Credits required for Theory : 128
Credit required for Practical : 36
Total Credit required : 164

Faculty of Fisheries

Bangladesh Agricultural University
Mymensingh

Duration of each Contact hour: 60 Minutes

Curriculum lay-out for B. Sc. Fisheries (Hons.) degree

Level-1

Semester-1	Credit hour
Compulsory	
FBG 1121 Fisheries Zoology	2
FBG 1122 Fisheries Zoology	1
AQ 1121 Principles of Aquaculture	2
FM 1101 Aquatic Ecology	3
FM 1122 Aquatic Ecology	1
FT 1121 Fishing Technology	2
FT 1122 Fishing Technology	1
LAN 1121 Communicative English	2
RS 1101 Sociology of Fisheries	2
Elective (Any One)	
FBG 1103 Developmental Biology of Aquatic Animals	2
AQ 1103 Ornamental Fish Culture	2
FM 1123 Aquatic Soil science	2
FT 1103 Responsible Fishing	2
Total Credit	**18**

Semester- 2	Credit hour
Compulsory	
FBG 1201 Ichthyology	3
FBG 1222 Ichthyology	1
AQ 1201 Freshwater Aquaculture	3
AQ 1222 Freshwater Aquaculture	1
FM 1221 Fisheries Resources and Conservation	2
MFS 1201 Physical and Geological Oceanography	2
MFS 1202 Physical and Geological Oceanography	1
BMB 1205 Biochemistry	3
BMB 1206 Biochemistry	1
Elective (Any One)	
FBG 1223 Biology of Farmed Fish and Shellfish	2
AQ 1203 Industrial Aquaculture and Certification	2
FM 1203 Management of Aquatic Plants	2
FT 1201 Handling and Preservation of Fish & Shellfish	2
MFS 1203 Marine Literacy: The Bay of Bengal	2
Total Credit	**19**

Level- 2

Semester-1	Credit hour
Compulsory	
FBG 2121 Fish Systematics and Taxonomy	2
FBG 2122 Fish Systematics and Taxonomy	1
AQ 2121 Coastal Aquaculture and Mariculture	2
AQ 2122 Coastal Aquaculture and Mariculture	1
FM 2121 Physico-Chemical Limnology	2
FM 2122 Physico-Chemical Limnology	1
FT 2101 Fisheries Microbiology	3
FT 2122 Fisheries Microbiology	1
MFS 2101 Chemical Oceanography	2
MFS 2102 Chemical Oceanography	1
AE 2107 Fisheries Economics	2
Elective (Any One)	
FBG 2103 Evolutionary Biology	2
AQ 2103 Environmental Management for Aquaculture	2
FM 2103 Water Quality Management in Fisheries	2
FT 2103 Biosecurity and Occupational Safety in Fisheries	2
MFS 2103 Marine Hydrophytes	2
Total Credit	**20**

Semester- 2	Credit hour
Compulsory	
FBG 2201 Fish Physiology	3
FBG 2222 Fish Physiology	1
AQ 2221 Fish Parasitology and Pathology	3
AQ 2222 Fish Parasitology and Pathology	1
FM 2221 Biological Limnology	2
FM 2202 Biological Limnology	1
AAS 2203 Statistics	3
AAS 2204 Statistics	1
CSM 2207 Computer Science	2
CSM 2208 Computer Science	1
Elective (Any One)	
FBG 2203 Reproductive Physiology	2
AQ 2203 Live food culture	2
FM 2203 Aquatic Pollution and Ecotoxicology	2
FT 2221 Fisheries Chemistry	2
MFS 2201 Meteorology and Ocean Forecasting	2
Total Credit	**20**

Level- 3

Semester-1	Credit hour
Compulsory	
FBG 3101 Fundamentals of Genetics	3
FBG 3122 Fundamentals of Genetics	1
AQ 3121 Aquafarm Design and Construction	2
AQ 3122 Aquafarm Design and Construction	1
AQ 3103 Fish Nutrition	3
AQ 3104 Fish Nutrition	1
FM 3101 Fish Population Dynamics	3
FM 3122 Fish Population Dynamics	1
FT 3121 Fish Processing Technology	2
FT 3122 Fish Processing Technology	1
Elective (Any One)	
FBG 3103 Genetics and Reproduction of Ornamental Fish	2
AQ 3105 Algal Product Technology	2
FM 3123 Haor Fisheries and Livelihood	2
FT 3103 Fishery Waste Management	2
MFS 3101 Sustainable Coastal Development	2
Total Credit	**20**

Semester- 2	Credit hour
Compulsory	
FBG 3221 Fish Biodiversity and Conservation	2
AQ 3221 Fish Feed Technology	3
AQ 3222 Fish Feed Technology	1
AQ 3223 Integrated and Organic Aquafarming	2
AQ 3224 Integrated and Organic Aquafarming	1
FM 3221 Climate Change and Fisheries	2
FM 3222 Climate Change and Fisheries	1
FT 3221 Fishery Products Technology	2
FT 3222 Fishery Products Technology	1
MFS 3201 Biological Oceanography	3
MFS 3202 Biological Oceanography	1
AM 3205 Agribusiness & Marketing	2
Elective (Any One)	
FBG 3203 Fish Cryobiology	2
AQ 3205 Geographical Information System in Fisheries	2
FM 3203 Fish Stock Assessment	2
FT 3223 Safety and Microbiology of Fishery Products	2
MFS 3203 Marine Hazards and Contaminants	2
Total Credit	**23**

Level- 4

Semester-1	Credit hour
Compulsory	
FBG 4101 Genetics and Fish Breeding	3
FBG 4122 Genetics and Fish Breeding	1
AQ 4121 Aquatic Animal Health and Immunology	2
AQ 4122 Aquatic Animal Health and Immunology	1
FM 4121 Inland Fisheries Management	2
FM 4122 Inland Fisheries Management	1
FT 4121 Quality Control of Fish and Fishery Products	3
FT 4102 Quality Control of Fish and Fishery Products	1
MFS 4101 Marine Policy and Legislation	3
FF 4101 Research Methodology in Fisheries	2
AGEXT 4127 Fisheries Extension	2
AGEXT 4128 Fisheries Extension	1
Elective (Any One)	
FBG 4103 Molecular Biology and Biotechnology	2
AQ 4103 Shellfish Diseases	2
FM 4123 Shellfish Exploitation and Management	2
FT 4103 Aquatic Product Biotechnology	2
MFS 4103 Ocean Mapping and Modeling	2
Total Credit	**24**

Semester- 2	Credit hour
Compulsory	
FBG 4221 Broodstock and Hatchery Management	2
FBG 4222 Broodstock and Hatchery Management	1
AQ 4221 Fish Pharmacology and Medicine	2
AQ 4222 Fish Pharmacology and Medicine	1
FM 4221 Marine Fisheries Management	2
FM 4202 Marine Fisheries Management	1
FT 4221 Fish Inspection and Legislation	2
FT 4222 Fish Inspection and Legislation	1
FF 4201 Internship	6
Elective (Any One)	
FBG 4223 Fish Genomics	2
AQ 4203 Larval and Broodstock Nutrition	2
FM 4203 Hilsa Shad Assessment and Management	2
FT 4203 Fishery Industry Management and System Analysis	2
MFS 4201 Blue Economy	2
Total Credit	**20**

- **Odd** and **Even** numbers of the courses are **Theory and Practical**, respectively

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B. Sc. Fisheries (Hons.)

