** 1.5

Frequency table construction and graphical representation of data. Calculation of various measures of central tendency, Quantiles, various measures of dispersion. Fitting Binomial and Poisson distribution to observed data. Calculation of correlation coefficient and fitting simple linear regression to observed data.

Testing hypothesis regarding population mean, testing significance of simple correlation coefficient and regression coefficient(s). Use of Chi-square for testing goodness of fit and test of independence of attributes in a contingency table.

Field layout, analysis of variance and interpretation of data collected in completely randomized design, randomized block design and Latin square design. Examples of covariance analysis in a completely randomized design and randomized block design.
**Text books and references:**
6. Avn‡g`, Avãyi iwk`, Avjx AvRMi f'Bqv I RyjwdKvi. cwimsL¨vbt ZË¡ I cÖ‡qvM, kvgmyb bvnvi Avn‡g` Ms, DËi †mIZv, gvwkbMÄ
7. Lvb †gvt Rqbvj Av‡e`xb I myfvl P›`ª †`ebv_ (1987). cÖv_wgK cwimsL¨vb, Rvnvbviv Lvb I AwgZ †´ebv_, gqgbwmsn|

**Department of Fisheries Biology and Genetics**

Course No. FBG 213
Course Title: Biology of Farmed Fishes
Credit: 3

Introduction: Course goals, objectives and outcomes

Present status of farmed fishes: an overview

Life history of important group of farmed fishes with references to food and feeding habit, digestion, growth and reproduction:
- Freshwater fishes:
  - Cyprinids, Cichlids, Catfishes, Snakeheads, Perches, Exotic fishes, and Trout Marine fishes
  - Sea bass, Sea bream, Eel, Flounder, Yellow tail, Mullet, Milkfish, and Salmon

Early life history stages of farmed fishes: Gonadal embryonic and larval development.

Environmental effects: Temperature, salinity, light, current and metabolic effects on feeding.

Behavior manipulation in farmed fishes:
- Environmental control through Pond/Cage/Tank/Pen design, Water quality and feeding patterns. Dominance regulation and suppression of aggressive behavior.
- Domestication and environmental manipulation.

5. Recent developments in the field of biology of farmed fishes

**Text books and references:**
Department of Fisheries Technology

Course No. FT 213
Course Title: Marine Food Chemistry
Credit: 3.0

1. Main groups of marine organisms used as food:
   Marine plants, mollusks, crustaceans and fish.
2. Nutritive values of proteins of major groups of marine food organisms:
   Protein content, protein groups, stability of muscle proteins under various conditions
3. Flavour compounds of sea-foods: Nitrogenous and volatile compounds.

Text books and references:

Level - II, Semester - II

Department of Fisheries Biology and Genetics

Course No. FBG 221
Course Title: Fish Physiology
Credit: 3

1. Introduction: Course goals, objectives and outcomes. Overview of physiological processes in fish.
2. Temperature regulation: Classification of fish based on thermal regulation; low and high thermal effect, temperature regulation in homeotherms. Fish as poikilotherms. Endothermic fishes.
3. Physiology of digestion: Digestion mechanism of different classes of food: role of HCl, bile, enzymes and hormones; gastric evacuation; parameters to study efficiency of digestion; absorption of digested food
8. Osmoregulation: Definition of relevant terminology; osmoregulatory approaches in hagfish, lamprey, elasmobranches, marine and freshwater teleosts and euryhaline fishes.
11. Special organs: light and electric organs

Course No. FBG 222
Course Title: Fish Physiology
Credit: 1.5

1. Test of pepsin enzyme in stomach.
2. Study of oxygen consumption rate under different metabolic levels.
3. Preparation of blood smear and study on different types of blood cells.
4. Counting of RBC and WBC by haemacytometer.
5. Histological study of fish gill.
7. Studies on ammonia excretion in fishes.
8. Study of the effects of salinity changes on different species of fish.

Text books and references:

Department of Aquaculture

Course No. AQ 221
Course Title: Fish Parasitology
Credit: 3

1. Introduction to parasitology: Definition. Symbiosis and its types, infestation and infection.
2. Parasitic fauna of freshwater and marine fishes: Classification of protozoan, helminth, copepod and annelid parasites of fishes; their characteristics and examples.
4. Life cycles of representative protozoan and metazoan fish parasites: key to their control.

Course No. AQ 222
Course Title: Fish Parasitology
Credit: 1.5

Students shall maintain a record of everything done in the practical and field sessions in a practical note book to be signed and checked by teacher(s) concerned. Viva voce test will form an essential part of the practical examination.

Text books and references:
1. Introduction: Importance, present status, and prospect of live food in aquaculture.
2. Types of live food organisms: Phytoplankton, zooplankton, microcrustaceans and other food organisms; their nutritive values.
5. Culture of micro-crustaceans: Daphnia, Moina, Copepod and Cyclops.
6. Culture of brine shrimp (Artemia): Decapsulation, hatching and culture techniques for Artemia in Lab condition and in salt ponds.
7. Culture of other food organisms: Oligochaete worms (Tubifex), nematodes (Trochophora larvae), earthworms and frog tadpoles.
8. Culture of microorganisms: Preparation of media, isolation and culture techniques for fish food microorganisms (Yeast and bacteria).

**Text books and references:**

**Department of Fisheries Management**

**Course No. FM 221**

**Course Title: Fish Population Dynamics**

**Credit: 3**

1. Introduction: Importance and definition of different terminologies, salient features of population ecology.
2. Factors limiting abundance: Physical, chemical and biological factors.
4. Marking and tagging: Objectives, group and individual marking methods (Tagging): types of tag - external and internal, tagging materials and choice of marking methods. Description of commonly used tags for marking fish.
5. Fish population estimation: Direct and indirect methods. Factors affecting the estimation of population.
7. Effects of exploitation: Effects of exploitation on size, age, species composition, catch per unit of effort (CPUE), economic level of abundance, area of eggs and young distribution, recruitment, equilibrium yield and shifting of fishing grounds.
8. Balanced and unbalanced population: Criteria of a balanced population, causes for unbalanced condition, F-class and C-class fishes. F/C ratio, Y/C ratio, A7 value and their uses.