Course Profile :

Course Code: FBG 1121 **Course Title: Fisheries Zoology**

Credit: 2 **Contact Hours: 32** **Level: 1** **Semester: 1**

Course offering department (s) :Department of Fisheries Biology and Genetics

Rationale: Studentwishing to develop their career in fisheries will need to have a thorough understanding on functional morphology, life history, adaptation and economic significance of selected aquatic animals.

Course learning Outcomes:

1. Classify the different phylum of invertebrates and chordates having fisheries and aquaculture importance.
2. Explain the functional morphology and adaptation of selected aquatic invertebrates and chordates.
3. Illustrate the life history of selected aquatic animals.
4. Discuss the economic significance of different phylum of invertebrates and chordates having fisheries importance.

Mapping CLO with PLO:

	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8	PLO9	PLO10
CLO1	√	√								
CLO2	√							√		√
CLO3	√							√		
CLO4	√	√						√		

Course Contents:

Course contents	Aligned CLO	No. of Lectures
1. General survey and classification of animals up to sub-class level with special emphasis on groups having fisheries importance.	**CLO 1**	**9**
2. Functional morphology of the following aquatic invertebrate: *Paramecium*, *Aurelia*, Snail, Mussels, Octopus, Loligo, Starfish, *Macrobrachium*, *Peneaus*, Crabs.	**CLO 2**	**9**

3. Life history: Dolphin, Crocodile, Frogs, Turtle.	**CLO 3**	**4**
4. Adaptation of animals to aquatic life with special reference to temperature, salinity, current, depth, light etc.	**CLO 3**	**2**
5. Economic significance of the following groups of animals: Protozoans, Porifera, Coelenterates, Rotifers, Nematodes, Oligochates, Mollusks, Crustaceans, Aquatic insects, Echinoderms, Frogs, Aquatic reptiles, Fishing birds and Cetaceans.	**CLO 4**	**7**
6. Mid-term Examination	**-**	**1**

Teaching strategy: Lectures, Problem based learning, Interactive learning, Group studies and Discussion.

Assessment Strategy: MCQ Test, Written test, Oral test, Assignment and Presentation.

Learning Resources:

1. Jordan, E. L. and P. S. Verma, 2010. Invertebrate Zoology. S. Chand and Company.
2. Jordan, E. L. and P. S. Verma, 2008. Chordate Zoology. S. Chand and Company.
3. Miller, S. A. and J. P. Harley, 2009. Zoology. McGraw-Hill Professional, New York.
4. Barnes, R.D. 1978. Invertebrate Zoology. WB Saunders Co., Philadelphia, London.
5. Hickman Jr., C. P., S. L Keen, A. L. Larson and D. J. Eisenhour, 2007. Integrated Principles of Zoology (Fourteenth Edition). McGraw Hill Science.
6. King, M. 2007. Fisheries Biology.John Wiley and Sons.
7. Kotpal, R. L. 2009. Modern Text Book of Zoology Invertebrates. Print Asia.
8. Little, C. and J. Meyer, 2008. General Zoology Laboratory Guide. McGraw Hill Science.
9. Miller, D. L. 2007 (ed.). Reproductive Biology and Phylogeny of Cetacea: Whales, Porpoises and Dolphins. Science Publishers, New York.
10. Tonapi, G. T. 1980. Freshwater Animals of India. Oxford and IBH Publishing Co, New Delhi.
11. Weinchert, C. K. and W. Presch. 1975. Elements of Chordate Anatomy. McGraw Hill Book Co., New York.

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B. Sc. Fisheries (Hons.)

Course Profile :

Course Code: FBG 1122 Course Title: Fisheries Zoology

Credit: 1 Contact Hours: 16 Level: 1 Semester: 1

Course offering department (s) :Department of Fisheries Biology and Genetics

Rationale: Studentwishing to develop their career in fisheries will need to have a thorough understanding on collection, preservation, characterization, identification, dissection of organs of selected aquatic animals.

Course learning Outcomes:

1. Classify and identify the different aquatic animals having fisheries and aquaculture importance.
2. Explain the external morphology of selected aquatic invertebrates and chordates.
3. Dissect the different organs/system of selected aquatic animals.

Mapping CLO with PLO:

	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8	PLO9	PLO10
CLO1	√							√		
CLO2	√							√		
CLO3	√					√		√		

Course contents:

Course contents	Aligned CLO	No. of Lectures
1. Collection and preservation of aquatic animals.	**CLO 1**	**2**
2. Characterization and identification of the collected specimens.	**CLO 1**	**2**
3. Study of external morphology of fresh and preserved specimens.	**CLO 2**	**7**
4. Study of anatomy of different organs systems of representative invertebrates and chordates	**CLO 3**	**4**
5. Mid-term Examination	**-**	**1**

Teaching strategy: Lectures, Problem based learning, Interactive learning, Group studies and Discussion.

Assessment Strategy: MCQ Test, Written test, Oral test, Assignment, Presentation and Viva voce.

Learning Resources :

1. Barnes, R. D. 1978. Invertebrate Zoology. WB Saunders Co., Philadelphia, London.
2. Hickman Jr., C. P., S. L Keen, A. L. Larson and D. J. Eisenhour, 2007. Integrated Principles of Zoology (Fourteenth Edition).McGraw Hill Science.
3. King, M. 2007. Fisheries Biology.John Wiley and Sons.
4. Kotpal, R. L. 2009. Modern Text Book of Zoology Invertebrates.Print Asia.
5. Little, C. and J. Meyer, 2008. General Zoology Laboratory Guide. McGraw Hill Science.
6. Miller, D. L. 2007 (ed.). Reproductive Biology and Phylogeny of Cetacea: Whales, Porpoises and Dolphins. Science Publishers, New York.
7. Tonapi, G. T. 1980. Freshwater Animals of India.Oxford and IBH Publishing Co, New Delhi.
9. Weinchert, C. K. and W. Presch. 1975. Elements of Chordate Anatomy. McGraw Hill Book Co., New York.

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B. Sc. Fisheries (Hons.)

Course Profile *(Profile of xx Number of Courses)*

Course Code:	**AQ 1121**	**Course Title:**	**Principles of Aquaculture**				
Credit:	**2**	**Contact Hours:**	**32**	**Level:**	**1**	**Semester:**	**1**

Course offering department(s): **Department of Aquaculture**

Rationale:

Students wishing to continue fisheries and aquaculture study are needed to learn terms, conditions and basic concepts of dynamic aquaculture.

Course Learning Outcomes (CLO): *(Max 5)*

CLO 1: Illustrate prospects and problems of aquaculture in Bangladesh

CLO 2: Explain aquaculture terms and dimensions

CLO 3: Differentiate aquaculture systems

CLO 4: Classify aquatic plants and their usage

Mapping CLO with PLO

CLO/ PLO	PLO 1	PLO 2	PLO 3	PLO 4	PLO 5	PLO 6	PLO 7	PLO 8	PLO 9	PLO 10
CLO 1	✓	✓		✓		✓	✓			✓
CLO 2	✓	✓			✓	✓				
CLO 3		✓		✓						
CLO 4		✓				✓				✓

Summary of Course Content

Content	Aligned CLO	No. of lectures
Introduction: Definition & terminologies, aims and history of aquaculture, present status, scope, problems and prospects of aquaculture in Bangladesh.	CLO 1	5
Aquaculture resources: Inland, brackish and marine water bodies. Cultureable indigenous and exotic fishes. Technology and human resources. Organizations of aquaculture.	CLO 2	4
Aquaculture dimensions: By Environment (Fresh water, Coastal water, Marine water); By Species (Monoculture, Polyculture, Integrated Aquaculture); By culture intensity (Traditional, Semi-intensive, Intensive, Super-intensive); By Ownership (Single ownership, Multiple ownership, Corporate ownership, Community base aquaculture).	CLO 2	10
Nutrition and Feeding: Major nutrients in fish feed. Natural food and artificial feed. Supplemental and balanced diets. Feeding habits and Food utilization. Different types of live food used in Aquaculture.	CLO 2	5
Aquatic plants and predators: Types, Aquatic plants as weeds, alternative use, preparation of compost using aquatic weeds. Methods of controlling weeds and predators in Aquaculture.	CLO 5	7
Class Test		1
Total		

Teaching Strategy:

Lecture, chalk and talk, multi-media, video clipping, demonstration.

Assessment Strategy:

Tutorials (written examination), quiz, assignment.

Recommended books and other resources:

1. Pillay, T. V. R. (1990). Aquaculture. Principles and practices. Fishing News. Books Ltd. U. K.
2. Stickney, R. R. (1994). Principles of Aquaculture. John Wiley & Sons, INC. New York.

3. Bardach, J. E., J. H. Ryther and W. O. McLarney. (1972). Aquaculture. Wiley-Interscience, New York.
4. Islam, M. A. (2001). Aquaculture. Bangla Academy. Dhaka.
5. Karim, M. A. 1975. An introduction to fish culture in Bangladesh. Ruby Press, Mymensingh, Bangladesh.
6. Landau, M. (1992). Introduction to aquaculture. John Wiley & Sons, New York.
7. Shang, Y. C. 1981. Aquaculture Economics: Basic Concepts and Methods Analysis. Westview Press, Croom Helmm, England.
8. Huet, M. (1979). Textbook of fish culture Fishing News Books Ltd. U.K.

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B. Sc. Fisheries (Hons.)

Course Code: FM 1101 **Course Title: Aquatic Ecology**

Credit: 3 **Contact hours: 48** **Level: 1** **Semester: 1**

Course offering department (s) :Department of Fisheries Management

Rationale: To become successful fisheries professionals, students should know the salient features of different types of aquatic ecosystems and their interactions among and between the living and nonliving components of the aquatic ecosystems.

Course Learning Outcomes (CLO)

1. Define basic terminologies of ecology and describe sub-divisions of ecology

2. Explain the structure and functions of different aquatic ecosystems

3. Classify limiting factors and explain laws of limiting factors

4. Analyze population group properties and differentiate between standing crop and carrying capacity

5. Evaluate community structure and predict ecological succession

Mapping CLO with PLO:

	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8	PLO9	PLO10
CLO1	√							√		√
CLO2	√	√	√		√	√	√	√	√	√
CLO3	√	√			√	√	√	√		
CLO4	√	√	√		√	√	√	√		
CLO5	√	√	√			√	√	√		

Course Contents:

Course contents	**Aligned CLO**	**No. of Lectures**
1. Definition and scope of ecology, levels of integration in biosphere, subdivisions of ecology.	**CLO 1**	**4**
2. Ecosystem: Concept of ecosystem, structure and functions, habitat and ecological niche, food chain and food web, primary and secondary productivity of water, trophic structure and ecological pyramids, homeostasis and ecological balance.	**CLO 2**	**7**
3. Limiting factors: Definition and types of limiting factors, Liebog's	**CLO 3**	**6**

"Law of Minimum", Shelford's "Law of Tolerance", combined concept of limiting factors, relative degree of tolerance.		
4. Population ecology: Concepts of population, population group properties, density, natality, mortality, age distribution, biotic potential, growth form and carrying capacity, population dispersal and Allee's principle.	**CLO 4**	**9**
5. Community ecology: Concepts of community, classification, composition, species diversity, ecological dominance, types of interaction between two species, diel and seasonal periodicity, ecological succession and concept of climax, ecotone and edge effect	**CLO 5**	**5**
6. Freshwater ecosystem: Types of freshwater ecosystems, ecological classification of freshwater organisms, lakes, pools and other waterbodies, running water communities, concept of floodplain and modification of floodplain ecosystems.	**CLO 2**	**7**
7. Estuarine ecosystem: Concept of estuary, classification of estuaries, biota and productivity.	**CLO 2**	**5**
8. Marine ecosystem: The marine environment, major features of the sea, zonation, function of marine ecosystem, communities of marine environment.	**CLO 2**	**5**

Teaching strategy: Lectures, Problem based learning, Interactive learning, Group studies and Discussion.

Assessment Strategy: MCQ Test, Written test, Oral test, Assignment and Presentation.

Learning Resources:

1. Odum, E.P. 1971. Fundamentals od Ecology. W.B. Saunders Company, London, 574 pp.
2. Charles, J. Krebs. 1985. Ecology: The Experimental Analysis of Distribution and Abundance. 3rd Edition. Harper & Row Publishers, New York. 800 pp.
3. Shelvy D. Gerking (Ed.). 1978. Ecology of Freshwater Fish Production. Blackwell. 520 pp.
4. Cairns, Jr. 1995. Rehabilitating damaged ecosystems. 2nd Edition. Lewis Publishers. 424 pp.
5. Elton, C.G. 1962. Animal Ecology. Sidgwick & Jackson, London.
6. Hynes, H.B. 1972. Ecology of Running Waters. Liverpool University Press, Kiverpool.
7. Lincoln, R., G. Boxshall and P. Clark. 1998. A dictionary of Ecology, Evolution and Systematics. Cambridge University Press, 361 pp.
8. Macan, T.T. 1974. Ecology of Coastal Waters. Blackwell, Oxford.

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B. Sc. Fisheries (Hons.)

Course Code: FM 1122 **Course Title: Aquatic Ecology**

Credit: 1 **Contact hours: 16** **Level: 1** **Semester: 1**

Course offering department (s) :Department of Fisheries Management

Rationale: To become successful fisheries professionals, students should identify aquatic animals and plants along with their ecological classification for explaining the interactions within and between abiotic and biotic components of different aquatic ecosystems.

Course Learning Outcomes (CLO)

1. List some equipment used in aquatic ecological field study along with their operation and uses
2. Identify and describe the ecological classification of important freshwater fishes, mollusks and arthropods of Bangladesh
3. Identify and classify different types of aquatic weeds
4. Analyze the structure and function of lentic and lotic habitats

Mapping CLO with PLO:

	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8	PLO9	PLO10
CLO1	√	√					√	√	√	
CLO2	√	√	√		√	√	√	√	√	
CLO3	√	√	√		√	√	√	√	√	
CLO4	√	√			√	√	√	√	√	

Course Contents:

Course contents	**Aligned CLO**	**No. of Lectures**
9. Acquaintance with the equipment used in ecological field study.	**CLO 1**	**2**
10. Collection of freshwater fishes and their ecological classification.	**CLO 2**	**4**
11. Collection of freshwater mollusks and arthropods and their ecological classification.	**CLO 2**	**4**
12. Identification of some aquatic weeds and their types.	**CLO 3**	**2**
13. Field visit to pond for analyzing lentic ecosystem.	**CLO 4**	**2**
14. Field visit to river analyzing lotic ecosystem.	**CLO 4**	**2**

Teaching strategy: Lectures, Field visits, Demonstration, Practical note book, Problem based learning, Interactive learning, Group studies and Discussion.