**Course No. FM 222**

**Course Title: Fish Population Dynamics**

**Credit: 1.5**

Students shall be required to show a good knowledge of the topics included in the theoretical portion of the paper. They shall maintain a record of everything done in practical classes/ field trips in a practical note book to be signed and checked by the teacher(s) concerned. Viva-voce test will form an essential part of the practical examination.
1. Estimation of catch per unit of effort and species composition and gear selectivity.
2. Estimation of fecundity by different methods.
3. Estimation of fish population by mark and recapture method and Delury’s Regression method.
4. Estimation of total mortality and fishing mortality rate by mark and recapture method.
5. Total length- standard length and total length-fork relationships of fish, length-weight relationship and condition factor of fish.
6. Determination of age and growth of fish by length-frequency method and scale method.

Text books and references:

Department of Fisheries Technology

Course No. FT 221
Course Title: Fisheries Microbiology-II
Credit: 3.0

1. Aquatic microorganisms: Microorganisms of freshwater and marine environment. Factors effecting growth of aquatic microorganisms and their activities related to aquatic animals. Economic importance of aquatic microorganisms.
2. Contamination and spoilage of fresh fish: Microorganisms of cold, temperate and tropical regions. Sources of contamination, causes of spoilage, factors affecting kinds and rates of spoilage, evidence of spoilage, chemical changes caused by microorganisms in fish.
4. Effect of processing on microorganisms: Effect of low and high temperature, curing and others processing methods.
5. Food borne illness Chemical and biological intoxication and bacterial food poisoning and infection (Botulism, Staphylococcal intoxication, Salmonellosis, Shigellosis, Clostridium perfringens infection etc.)

Course No. FT 222
Course Title: Fisheries Microbiology-II
Credit: 1.5

Students shall maintain a record of everything done in the practical and field sessions in a Practical Note Book to be signed and checked by teacher(s) concerned.

1. Important terminology and guideline for exercise in the practical classroom.
2. Study of different types of microscopes (principles and operation)
4. Study of culture media: Ingredients, types, and preparation of culture media.
5. Culture of microorganisms: Broth culture, pour plate culture, spread plate culture, streak plate culture, stab culture and shake culture.
6. Microscopic observation of bacteria: Gram’s stain, spore stain, flagella stain, Ziehl-Neelsen’ s stain, Hiss’s methods and Albert’s staining.
8. Quantitative estimation of bacteria: Consecutive decimal dilution method and most probable number method.
9. Field visit for sample collection from selected fish landing centers, fish markets and processing plants and bacteriological analysis and preparation of report.

**Text books and references:**

Course No. FBG 223  
Course Title: Shellfish Biology  
Credit: 3

1. Introduction: Course goals, objectives and outcomes.  
2. Shellfish resources and their role in the economy of Bangladesh  
3. Factors affecting the life of shellfishes in aquatic environment  
4. Morphological features and biology with special reference to food and feeding habits, digestion, respiration, reproduction, embryonic and larval developments and shell formation of:  
   (a) Freshwater giant prawn; (b) Marine shrimp; (c) Mudcrab; (d) Octopus; (e) Lobster, and (f) Oyster.  
5. Adaptation of shellfish in relation to food and feeding, respiration, reproduction osmoregulation and migration.

Textbooks and references:  

Course No. FM 223  
Course Title: Aquatic Environmental Science  
Credit Hours: 3

1. Introduction on aquatic environment: Key concepts; Importance of aquatic environmental maintenance; Sensitivity of aquatic biota on environmental changes.  
2. Environmental degradation and fisheries resources: River-bed siltation, loss of habitats, water development Projects (FCD and FCDI installations), impact of water abstraction and irrigation, barrages, roads, highways and embankments etc.  
3. Agriculture and aquatic environment: Practices and inputs used, fertilizers (phosphatic and nitrogenous), pesticides and insecticides, impacts on aquatic flora and fauna.  
4. Impact of aqua farming on aquatic environment: Nutrient accumulation and eutrophication, drainage effect due to excess feed, fertilizer and therapeutants. Loss of natural habitats- mangroves, agricultural lands, livestock pastures etc.  
5. Industrial development and environment: Types of industries, location, raw materials used and byproducts, effects of tannery, pharmaceutical, dying, fertilizer industries on underground and riverine waters.  

Textbooks and references:  

Level - III, Semester - I

Department of Fisheries Biology and Genetics

Course No. FBG 311
Course Title: Principles of Genetics
Credit: 3

1. Introduction: Course goals, objectives and outcomes; milestone of genetics; scope and significance of genetics
2. Physical bases of heredity: Introduction of animal and plant cells, prokaryotic and eukaryotic cell, constituents of eukaryotic cells, their structure and function; structure of chromosome and its organization, variation in chromosome number; cell division; gametogenesis- spermatogenesis and oogenesis.
3. Mendelian genetics: Mendel and his work; Mendel’s laws of inheritance- principles of segregation, principles of independent assortment; monohybrid and dihybrid cross; lethal genes, pleiotropy, penetrance and expressivity; linkage and linked genes, kinds of linkage, difference in linkage and independent assortment, arrangement of linked genes; crossing over and meiosis, genetic recombination.
4. Interaction of genes: Complete and incomplete dominant gene action, additive gene action; epistasis, epistatic and non-epistatic interaction, dominant and recessive epistasis; multiple allelism.
5. Sex determination and sex chromosome: Different sex determining systems; sex-linked traits, sex-influenced and sex-limited traits; sex manipulation techniques.
6. Chemistry of gene: Introduction of nucleic acid, nucleic acid structure and nomenclature; DNA and RNA structure; Chemistry of DNA synthesis; DNA repairing, packaging of DNA as nucleosome.
7. Phenotypic expression of gene: Protein synthesis, transcription and translation, regulation of protein synthesis; the genetic code and its properties.
8. Mutation: Definition, germinal and somatic mutation, spontaneous and induced mutation; types of mutation, mutagens; practical application of mutations.