Assessment Strategy: MCQ Test, Written test, Identification of samples, Oral test, Assignment and Presentation.

Learning Resources:

1. Talwar, P.K. and Jhingran, A.G. 1991. Inland Fishes of India and Adjacent Countries. Oxford-IBH Publishing Co. Pvt. Ltd., New Delhi, 1158 p.
2. Karim, S.M.R. 2013. Important Tropical Weeds. UMK Press, University Malaysia Kelantan. 351p.
3. Odum, E.P. 1971. Fundamentals od Ecology. W.B. Saunders Company, London, 574 pp.

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B. Sc. Fisheries (Hons.)

Course Profile :

Course Code:		**FT1121**	**Course Title:**		**Fishing Technology**		
Credit:	**2**	**Contact Hours:**	**32**	**Level:**	**1**	**Semester:**	**1**

Course offering department(s): **Department of Fisheries Technology**

Rationale:

The course provides a wide coverage of most fundamental and advanced aspects of fishing science that could be used in various fields of harvesting fish from different water bodies to keep a sustainable fish stock in both open and closed water.

Course Learning Outcomes (CLO):

CLO 1: Describe different methods of fishing from different water bodies.

CLO 2: Apply the knowledge of fishing gears and crafts for successful and efficient fishing.

CLO 3: Assess the impact of fishing gears on the freshwater and marine ecosystem.

CLO 4: Adopt good management practices in traditional, artisanal and commercial fishing to ensure sustainable production.

CLO 5: Participate in policy making of different fields for fishing industry of the country.

Mapping CLO with PLO

CLO/PLO	PLO 1	PLO 2	PLO 3	PLO 4	PLO 5	PLO 6	PLO 7	PLO 8	PLO 9	PLO 10
CLO 1	✓			✓						
CLO 2	✓									
CLO 3		✓								
CLO 4						✓	✓			
CLO 5		✓				✓				

Summary of Course Content

Content	Aligned CLO	No. of lectures
1. **Introduction:** Principles of fishing, Concept on fisheries as a renewable resource, relationship of fishing with fish quality, fisheries management etc.	CLO 1	2
2. **Fishing crafts and gears:** Fishing crafts in Bangladesh, their types, technical terms for various parts of crafts and operational methods	CLO 1 & CLO 2	4
3. **Classification of fishing gears:** Classification given by FAO (1982), Schematic diagram of fishing gears	CLO 1 & CLO 2	5
4. **Fishing net and its raw material**: Construction of fishing twine, numbering systems of fishing twine, properties of synthetic fibre, mesh and mesh size of nets, knotted and knotless net, fabrication and designing of fishing net and choice of materials for efficient fish net, float, buoy, sinkers	CLO 3	6
5. **Navigation in fishing:** Navigation equipment, fish location in the sea, factors concerned in locating fishing grounds, fish detection. Fishing grounds in the Bay of Bengal.	CLO 4 & CLO 5	4
6. **Fish response to gears and stimuli:** Attraction of fish, Chemical fishing, Light fishing, Jigging, Electrofishing.	CLO 4	3
7. **Methods used in traditional, artisanal and commercial fishing:** Trawling, gill netting, purse seining, long lining, trammel netting, fish trapping, light fishing, trolling, jigging, estuarine and marine set bag nets, traps, lift nets, cast nets, pond draining, fish aggregating device (FAD) and others	CLO 4	5
8. **Net preservation:** Objectives, methods, merits and demerits.	CLO 2	2
Class test		1
Total		**32**

Teaching Strategy:

Methods of teaching:

- Classroom lectures using multimedia projector, white board, discussions
- Group work, self-study, assignments, practical demonstrations
- Field trips or visits

Assessment Strategy:

1. Continuous assessments: (will contribute 20% of final examination mark)
   - Written tests, Written assignment, Oral tests and, Practical tests

2. Final examination:
   - Written tests, Oral tests and, Other assessments

Recommended books and other resources:

1. Brandt, A. V. 1984. Fish catching methods of the world (3rd Edition). Fishing News (Books) Ltd. Surrey, England.
2. Kristijohnsson, H. 1975. (ed.). Modern fishing of the world. Fishing News (Books) Ltd. Surrey, England.
3. Sainsbury, J. C. 1975. Commercial fishing methods: an introduction to vessels and gears. Fishing News (Books) Ltd. Surrey, England.
4. Training Department, SEAFDEC. 1988. (ed.). Fishing technology outline. TD/TRB/45. October, 1988. Text Reference Book. Southeast Asian Fisheries Development Centre, Phrapradaeng, Samutprakarn, Thailand.
5. Deep Sea Trawling and wing Trawling. 1956. (ed.). The Gourock Ropework Co. Ltd., Port Glasgow, Scotland.
6. FAO. 1980. (ed.). Echo Sounding and Sonar for Fishing. Fishing News Book Ltd., 1 Long Garden Walk, Farnham, Surrey, England.
7. Fishing Technologies for Developing Countries. 1988. (ed.). National Academy Press, Washington, D.C.
8. Fyson, J. 1985. (ed.). Design of small fishing vessels. FAO Publication. Fishing News (Books) Ltd. Surrey, England.
9. Garner, J. 1982. How to make and set nets or the technology of netting. Fishing News (Books) Ltd. Surrey, England.
10. Gerhard, K. 1973. Netting materials for fishing gear. FAO Fishing Manuals. Fishing News (Books) Ltd. Surrey, England.
11. Masthawee, P. and B. Chokesanguan. 1986. Basic Fishing Gear Technology. Training Departments, Southeast Asian Fisheries Development Centre (SEAFDEC), Phrapradaeng, Samutpraken, Thailand.
12. Munprasit, A., Y. Theparoonrat, S. Sae-Ung, S. Soodhom, Y. Matsunaga, B. Chokesanguan and S. Siriraksophon. 1989. Fishing Gear and Methods in Southeast Asia: II. Malaysia. Training Departments, Southeast Asian Fisheries Development Centre (SEAFDEC), Thailand.
13. Nomura, M. 1978. Outline of fishing gear and method. Kanagawa International Fisheries Training Centre. Nagai, Yokoshika-shi, Kanagawa-ken, Japan.

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B. Sc. Fisheries (Hons.)

Course Profile:

Course Code: FT 1122 **Course Title:Fishing Technology**

Credit: 1 **Contact Hours: 16** **Level: 1** **Semester: 1**

Course offering department: Fisheries Technology

Rationale:

In order to keep a sustainable fish stock at different water bodies, the fundamental and advanced aspects of different fishing gears and crafts used in practice be studied at laboratory and field levels.

Course Learning Outcomes (CLO):

CLO1: Identify different types of gears, crafts and net materials used in fishing and outline their appropriate selection.

CLO2: Prepare nets with appropriate mesh size and extend their shelf-life in order to ensure economically viable fishing.

CLO3: Describe traditional, artisanal and modern fishing methods practiced in the Bay of Bengal.

Mapping CLO with PLO

CLO/PLO	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8	PLO9	PLO10
CLO 1	✓	✓		✓		✓				✓
CLO 2	✓	✓	✓			✓	✓	✓		
CLO 3	✓	✓		✓		✓	✓			

Summary of Course Content

Content	Aligned CLO	No. of lectures
1. **Acquaintance with different types of fishing gears:** Wounding gears, fish traps and nets, their identification, description, operation and significance.	CLO 1	3
2. **Acquaintance with different types of fishing crafts in Bangladesh:** Identification, carrying capacities, use and significance in fishing.	CLO 1	1
3. **Acquaintance with the modern fishing methods practiced in the Bay of Bengal:** Identification, description, operation and significance.	CLO 1 & CLO 3	1
4. Examination and identification of different types of net materials and study of count system of fishing twines.	CLO 2	1
5. Identification of different types of knots and demonstration of net making/ mending and measurement of mesh size.	CLO 2	1

6. Study on different techniques of net preservation.	CLO 2	1
7. **Field visit** to different fishing locations (inland and marine) to gather experience on traditional and commercial fishing operations.	CLO 1 & CLO 3	1
8. Class test		1
Total		**10**

Teaching Strategy:

Lecture, demonstration, handouts, group discussion, web based learning and field trip.

Assessment Strategy:

Written exam, identification, assignments, quiz, MCQ and viva-voce.

Recommended books and other resources:

1. Brandt, A. V. 1984. Fish Catching Methods of the World. 3rd Edition. Fishing News Books Ltd. Surrey, England. 432 pp.
2. Fyson, J. 1985. (ed.). Design of Small Fishing Vessels. FAO Publication. Fishing News Books Ltd. Surrey, England.
3. Garner, J. 1961. (ed.). Deep Sea Trawling and Wing Trawling. The Gourock Ropework Co. Ltd., Port Glasgow, Scotland. 106 pp.
4. Garner, J. 1982. How to Make and Set Nets: The Technology of Netting. Fishing News Books Ltd. Surrey, England. 96 pp.
5. Gerhard, K. 1973. Netting Materials for Fishing Gear. FAO Fishing Manuals. Fishing News Books Ltd. Surrey, England.
6. Kristijohnsson, H. 1959. (ed.). Modern Fishing Gear of the World. Fishing News Books Ltd. Surrey, England. 607 pp.
7. Nomura, M. 1978. Outline of Fishing Gear and Method. Kanagawa International Fisheries Training Centre. Nagai, Yokoshika-shi, Kanagawa-ken, Japan.
8. Sainsbury, J. C. 1975. Commercial Fishing Methods: An Introduction to Vessels and Gears. Fishing News Books Ltd. Surrey, England. 119 pp.
9. Training Department, SEAFDEC. 1988. (ed.). Fishing Technology Outline. TD/TRB/45. Text Reference Book. Southeast Asian Fisheries Development Centre, Phrapradaeng, Samutpraken, Thailand. 293 pp.

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B. Sc. Fisheries (Hons.)

Course Profile:

Course Code: LAN 1121 **Course Title: Communicative English**

Credit: 2 **Contact Hours: 32** **Level: 1** **Semester: 1**

Course offering department: Department of Languages

Rationale:

The aim of this course is to refine freshmen students' ability to communicate effectively in English in social, academic and professional life.

Objective:

The course focuses mostly on the reading and writing skills of students. It also exposes students to a holistic communicative environment in the classes where all the four skills of language learning – listening, speaking, reading and writing – are simultaneously taught to improve their language proficiencies.

Course Description

This is a foundation-level 2 credit course. It is designed to lay the foundation for future academic reading & writing requirements including the ability to analyze, synthesize, evaluate, summarize, paraphrase, cite textual sources from required course readings, make good presentations and understand the instructions in English to enable learners to meet their academic as well as professional needs.

Course Learning Outcomes (CLOs):

Upon completion of this course, the students will be able to:

CLO-1:	Understand and use a variety of English expressions related to their academic and everyday lives by participating in routine conversations and fulfilling a variety of speaking functions
CLO-2:	Demonstrate a significant increase in word/ vocabulary knowledge
CLO-3:	Employ reading and writing techniques with a view to increasing confidence in their ability to read, comprehend, and organize written information and performing writing exercises to express an understanding of readings
CLO-4:	Show confidence in making presentations in English
CLO-5:	Communicate through professional and academic correspondence

Mapping of Course Learning Outcomes (CLOs) with Program Learning Outcomes (PLOs)

CLOs	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8	PLO9	PLO10
CLO-1			✓						✓	
CLO -2										
CLO -3									✓	
CLO -4									✓	
CLO -5			✓						✓	✓

Course Content	Aligned CLOs
➢ Introducing oneself and others ➢ Social interaction (Making conversation, applying proper register to perform language functions in English) ➢ Listening for practice & tests: monologues, dialogues, narratives, songs (Questions and exercises include WH & yes-no questions/synonyms-antonyms/sentence making with words/ fill in the blanks/matching/ MCQs/ True-false/ given-not given/ flow chart etc.)	**CLOs – 1, 2 & 4**
➢ Verb Tenses (syntax, sentence correction, right forms of verbs etc.) ➢ Types of sentences ➢ Transformation of sentences ➢ Subject-verb agreement rules & exercises ➢ Rules of punctuation & capitalization	**CLOs – 1, 4 & 5**
➢ Making effective presentations ➢ Situation based role playing & simulations ➢ Extempore speech ➢ Public speaking	**CLO - 4 & 5**
➢ Reading passages for comprehension with follow-up questions (WH & yes-no questions/synonyms-antonyms/sentence making with words/ fill in the blanks/matching/MCQs/ True-false -not given/ flow chart etc.)	**CLOs – 2 & 3**
➢ Academic & professional correspondence • **Academic**: Application for stipend, scholarship, certificate, mark sheet etc./research motivation letter • **Professional**: Job application/Job offer acceptance or joining letter/ Resignation letter/ Memo writing/ Report writing/ Proposal writing • CV & Resume preparation	**CLOs –3 & 5**
➢ Use of linking devices ➢ Paraphrasing & summary writing ➢ Paragraph writing ➢ Describing graphs, charts and tables	**CLOs – 2, 3 & 5**

Teaching Strategy:

- Lecture
- Demonstrations
- Simulation and role-play
- Presentations

Assessment Strategy:

- MCQs
- Presentations
- Assignments

Books Recommended:

i. Speaking Naturally (Audio CD) Communication Skills in American English by Bruce Tillitt and Mary Newton Bruder, 1985, 2005. CUP

ii. Speaking Effectively - Developing Speaking Skills For Business English, Comfort Rogerson Stott & Utley, 1994 CUP

iii. High School English Grammar and Composition, by Wren and Martin. 1980. S. Chand & Company, India.

iv. Guide to Patterns and Usage in English, by Hornby A. S. 1998. 2nd edition, Oxford University Press, Delhi.

v. Accelerator (An Effective English Language Workbook), by Karim, Z. & Arifeen, M. S. 2016, Madhorse Publications, Dhaka.

vi. Writing Skills Handbook, by Wiener, B. 1988, 4th edition, Houghton Miffin Company, Boston and New York, USA.

vii. English Pronouncing Dictionary, by Jones, D. 1977. University of Cambridge, UK.