Course No. FBG 312
Course Title: Principles of Genetics
Credit: 1.5

Students shall maintain a record of everything done in the practical and field sessions in a Practical Note Book to be signed and checked by teacher(s) concerned.

Viva voce test will form an essential part of the Practical Examinations.
1. Introduction to practical session: Familiarization with the practical courses and facilities of the department for the practical classes.
2. Cell division and chromosome: Study of cell division; chromosome preparation from tissue or embryo.
3. Mendelian genetics: Exercise on inheritance of qualitative phenotypes; pedigree analysis and chi-square.
4. Sex ratio analysis: Sex ratio analysis from crosses of fish with pre-determined sex chromosome. Chi-square test will be used to determine any significant difference between the observed and expected sex ratio.
5. Genomic DNA isolation: Techniques of genomic DNA isolation from fish tissue or embryos.

Text books and references:

Department of Aquaculture

Course No. AQ 311
Course Title: Fish Pathology
Credit: 3

2. Pathological changes in diseased fish: Circulatory disturbances, cellular degeneration, necrosis, inflammation, disturbances of growth and development.
7. Stress and infectious disease: Environmental stress and their effects on fish.
Students shall maintain a record of everything done in the practical and field sessions in a practical note book to be signed and checked by teacher(s) concerned. Viva voce test will form an essential part of the practical examination.

1. Diagnostic procedure for fish diseases: (a) conventional laboratory techniques for viral, bacterial and fungal identification (b) case study.
2. Study on clinical and pathological signs of diseased fish under laboratory and field condition.
3. Study on histopathological techniques: Sampling, tissue processing, microtomy, staining, mounting and microscopic observation.
4. Observation of histopathological changes of different tissues and organs of diseased fish.
5. Case study for investigation of clinical and pathological signs of fish.

Textbooks and references:
6. Periphyton (aufwuchs): Characteristics of major groups, substrates, seasonal variations in abundance and distribution in lentic and lotic habitats. Importance in the ecosystems and relations with other organisms.
7. Secondary production: Factors affecting secondary production; estimation of secondary production (zooplankton, benthos), relations with water depth and water areas; variation in lentic and lotic habitats
8. Bacteria and their role in bio-geochemical cycles: Bacteria, phytoplankton, zooplankton and benthos relations; feeding relations, detritus and filter feeders, bottom deposits and detritivores.
9. Aquatic vascular plants: Major groups available in closed and open freshwater systems; role in the floodplain and oxbow lake systems; influence on biological production; economic and aesthetic importance.

Course No. FM 312
Course Title: Biological Limnology
Credit: 1.5

Students shall be required to show a good knowledge of the topics included in the theoretical portion of the paper. They shall maintain a record of everything done in practical classes/field trips in a practical note book to be signed and checked by the teacher(s) concerned. Viva-voce test will form an essential part of the practical examination.

1. Collection, preservation, identification, enumeration and estimation of phytoplankton, zooplankton, macrophytes and benthos from different freshwater habitats.
2. Quantitative study of phytoplankton, zooplankton, periphyton and benthos.
3. Estimation of primary productivity using light and dark bottle method.
5. Demonstration of plankton culture techniques: Isolation of plankton, culture media preparation, inoculation, incubation; maintenance of stock.

Text books and references:

Department of Fisheries Management

Course No. FM 313
Course Title: Fish Stock Assessment
Credit: 3

1. Introduction: Concept of stock, objective of stock assessment, types of assessments, information collection techniques.
2. Criteria for separation of stock: Importance, characteristics of unit stock and Criteria of separation - study of racial characters, genetic characters, age composition, growth rate, vital parameters, bio-chemical study and tagging method.
3. Collection and handling of stock assessment data: Sample and sampling, general sampling, truisms of sampling, basic tenets of sampling, sources of assessment data, types of measurements, data from commercial fisheries, catch effort data, commercial catch-at-length data.
4. Overview of stock assessment models: Analytical models, holistic models and surplus production models.
5. Cohort, VPA and gear selectivity: Concept of cohort and dynamics of a cohort. Concept of Virtual population analysis (VPA) and analysis of VPA. Concept of gear selectivity and estimation of trawl net, seine net and gill net selectivity.
8. Yield models: ELEFAN-I and II, FiSAT and surplus yield models-Schaefer models and Fox models, yield per recruit models, length based models and stock assessment from egg survey.
9. Maximum sustainable yield (MSY): Concept and usefulness

Text books and references:

Department of Fisheries Technology
Course No. FT 311
Course Title: Fish Processing
Credit: 3

1. Introduction to fish processing: Production and marketing steps of fish and prawn in Bangladesh. Loss of food value due to improper handling and transportation. Bio-factor of fish and quantity of bio-factors in different groups of fish. Role of bio-factor on human health.
2. General principles of fin fish and shellfish preservation and storage. Structure of fish muscle, biochemical properties of white and dark muscle of fish.
5. Fish curing (Drying and dehydration, salting, smoking): Basic principles and methods of fish curing. Details of each curing method. Variations in curing methods for different species of fish. Quality aspects and storage.
6. Fish canning: Principles, preparation of raw materials and steps of canning. Types of can materials. Examination of processed fish can.
9. Planning and design of cold storage and fish processing plant.
Students shall maintain a record of everything done in the practical and field sessions in a Practical Note Book to be signed and checked by teacher(s) concerned.