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B. Sc. Fisheries (Hons.)

Course Profile:

Course Code: RS 1101 **Course Title: Sociology of Fisheries**

Credit: 2 **Contact Hours: 32** **Level: 1** **Semester: 1**

Course offering department: Department of Rural Sociology

Rationale

The course provides knowledge on sociological way of thinking about rural society, fishermen's community and rural development.

Course Learning Outcomes (CLOs)

CLO 1 Describe the basic features of rural society and rural sociology

CLO 2 Identify and explain different elements of culture

CLO 3 Interpret rural social change, agrarian transformation and rural development

CLO 4 Explain gender roles in fisheries and rural livelihoods

CLO 5 Carry out social research independently

Mapping of CLO with PLO

CLO/PLO	PLO 1	PLO 2	PLO 3	PLO 4	PLO 5	PLO 6	PLO 7	PLO 8	PLO 9	PLO 10
CLO 1							✓		✓	
CLO 2							✓		✓	
CLO 3							✓		✓	
CLO 4	✓		✓		✓		✓		✓	
CLO 5			✓					✓		

Course Content

Course Content	Aligned CLOs	Number of lectures
Introduction: Concept of Sociology and Rural Sociology, scope and importance of Sociology of Fisheries, rural and urban intertwinement, status of fishing communities in the peri-urban areas, role of rural sociologists to the fishermen's community development	**CLO 1**	**6**
Culture: Meaning, importance and functions, elements, characteristics, variability and uniformity, differences among different social and economic groups, common heritage of different castes, creeds and religious identities, culture of fishermen community	**CLO 2**	**5**
Agrarian structure and rural development: Transformation in agricultural practices and land use patterns, social transformation, employment opportunities, agricultural labour forces, development of Agro-Fisheries industries, training of rural youths for self-employment (TRYSEN), poverty alleviation and food security, GO and NGO activities and rural development	**CLO 3**	**6**
Sustainable livelihoods: Sustainable livelihood approach, livelihood framework, vulnerability context and risks, livelihood strategies of the fishermen in the inland capture, and coastal artisan fisheries, livelihood outcomes, ecosystem services, environmental degradation and fishermen's activities	**CLO 4**	**5**
Gender issues in sociology: Gender differences and division of labour, gender roles in society and empowerment of women, gender inequality, equity and security, gender involvement in fisheries	**CLO 4**	**5**
Social research: Necessity and importance of social research, problem identification, scientific research methods, judgment and ethical issues, research process, sampling methods and data collection, analyses and interpretation, PRA: Meaning and principles; Output of PRA; Commonly used PRA tools	**CLO 5**	**5**

Teaching Strategy

Class lecture, Short lecture by the students, Assignment, Brain storming, Interactive group discussion, Presentation, Debate, Role play, Recap, Question & Answer, Self-study

Assessment Strategy

Class performance, Class attendance, Class test, Assignment, Presentation, Final examination

Recommended Books and other resources

Browne. (1998). An Introduction to Sociology 2nd edition. Polity Press, Cambridge.

Chambers, R. (1983). Rural Development: Putting the Last First. Prentice Hall:Harlow.

Chittambar, J.B. (2015). Introductory Rural Sociology. New Age Int: New Delhi.

Green, G. P. (Ed.). (2013). Handbook of Rural Development. Edward Elgar Publishing.

Ellis, F. (2000). Rural Livelihoods and Diversity in Developing Countries. Oxford University Press. Oxford Sage Publications. London

Hillyard, S. (2011). The Sociology of Rural Life. Berg Publishers: Oxford.

IFAD (2009). Gender in agriculture Sourcebook. The World Bank.

Macionis, J.J. (2016). Sociology. London: Prentice-Hall.

Rahman, H.Z. (1995). Rethinking Rural Poverty: Bangladesh as case Study .UPL. Dhaka

Rogers, E.M. et al. (1988).Social Change in Rural Societies: An Introduction to Rural Sociology. Prentice-Hall:NJ.

Shaefer, Richard T. (2011). Sociology (9th edition), McGraw Hill, New York.

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B. Sc. Fisheries (Hons.)

Course Profile :

Course Code: FBG 1103 Course Title: Developmental Biology of Aquatic Animals

Credit: 2 Contact Hours: 32 Level: 1 Semester: 1

Course offering department: Department of Fisheries Biology and Genetics

Rationale:

Students successfully completing this course should be able to describe the processes of cleavage, gastrulation, neurulation, and organogenesis common to all vertebrates and identify embryological structures in multiple planes over successive developmental stages.

Course learning Outcomes:

CLO1. Understand the mechanisms of development from genes to the formation of an organism.

CLO2. Explore selected areas of developmental biology of aquatic animals in depth

CLO3. Critically analyze, present, and discuss scientific material.

CLO4. Apply concepts in developmental biology to your development as a biologist.

Mapping CLO with PLO:

	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8	PLO9	PLO10
CLO1	√									
CLO2	√									
CLO3	√	√							√	
CLO4	√		√		√	√		√		√

Course Contents:

Course contents	Aligned CLO	No. of Lectures
1. The origin and structure of gametes.	**CLO 1**	**3**
2. **Fertilization**: Types, mechanism of egg-sperm interaction, fusion of gametes, prevention of polyspermy, Calcium as the initiator of the cortical granule reaction, Activation of Egg Metabolism	**CLO 1, CLO 2**	**9**
3. Early developmental processes in the selected aquatic animals (zebrafish, sea urchin, snail, tunicate, and frog) : **Cleavage**: Patterns of embryonic cleavage in different animals, **Gastrulation**: Fate of cells, gastrulation in different animals, and Axis formation	**CLO 1, CLO 2**	**9**

4. **The stem cell**: **Organogenesis**: formation of general body form.	**CLO 3, CLO 4**	**6**
5. **Post-embryonic Development**: Metamorphosis, Regeneration,	**CLO 2, CLO 3, CLO 4**	**4**
6. Class test	**-**	**1**

Teaching strategy: Lectures, Problem based learning, Interactive learning, Group studies and Discussion.

Assessment Strategy: MCQ Test, Written test, Oral test, Assignment and Presentation.

Learning Resources:

1. Balinsky, B. I. 1981. Introduction to Embryology (4th edition). Holt Rinehart & Winston. 688 pp.
2. Gilbert, S. F. 2010. Developmental Biology (9th edition) Sinauer Associates, Inc. Sunderland.711 pp.
3. Yvette, W. K. 2004. Developmental Biology of Teleost Fishes. Springer. 636 pp.
4. Belon, E. K. 1985. Early Life History of Fishes. Dr. W. Junk Publisher.
5. Nelson, O. E.1953. Comparative Embryology of Vertebrates. MaGraw Hill Book Company. 982 pp.
6. Wolpert, L. 1983. From Egg to Embryo: Determinative Events in Early Development. Cambridge University Press.

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B. Sc. Fisheries (Hons.)