1. Acquaintance with fish processing laboratory.
2. Study of proximate composition of fish- (Moisture, lipid, ash and crude protein)
3. Determination of non-protein nitrogen (NPN) of fish.
4. Determination of salt (NaCl) content in salted fish.
5. Freshness test of fish by subjective method.
6. Processing and preservation of fish by sun drying, salting and smoking method and observation on their physical and chemical changes.

Text books and references:

Department of Aquaculture

Course No. AQ 313
Course Title: Environmental Management for Aquaculture
Credits: 3

2. Impact of aquaculture on environment: Chemicals used in aquaculture, administration, environmental concerns and their effects on microbial community and environment.
3. Waste production in aquaculture: Feed derived and metabolic waste products, wastes from food and foodstuffs, methods of measuring waste production and fertilizer-derived wastes.
6. Wastewater treatment-biological methods: Biofilters, implication of biofilter design and management and application of biofilters in aquaculture.
7. Socio- economic impacts: Impacts of aquaculture on socio-economic condition of the community.

Text books and references:


Department of Fisheries Technology

Course No. FT 313
Course Title: Microbiology of Fishery Products
Credit: 3

1. Microbiology of finfish and finfish processing: Harvesting and onboard handling, fishing vessel sanitation, processing and preservatives.
2. Microbiology of molluscan shellfish: Microflora of molluscan shellfish at harvest, during processing. Indicators of spoilage and public health concern.
3. Microbiology of crustacean processing (crabs, shrimps, prawns and crayfish): Naturally occurring microflora, microbiological changes through distribution system, microorganism associated with spoilage and public health concern. Effect of processing, handling and retail procedures.
5. Microbiology of mince, surimi and value added products.
6. Indicator microorganisms and pathogens in fish and fishery products.

Text books and references:


Department of Fisheries Biology and Genetics

Course No. FBG 321
Course Title: Reproductive Physiology of Fishes
Credit: 3

1. Introduction: Course goals, objectives and outcomes.
4. Viviparity in fishes: Viviparity and gestation- evolutionary considerations, viviparity among the chondrichthyes, internal fertilization, ovoviviparity, viviparity among the teleosts and maternal-embryonic relationship.
6. Reproductive behavior: Pheromones, sex recognition and behavior; territory and space recognition; courtship, nest-building and parental cares.

Text books and references:

1. Introduction: Role of nutrition in aquaculture practices. Terminology used in fish nutrition.
2. Protein and amino acids: Classification and functions, quantitative dietary protein requirements for fish and crustaceans, protein as an energy source and amino acid requirement. Factors affecting protein and amino acid requirement. Amino acid availability, evaluation of protein quality.
3. Lipid and fatty acids: Dietary lipid requirement of fish and shellfish, lipid as energy and essential fatty acid source, essential fatty acid requirement of fish and shellfish and sources of fatty acids.
5. Minerals: Classification and general functions, macro and microelements, functions and sources, and mineral requirement for fish.
6. Vitamins: Water-soluble and fat-soluble vitamins, biological functions and dietary sources.
8. Digestion and absorption of nutrients: Digestive fluids and enzymes, protein, fat, carbohydrate and microbial digestion. Rate of digestion, factors affecting rate of digestion, absorption and assimilation and excretion.
10. Nutritional disorders in fish due to nutrients.
11. Larval and broodstock nutrition: Energy partitioning for reproduction, effect of dietary quality on reproductive output, nutritional requirements of broodstock and larvae.

Students shall maintain a record of everything done in the practical and field sessions in a practical note book to be signed and checked by teacher(s) concerned. Viva voce test will form an essential part of the practical examination.

Text books and references:
4. Design process: Project planning; farm layout including hatcheries, nurseries and grow out units for carp, catfish and shellfish. Cages, raceways, tanks, recirculatory system, on-bottom and off-bottom culture systems.
5. Construction process: Contract, tender and bid; bill of quantity, project costing, project site management, project monitoring and project ancillaries.
6. Basic hydraulic systems: Basic relationships in hydraulic systems; pumps and its installation procedures. Water flow through channel, pipe, sluice gate, monk, tidal gate and pen stock gate.
7. Feeding system: Feed storage, different type of feeders and feed delivery systems.
8. Aeration systems: Oxygen budget; types of blowers, aerators, compressors and oxygenation systems.
9. Farm hygiene: Sterilization and disinfection of farm units by heat, clorination, ozonation, UV-irradiation and other methods.
10. Wastewater treatment and disposal: Types of wastes in aquafarms, waste management, wastewater treatment by physical, chemical and biological methods.

Course No. AQ 324
Course Title: Fish Farm Design and Construction
Credit: 1.5

Students shall maintain a record of everything done in the practical and field sessions in a practical note book to be signed and checked by teacher (s) concerned. Viva voce test will form an essential part of the practical examination.

1. Acquaintance with laboratory equipment.
2. Determination of soil texture.
4. Site selection for commercial farms by individual student in his/her respective locality.
5. Design and cost estimation of a pond construction.
6. Design and cost estimation for the construction of pond complex.
7. Design and cost estimation for the construction of cage, recirculatory system, raceway, finfish and shellfish farm.
8. Design and construction of inlet, outlet and overflow structures.
9. Case study: Field visit to different government and private fish farms to study their design and construction.
Text books and references:

Department of Aquaculture
Course No. AQ 325
Course Title: Shellfish Diseases
Credit: 3

1. Introduction: Importance of shellfish diseases with special reference to shrimp. Disease producing factors and general indications of shellfish health.
2. Viral diseases of shrimp and prawn: Etiology, epizootiology, clinical signs, pathology, diagnosis, distribution, prevention and control measures.
4. Fungal diseases of shrimps and prawns: Clinical signs, pathology, epizootiology, diagnosis, distribution, prevention, and control measures.
5. Common protozoan and metazoan parasitic diseases in shrimp and prawn: Causative agents, clinical signs, pathology and control measures.
8. Diagnostic procedures for shrimp diseases: Clinical and laboratory diagnoses.
10. Diseases of molluscs: Causative agents, clinical signs and control measures for common diseases in oyster, clam and abalone.

Text books and references:

Department of Fisheries Management
Course No. FM 321
Course Title: Aquatic Soil Science
Credit : 3

1. Definition, physical properties of soil- texture, colour, consistency and temperature. Suitability of soil for pond construction and fish culture.
3. Soil-water interactions and their effects on productivity of waterbodies.
4. Bioturbation: Benthic organisms responsible for bioturbation, effects of bioturbation on physico-chemical properties of overlying water.
7. Sandy soils: Problems of very sandy soils in pond construction and fish culture and their solutions.
8. Red soil: Characteristics, problems to fish culture and mitigation measures.
9. Soil microorganism: Role in nutrient cycling.

**Text books and references:**

**Department of Agricultural Economics**

**Course No. AE 327**
**Course Title: Fishery Economics**
**Credit: 3**

Economic Concepts and Principles Applicable to Fishery Economics: Definition and basic concepts of economics, Consumer behaviour, Law of demand and supply, Factors of production, Production function, Law of returns, Costs and revenue, Market mechanism, Banking system and financing.

Economics of fish production: Fish Production and its economic importance, culture, capture and marine fisheries, Economic factors related to aquacultural production, Investment and economic returns, Fish population dynamics and sustainable yield. Present status and potentiality of inland and marine fish production. Problems and constraints related to fish production. Measures and steps for improvement of fishery sector.

**Text books and references:**

**Department of Fisheries Biology and Genetics**

**Course No. FBG 323**
**Course Title: Genetics and Reproduction of Ornamental Fish**
**Credit: 3**

1. Introduction: Course goals, objectives and outcomes.
2. An overview of the ornamental fishes. Economic importance. Importance as model animals for basic, genetical and molecular biological research. Prospects of ornamental fish seed business in Bangladesh.
5. The basic principles of setting up aquarium for fish keeping and breeding: Induced breeding technique of the ornamental fishes. Breeding by creating environment and hormonal induction. Breeding behavior of ornamental fishes in the aquarium.

6. Embryonic and larval development. Care for larvae and mass seed production techniques.

**Text books and references:**

**Department of Fisheries Technology**

*Course No. FT 321*

**Course Title: Fishery Products and By-products**

**Credit: 3.0**

1. Introduction to fishery products and by-products in Bangladesh. Scientific and technological development in fishery products.
2. Chilled and frozen products: Chilled and frozen fishery products, frozen storage, scientific and technological problems associated with chilled and frozen fishery products.
3. Dried and dehydrated fishery products: Types of various traditional sun dried and dehydrated products. Technological problems and quality control of dehydrated and dried products.
6. Canned products: Kinds of canned products, shape and size of can, storage of canned fish, technical problem in canned fish.
7. Fermented fishery products: Types of fermented products and technical problems in fermented products.
8. Surimi and diversified value-added fishery products: Various minced and surimi based fish and shrimp products, fish ball, fish finger, kamaboko, chikwa, fish cakes, fish pickles, fish soup powder etc.
9. Fishery By-products: Fish meal, fish protein concentrate, fish oil and refining, shark fin rays, fish maws/Isinglass, pearl essence, fish glue, ambergris, fish marinades, fish silage, fish hydrolysate etc.

**Text books and references:**

**Department of Fisheries Biology and Genetics**

*Course No. FBG 411*

**Course Title: Genetics and Fish Breeding**

**Credit: 3**

1. Introduction: Course goals, objectives and outcomes.
2. Breeding, the applied aspects of genetics: Prospects of genetics and breeding in aquaculture and fisheries.
5. Selection as a breeding program: Heritability and selection response, different types of selection programs, individual selection, family selection and mass selection.
7. Inbreeding: Genetic effects of inbreeding, practical applications of inbreeding, inbreeding coefficient, calculation of inbreeding coefficient, inbreeding depression, approaches for reducing inbreeding accumulation; assortative mating and inbreeding, genetic drift.
10. Seed storage and genetic conservation: Cryopreservation of gametes, live and cryogenic gene banking.
12. Recent developments in genetics: Gene transfer: applications and biosafety of GMOs.

Course No. FBG 412
Course Title: Genetics and Fish Breeding
Credit: 1.5

Students shall maintain a record of everything done in the practical and field sessions in a Practical Note Book to be signed and checked by teacher(s) concerned.

Viva voce test will form an essential part of the Practical Examinations.

1. Study of quantitative phenotypes: Collection of fish from a natural population; Measurement of their length and weight. Creating frequency distribution to study the normality of the distribution.
2. Comparison of difference in the distribution between a large and a small population. Calculation of heritability from a given data. Calculation of expected response from selection differential and heritability.
3. Population genetics: Familiarization with the techniques of starch gel electrophoresis. Calculation of gene and genotype frequencies from allozyme data/blood group data.
4. Study of sex-reversal and sex identification: Setting up experiment for hormonal sex-reversal using androgen and/or estrogen treated feed. Feeding the fry everyday and observation. Identifying the sexes of juvenile fish by acetocarmine squash method to evaluate the results of sex-reversal experiments.
5. Study of chromosome manipulation: Familiarization with the chromosome manipulation techniques to produce polyploid and gynogenetic fish.
6. Familiarization with cryobiology: Cryopreservation techniques.
7. Field visit: Visiting different government and privately-owned fish hatcheries to know the brood stock management practices by the hatchery operators and to learn the problems currently faced by the hatchery operators/fish farmers.