Course Profile

Course Code: **AQ 1103** **Course Title:** **Ornamental Fish Culture**

Credit: **2** **Contact Hours:** **32** **Level:** **1** **Semester:** **1**

Course offering department(s): **Department of Aquaculture**

Rationale:

To be a successful aquarist, a student should have familiarized with different ornamental fish species along with their breeding and culture techniques that would subsequently be helpful in developing private entrepreneurship for commercial purpose.

Course Learning Outcomes (CLO):

CLO 1: Discuss on the context and prospects of ornamental fish in Bangladesh

CLO 2: Identify indigenous and exotic ornamental fish species

CLO 3: Design aquarium with all amenities for rearing compatible species

CLO 4: Explain aquarium fish breeding, feeding and health management strategies

CLO 5: Plan for popularization of aquarium fish culture

Mapping CLO with PLO

CLO/ PLO	PLO 1	PLO 2	PLO 3	PLO 4	PLO 5	PLO 6	PLO 7	PLO 8	PLO 9	PLO 10
CLO 1	✓									
CLO 2	✓	✓								
CLO 3	✓	✓		✓	✓			✓	✓	✓
CLO 4		✓	✓	✓	✓	✓		✓	✓	✓
CLO 5		✓	✓		✓		✓		✓	✓

Summary of Course Content

Content	Aligned CLO	No. of lectures
Introduction: Definition, history and importance of ornamental fish culture, present status and prospect of ornamental fish culture in Bangladesh. Important ornamental fish species (indigenous and exotic).	CLO 1 &CLO 2	4
Aquarium preparation and maintenance: Types and size of aquaria, preparation, aeration, filtration (chemical and biological), lighting, plantation, water exchange, cleaning, pruning and manuring of aquatic plants.	CLO 3	9
Stocking and rearing of fish in aquarium: Species selection, transportation and release in aquaria, food and feeding, waste removal, health management	CLO 3 & CLO 4	6
Seed production of some ornamental fishes: Brood selection, breeding, fry production and rearing of guppy, zebra fish, gold fish and some indigenous ornamental fishes.	CLO 4	8
Popularization of ornamental fish keeping: Display, demonstration, training and exhibition.	CLO 5	4
Class Test		1
Total		32

Teaching Strategy:
Lecture, chalk and talk, multi-media, video clipping, demonstration.
Assessment Strategy:
Tutorials (written examination), quiz, assignment, class response.

Text books and references:

1. G.E. Hervey, and J. Hems. 1965. Freshwater tropical fishes. Spring Books. London, UK.
2. Mills, D. 1992. Tropical Aquarium Fishes, How to keep freshwater fish. Chancellor Press, London, UK.
3. Petrovicky, I. 1993. The illustrated guide to Tropical Aquarium fishes. Chancellor Press, London, UK.
4. Islam, M. A. 1985. *Macher Pokurer Pani*, Bangla Academy, Dhaka.
5. Islam, M. A. 1985. *Macher Roog*, Bangla Academy, Dhaka.
6. Grzimek, B and Ladiges, W (Editors). 1973. Grzimek's animal life encyclopedia. Van Reinhold Company, UK.
7. Roberts, R.J. 1989. Fish Pathology (2nd Ed.). Baillere Tindall, London, UK.

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B. Sc. Fisheries (Hons.)

Course Code: FM 1123 **Course Title: Aquatic Soil Science**

Credit: 2 **Contact Hours: 32** **Level: 1** **Semester: 1**

Course Offering Department (s) :Department of Fisheries Management

Rationale:

To become a successful fisheries professional the students need to know the various physical, chemical and biological properties of aquatic soils, their interactions with water as well as the productivity of a waterbody

Course learning Outcomes:

CLO1: Explain soil, components and formation of soil, soil physical properties, textural classes and suitability of soil textural classes for fish culture, pond construction and fisheries management.

CLO2: Describe the various chemical properties of soil, soil fertility and productivity for fish culture.

CLO3: Relate soil-water interactions and their effects on productivity of waterbodies.

CLO4: Suggest solution for problems of very sandy soils, salted and acid sulphate soils for fish culture and management.

CLO5: Explain different soil organisms and theirimportance in aquatic nutrient cycling on the productivity of waterbody.

Mapping CLO with PLO:

	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8	PLO9	PLO10
CLO1	√	√	√			√		√		√
CLO2	√							√		
CLO3	√	√	√					√		
CLO4	√	√			√			√		
CLO5	√	√						√		

Course Contents:

Course contents	Aligned CLO	No. of Lectures
7. Definition of soil and soil science, component of soil, soil formation, significance in fisheries, physical properties of soil, soil texture and textural classes, soil temperature, suitability of soil textural classes for fish culture, pond construction and fisheries management.	**CLO 1**	**9**
8. Chemical properties of soil: Soil pH, cation and anion exchange and adsorption, soil fertility and productivity.	**CLO 2**	**5**
9. Soil-water interactions and their effects on productivity of waterbodies. Bioturbation: benthic organisms responsible for bioturbation, effects of bioturbation on physico-chemical properties of overlying water. Bottom-mud: bottom mad as a store-house of nutrients for aquatic productivity, physico-chemical factors affecting release and retention of nutrients from/to sediment, management of bottom mud.	**CLO 3**	**8**
10. Very sandy soils: Properties and problems in pond construction, fish culture and management, clay soils - properties and problems in pond construction, fish culture and management.	**CLO 4**	**3**
1. Salted and acid sulphate soils: Properties and problems in coastal aquaculture and mangrove fisheries and reclamation.	**CLO 4**	**3**
2. Soil biology: General discussion, significance and management, importance in aquatic nutrient cycling in productivity of waterbody.	**CLO 5**	**3**

Teaching strategy: Lectures, Problem based learning, Interactive learning, Group studies and Discussion.

Assessment Strategy: MCQ Test, Written test, Oral test, Assignment and Presentation.

Learning Resources:

1. Donahue, R. L., R. W. Miller and F. C. Shickluna. 1990. Soils: An Introduction to Soils and Plants Growth. 5th Edition. Prentice-Hall of India Private Ltd. New Delhi.
2. Golterman, H. L. (ed.). Interactions between sediments and freshwater: Proceedings of an international symposium held at Amsterdam. The Netherlands, September 6-10, 1976.
3. Miller, R. W. and R. L. Donahue. 1992. Soils: An Introduction to Soils and Plant Growth. 6th Edition. Prentice Hall of India Pvt. Ltd. New Delhi 110001.
4. Boyd, C. E. 1988. Water quality management for pond fish culture. Elsevier Science Publishers B.V., Amsterdam. 318 pp.
5. Buckman, H. O. and N. C. Brady. 1988. The Nature and Properties of Soils. Ninth edition. S. Chand &Company ,Pvt. Ltd. Co. 750 pp.
6. Fitzpatrick, E. A. 1986. Soils-their formation, Classification and distribution. English language Book Society. Longman, England. 353 pp.
7. Tamhance, R. V., D. P. Motiramoni and Y. P. Bali. 1970. Soils: Their Chemistry and Fertility in Tropical Asia. 3rd Edition. Prentice-Hall. Inc. 475 pp.
8. Thomson, L. M. and F. R. Troeh. 1978. Soils and soil fertility. 4th Edition. McGraw Hill Book Co., New York. 516 pp.

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B. Sc. Fisheries (Hons.)