Text Books and references:
4. Non-specific and specific responses: Organs involved in fish immune system and their role in the maintenance of non-specific and specific immunity.
5. Immunodiagnostic methods and vaccination
7. Prevention and control of viral, bacterial and fungal diseases of fish.

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Course No. AQ 412
Course Title: Prevention and Control of Fish Diseases
Credit: 1.5

Students shall maintain a record of everything done in the practical and field sessions in a practical notebook to be signed and checked by the relevant teacher(s). Viva-voce test is an essential part of the practical examination.

1. Study of prevention and control of diseases:
   a. Diagnosis of fish diseases,
   b. Chemotherapy in laboratory and farm condition, and
   c. Health management by husbandry method.
2. Study of immunodiagnostic techniques: ELAT, ELISA, IFAT, PCR, Western blot and immunohistochemistry
3. Immunization: Methods and vaccination trials
4. Pretreatment trial for reducing diseases in culture ponds
5. Case study for particular disease problem on any fish farm or culture facilities

Text books and references:
5. Stolen, J. S., Fletcher, T. C., Anderson, D. P., Robertson, B. S. and Uan Muiswinkel, W. B. (editors). 1993. Techniques in Fish Immunology, FITC-1
4. Fishery regulation: Purpose, theories, classification and application. Fish and wild life ordinance of Bangladesh.
7. Fish market and marketing system: Types, marketing channels and transportation of fish and fishery products. Problems and mitigation measures.
8. Fish market and marketing system: Types, marketing channels and transportation of fish and fishery products. Problems and mitigation measures.
9. Fisheries cooperative: Role, general principles, objectives and activities. Problems and mitigation measures.

5. SWOT (strength, weakness, opportunities and threats) analysis for fisheries research: Ponds, reservoirs and lakes, floodplains and rivers, coastal waters, coral reefs and soft bottom shelves.

6. Research priority setting: Potential benefits, ability to utilize benefits, scientific potential, research capacity, feasibility.

7. Environmental impact assessment (EIA): Need for an EIA, steps in the EIA process, operational EIA.

8. Research project monitoring and evaluation: Definition, steps and scoring.

9. Preparation of fisheries research projects and report writing: Justification, objectives, economics, outcomes, scientific report writing and technology packaging.

10. Case study on fisheries research in Bangladesh

Text books and references:


4. ICLARM, 1999. Aquatic resources research in developing countries: Data and evaluation by region and research system. ICLARM, Manila, Philippines, 131 pp.


Department of Fisheries Technology

Course No. FT 411
Course Title: Quality Control of Fishery Products
Credit: 3

1. Introduction: Concept and purpose of quality assurance, importance of fish inspection and quality control programs, problems in quality assurance of fishery products.

2. Food laws and regulations: Food laws and competent authority, organization of quality control and official inspection system, regulatory standards for products and processing plants.

3. Quality assurance: Hygiene and safety aspects of quality control, standard sanitary operating system (SSOP) and standard operating system (SOP) in processing plant, inspection of fish and fishery products. Quality management information.


6. Raw material and finished products quality: Raw material collection system, maintenance of raw material quality and finished product quality.

7. Quality deterioration and defects in products: Chilled processed fish, frozen fish, smoked fish, dried and salted fish, canned fish, marinades and heat processed fish.

Course No. FT 412
Course Title: Quality Control of Fishery Products
Credit: 1.5

Students shall maintain a record of everything done in the practical and field sessions in a Practical Note Book to be signed and checked by teacher(s) concerned.

1. Study of sensory evaluation techniques: basic taste recognition test, basic colour recognition test, preference test and ratio profile.

2. Organoleptic, physical, biochemical and bacteriological evaluation of fresh, chilled and frozen fish and shellfish products.

3. Organoleptic, physical, biochemical and bacteriological evaluation of dried and salted dehydrated, salted and smoked products.


7. Samples collection of various products from processors, industries and market and assessment of their qualities by determining physical, organoleptic, bacteriological and microbial aspects.

8. Evaluation of gel-forming ability of the various surimi based products by determining rheological and biochemical parameters of fish products.

9. Group work and presentation about GMP, HACCP and ISO 9000.

Text books and references:


Department of Aquaculture
Course No. AQ 413
Course Title: Ornamental Fish Culture
Credit: 3

1. Introduction: History and importance of ornamental fish culture. Important ornamental fish species (indigenous and exotic), natural habitats, present status and prospect of ornamental fish culture in Bangladesh.

2. Aquarium preparation: Types and size of the aquaria, preparation, aeration, filtration (chemical and biological), water exchange, photosynthesis, and decomposition.

3. Selection of aquarium fish: Species selection, transportation of fish, stocking, introduction of suitable communities, acclimatization and release of fish into the aquarium.

4. Maintenance of the aquarium: Aeration, water exchange, maintenance of biological filters, handling of ornamental fish, pruning and manuring aquarium plants, removing dust and sediments and disinfecting the aquarium.

5. Food and feeding: Live food, balanced artificial feed, feeding regime, waste removal.

6. Seed production of ornamental fish: Brood selection, conditioning, spawning and fry rearing of guppy, swordtail, gold fish, koi-carp, zebra fish, angel fish and other local and exotic ornamental fish species.


8. Popularization of ornamental fish keeping: Display, demonstration, training and exhibition.

Text books and references:

Department of Fisheries Management
Course No.: FM 415
Course Title: Aquatic Pollution and Toxicology
Credits: 3

1. Introduction: Importance, lethal and sub-lethal effects.


3. Industrial pollution: Sources and types of industrial pollution. Major polluting industries. Toxic effects of pollutants from tanneries, textiles and chemical industries on freshwater and marine waters.


5. Heavy metals: Lethal and sub-lethal effects of heavy metals on aquatic biota; Effects on domestic animals and public health.

6. Aquatic Toxicity: Factors influencing toxicity. Toxicity testing.

7. Algal toxins: Implications on aquatic food webs; Mode of action of toxins in seafood poisoning; paralytic shellfish poisoning (PSP), diarrhetic shellfish poisoning (DSP), ciguatera fish poisoning (CFP), pfiesteria toxin and domoic acid. Measurement of toxins from different groups of toxic algae; Economic and social effects of algal toxin and control strategy.

Text books and references:
1. Introduction: Course goals, objectives and outcomes. Relevance of the course to other fishery courses. Importance of fish hatchery. Present status of hatchery in Bangladesh. Its role to meet the present fish seed requirement.
2. Fish hatchery: Site selection- soil and water quality, communication, market demand, transport and marketing facilities. Essential component: Hatchery proper (spawning and incubation facilities), brood rearing ponds, nursery ponds etc. Layout of a typical carp hatchery and a shrimp hatchery.
5. Hatchery operation: Water quality monitoring, water supply and treatment, treatment of water for reuse and water pollutant.
6. Spawning and egg handling: Natural and artificial spawning methods, control of spawning and egg incubation.
8. Larvae and fry rearing: Initial feeding, feeding frequency and feed particle size, larval feed. Pond preparation for fry nursing: One stage and two stage fry rearing.

Students shall maintain a record of everything done in the practical and field sessions in a Practical Note Book to be signed and checked by teacher(s) concerned.

Viva voce test will form an essential part of the Practical Examinations.

1. Lay out of typical fish and shrimp hatchery.
2. Selection of breeders, handling and their management:
   (a) Sex determination and selection of the ready-to-spawn breeders.
   (b) Dose calculation of inducing agents, injection, stripping and fertilization.
3. Use of incubators for hatching of eggs:
   (a) Incubation of fertilized eggs in different types of incubators.
   (b) Study of fertilization, hatching and survival rates.
4. Field visit to commercial fish and shrimp hatcheries

Text books and references:

2. Feedstuffs: Significance of animal versus plant foodstuffs. Conventional, unconventional and novel feedstuffs as applied in aquaculture (manufacture and processing, chemical and physiological properties, feeding value, recommended inclusion levels and legal aspects).

3. Feedstuffs of Bangladesh origin: Feedstuffs available with respect to cost and continuity of supply, variation to proximate composition, nutrient bioavailability and palatability.

4. Antinutritional/toxic factors: Antinutrients in plant feedstuffs including the mode of action and processing methods to reduce their toxic effects. Adventitious toxic factors of plant and animal origin.


6. Feed formulations: Criteria for feedstuff selection, basic problems with plant feedstuff selection. Pearson’s square hand formulation, spreadsheet formulation and least-cost feed formulations for semi-intensive and intensive culture of fish and crustaceans.


8. Farm-made aqua-feed: Classification of on-farm feeds ingredients, processing equipment and options. Farm made aquafeed and feeding strategies in Bangladesh - importance, availability of ingredients, on-farm feed formulation and feed manufacturing. Feeding strategies - problems and constraints.

9. Larval and broodstock feed: First feed, weaning feed, starter feed, encapsulated diets. Special diets for broodstock prior to spawning.

10. Feed storage and quality control: Deteriorative changes in feedstuffs and feeds during storage. Quality control and preventive measures.


Course No. AQ 422
Course Title: Fish Feed Technology
Credit: 1.5

Students shall maintain a record of everything done in the practical and field sessions in a practical note book to be signed and checked by teacher(s) concerned. Viva voce test will form an essential part of the practical examination.

1. Quick test for feedstuffs evaluation:
   a) Bulk density measurement
   b) Non-protein nitrogen in fish meal
   c) Rancidity test for animal products and oilseed meals
   d) Estimation of proportion of ingredients in feed mixture by floatation technique.

2. Formulation of a supplemental and balanced feed using square technique for semi-intensive and intensive aquaculture respectively.

3. Formulation of experimental diets replacing dietary fish meal using a potential plant protein source available in Bangladesh.

4. Formulation of a least cost diets using spreadsheet method or linear programming.

5. Analysis of prepared diets for their proximate composition.


7. Determination of nutrient digestibility of a diet through feeding trial using chromic oxide as an external marker in the diet.

8. Determination of fish growth parameters such as weight gain, specific growth rate, food conversion ratio, protein efficiency ratio, apparent net protein utilization and energy retention through laboratory trial using a prepared diet.

9. Survey of feeding practices and feed resources in a rural fish-farming village and cost benefit analysis of cost of production.

10. Visit to a commercial feed manufacturing plant.

Textbooks and references:

Department of Aquaculture
Course No. AQ 423  
Course Title: Integrated Aquafarming  
Credit: 3

1. Introduction: Concept of integrated aquafarming, its importance, present status and prospects.

Text books and references:

Department of Fisheries Management

Course No. FM 421  
Course Title: Oceanogrphy and Marine Biology  
Credit: 3

3. Oceanic tides, waves and currents: Tide, wave and current producing forces. Influence of tides, waves and currents on marine environment and fisheries. Major surface currents of the oceans and upwelling.
5. Fisheries oceanography: Utilization of oceanographic knowledge in locating new fishing areas/grounds, identification and location of unused fishery resources, information for improving fishing tactics, and fishery forecasting.
Course No. FM 422  
Course Title: Oceanography and Marine Biology  
Credit: 1.5

Students shall be required to show a good knowledge of the topics included in the theoretical portion of the paper. They shall maintain a record of everything done in practical classes/field trips in a practical note book to be signed and checked by the teacher(s) concerned. Viva-voce test will form an essential part of the practical examination.

1. Acquaintance with different oceanographic equipment.
2. Study of some physico-chemical parameters of seawater.
3. Collection, preservation, identification, counting and estimation of phytoplankton, zooplankton, ichthyoplankton from coastal and marine waters.
5. Analysis of phytoplankton pigments.
6. Identification of some seaweeds.
7. Analysis of marine sediments.
8. Field trips to the coastal areas of Bangladesh.

Text books and references:
Department of Agricultural Extension

Course No. AgExt 427
Course Title: Agricultural Extension
Credit: 3

1. Introduction: Characteristics of rural society and fisheries situation in Bangladesh; Meaning of agricultural extension and its philosophy, principles, phases, functions and objectives; Need for extension work for fisheries development in Bangladesh; Gradual growth of extension work in Bangladesh with special reference to fisheries development.
2. Organization for Extension Work: Main features of an extension organization; Categories of personnel constituting an extension service; Qualifications and responsibilities of different categories of personnel in the extension service; Principles of supervision and coordination in extension work.
4. Communication in Extension: Meaning and importance of Communication in extension work for fisheries development; Communication process and its elements; Barriers to communication and possible solution.
5. Extension Teaching Methods and Teaching-aids: Steps in extension teaching; Meaning, classification, procedures, advantages and limitations of different extension teaching methods; Individual methods, group methods and mass methods; Projected and non-projected visual and audio-visual aids-their classification, importance and use.
6. Innovation-Decision Process and Transfer of Technologies: Meaning of diffusion, elements in the diffusion process, models of innovation-decision process; Innovativeness and adopter categories, Rejection and discontinuance of innovations; Factors affecting the transfer of technologies in fisheries development.
7. Leadership: Concept and types of group; Importance of leadership in group work; Kinds of leadership-authoritarian and democratic; Role of professional and local leaders; Selection and training of local leaders; Recognition for good leadership.
8. Programme Planning and Evaluation in Extension: Concept, importance, principles and procedures of programme planning for fisheries development; Participation for programme planning; Principles, types and procedures for evaluation of programmes.
9. Extension Problems and Programmes for Fisheries Development: Current extension programmes and approaches for fisheries development in Bangladesh; Problems of extension work for fisheries development and their possible solutions.
10. Rural Youth in Extension Work: Present condition of rural youth in Bangladesh; Needs and interests of rural youths; Past and present programmes for development of rural youth in Bangladesh; Youth Programmes in other countries; Involvement of rural youth for development of fisheries and related agricultural development activities.
11. Office Management: Meaning of office management; Features of office management, functions of office management, factors in increasing efficiency in office management.

Course No. AgExt 428
Course Title: Agricultural Extension
Credit 1.5

1. An orientation to different organizations related to agricultural and fisheries development.
2. Preparation of questionnaire/interview schedule for collection of data from the villages.
4. Preparation of extension programme for fisheries development in an area, preparation of annual plan and calendar of work.
5. Preparation and use of extension communication materials and visual aids; leaflet, poster, flash cards, flip charts.
6. Practice of techniques facilitating participation of people in group: Lecture, small group discussion, Phillips-6 method, symposium, panel discussion, brain-storming, role playing demonstration.
7. Preparation of Training programme and practice training.
8. Extension Field trip rural areas/Upazila Headquarters to observe rural development activities in the field situation with special emphasis on fisheries.
9. Use and handling of audio-visual aids.

Text books and references:


Department of Fisheries Biology and Genetics

Course No. FBG 423
Course Title: Principles of Molecular Biology and Biotechnology
Credit: 3

1. Introduction: Course goals, objectives and outcomes.
4. Gene expression: Protein synthesis, transcription, the genetic code and translation.
5. DNA Technology: Restriction endonucleases; properties of restriction endonucleases, restriction mapping, general plan of protein coding genes, creation of recombinant DNA molecules.
6. Gene cloning: Cloning vectors, plasmid and cosmid vectors; reverse transcription and creation of DNA library, creation of genomic DNA library, cloning restriction fragments in plasmids;
7. Molecular techniques: Electrophoresis; Southern blotting; Northern blotting; Polymerase Chain Reaction (PCR);
8. Molecular markers in fisheries and aquaculture: DNA fingerprinting (RFLP analysis), miDNA RFLP analysis; AFLP; RAPD and microsatellite markers.

Text books and references:

Course Title: Fish Immunology
Credit: 3

1. Introduction to Fish Immunology: Terminology. Role of immunity in preventing infectious diseases.
3. Fish blood cells: Characters and immune functions, phagocytes, lymphocytes and thrombocytes.
4. Specific immunity of fish: Mechanisms of immunoglobulin formation and their role in specific immunity; B and T Lymphocytes, helper and killer cells.
5. Environmental factors in fish health: Immunological aspects - immunoassays, immunostimulation, immunosuppression, immunoreversion and immunomodulators.
6. Antibody probes: Polyclonal and monoclonal antibodies; hybridoma technology and preparation of monoclonal and polyclonal antibody.
7. Principles of immunodiagnoses: Application of antibody probes in diagnosis and control of fish diseases. Immunodiagnostics techniques - slide agglutination, agglutination titrations, enzyme labelled antibody technique (ELAT), indirect fluorescent antibody technique (IFAT), enzyme-linked immnosorbert assay (ELISA); immunohistochemistry (IHC) and Western blot analysis.
8. Immunisation and Vaccination: Active and passive immunisation; types of vaccine and vaccination. Commercial fish vaccines, use of adjuvant and immunostimulants, effectiveness of a vaccine, advantages of vaccination over chemotherapy, prospects of vaccine development.

Text books and references:


12. Stolen, J.S., T.C. Fletcher, D.P. Adrerson, B.S. Rohrson, W. B. Van Muiswinkel 1993. Techniques in Fish Immunology. Fish Immunology Technical Communication 1 (FITC 1), 2nd Ed.. SOS publication, USA.