Course Profile :

Course Code :FT 1103 **Course Title : Responsible Fishing**

Credit: 2 **Contact Hours: 32** **Level: 1** **Semester: 1**

Course Offering Department (s) : Department of Fisheries Technology

Rationale:

In order to maintain the ecosystem balance and ensure sustainable fish production, its practitioners will need to become knowledgeable about aspects of responsible fishing.

Course Learning Outcomes (CLO):

CLO1: Explain Code of Conduct for Responsible Fishing.
CLO2: Describe ecosystem balance to improve fish stock and existing national and international fishing rules and regulations to be followed to fish responsibly.
CLO3: Estimate science-based catch limits for open water fisheries including hilsa
CLO4: Prepare action plan for reducing catch of non-targeted species.
CLO5: Choose appropriate steps for ensuring fish quality and workers' safety on board vessel.

Mapping CLO with PLO

CLO/PLO	PLO 1	PLO 2	PLO 3	PLO 4	PLO 5	PLO 6	PLO 7	PLO 8	PLO 9	PLO 10
CLO 1	✓	✓								
CLO 2	✓	✓								
CLO 3						✓				✓
CLO 4				✓	✓			✓		
CLO 5		✓	✓	✓	✓					✓

Summary of Course Content

Content	Aligned CLO	No. of lectures
9. **Introduction:** Definition, history and importance of responsible fishing, FAO-CCRF. Areas of responsibility. Present status of fishing in inland, coastal and marine (EEZ) waters of Bangladesh.	CLO 1 & CLO 2	5
10. **Fishing gears and their use**: Selectivity properties, destructive fishing and their impacts. Destructive fishing, overfishing and degradation of marine resources, ghost fishing.	CLO 1 & CLO 2	7

11. **Responsibility towards natural water resources and environments:** Maintenance of ecosystem, pollution mitigation. Specific measures for protected species- marine protected area, sanctuary and marine ranch.	CLO 1, CLO 2 & CLO 3	6
12. **Responsibility in fishing practices:** IUU fishing, MCS, By-catch reducing devices (BRDs). Plan of action for conservation and management of sharks, turtles and mammals.	CLO 3 & CLO 4	4
13. Responsibility towards food safety and quality of fish: Code of Conduct for seafood product safety on board vessel, landing and in seafood distribution chain.	CLO 5	4
14. Safety onboard vessel: Personal hygiene and sanitation, welfare of Fishermen.	CLO 5	5
Class test		1
Total		32

Teaching Strategy

Lecture, power point presentation, handouts, group discussion and web based learning.

Assessment Strategy

Written exam, presentation on specific topic, assignment and MCQ

Books and References:

1. Cochrane, K. L. (ed.) 2002. A Fishery Manager's Guidebook - Management Measures and Their Application. *FAO Fisheries Technical Paper*. No. 424. Rome, Italy.
2. Hilborn, R. and U. Hilborn. 2019. Ocean Recovery: A sustainable future for global fisheries? Oxford University Press. Oxford, UK.
3. Garcia, S.M., A. Zerbi, C. Aliaume, T. Do Chi andG. Lasserre. 2003. The ecosystem approach to fisheries. Issues, terminology, principles, institutional foundations, implementation and outlook. *FAO Fisheries Technical Paper*. No. 443. Rome, Italy.
4. Sinclair, M. and G. Valdimarsson. 2003. Responsible Fisheries in Marine Ecosystem. Food and Agriculture Organisation of United Nations. Rome, Italy.
5. Kennelly, S. J. (ed.) 2007. By-catch Reduction in the World's Fisheries. Reviews: Methods and Technologies in Fish Biology and Fisheries. Springer publication. Netherlands.
6. Haque, S. M. R. 2010. Khamar (In Bengali, Translated to English by Prof. M. Shahidur Rahman, Dept. of Fisheries Management, BAU, Mymensingh), 16(3): 29-32.
7. IUCN Bangladesh. 2000. Red Book of Threatened Fishes of Bangladesh. IUCN-The World Conservation Union, Bangladesh. 116 pp.
8. Madakia, H. 1985. Fish Handling. ASEAN-CIDA-SEAFDEC Regional Training Course in Fish Handling and Processing, Samutprakarn: 6-30 March 1985.
9. Wiryanti, J. and H. Madakia. 1997 (eds.). Improved Quality Control for the Handling and Processing of Fresh and Frozen Tuna at sea and on shore. ASEAN-CANADA Fisheries Post-harvest Technology Project-Phase II.
10. Department of Fisheries Post-Harvest Technologies and Quality Control (DFPTQ), Fisheries Administration (FiA), Cambodia. 2012. Manual of Good Hygiene Practice for Fishing Boats and Fish Landing Sites in Small Scale Fisheries. Regional Fisheries Livelihood Program in South and Southeast Asia (RFLP), FAO.

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11.
B. Sc. Fisheries (Hons.)

Course Profile :

Course Code: FBG 1201 **Course Title: Ichthyology**

Credit: 3 **Contact Hours: 48** **Level: 1** **Semester: 2**

Course Offering Department (s) :Department of Fisheries Biology and Genetics

Rationale:

In order to acquire the knowledge necessary for classification and identification of major groups of fish based on their anatomical features, students will need to know the external morphology, anatomy and functions of various organs, and integration systems (nervous system, endocrine system, receptors) of different fish groups.

Course learning Outcomes (CLOs):

CLO1.Classify different groups of both freshwater and marine fishes having economic importance.
CLO2.Explain different external morphological features and principle of fish coloration.
CLO3.Illustrate different skeletal and musculature features with their respective types and importance.
CLO4. Illustrate anatomy of different fish organs.
CLO5. Describe the mechanism, function and role of swim bladder in buoyancy.
CLO6. Explain different integral systems (nervous system, endocrine system, receptors)in fish with their corresponding types and functions.

Mapping CLO with PLO:

	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8	PLO9	PLO10
CLO1	√	√	√			√	√	√	√	√
CLO2	√	√	√	√		√	√	√	√	√
CLO3	√	√				√		√	√	√
CLO4	√	√				√		√	√	√
CLO5	√									√
CLO6	√	√	√			√	√	√	√	√

Course contents:

Course contents	Aligned CLO	No. of Lectures
6. Introduction: Definition of fish, important facts and figures about fishes, classification of major groups of freshwater and marine fishes.	**CLO 1**	**8**
7. External morphology: Body forms, shapes and sizes, body coverings, skins, scales, skeleton, fins and openings, derivatives of skin, coloration in fishes and its significance.	**CLO 2**	**8**
8. Muscles and locomotion: Types and their roles in locomotion and movements of different body parts.	**CLO 3**	**6**
9. Anatomy of different organs: Respiratory system- structure of gills, accessory air-breathing organs, digestive system - food and feeding habits, feeding adaptations, comparative study of the alimentary canal in different groups of fishes, structure of excretory, circulatory, electric and bioluminescence organs.	**CLO 4**	**11**
10. Swim bladder: Origin and role in buoyancy, functions and mechanism of filling and emptying of gases.	**CLO 5**	**5**
11. Integration systems in fishes: Nervous systems - brain and cranial nerves, spinal cord and nerves, receptors- types and functions, endocrine systems- types of endocrine glands, their location, secretion and function.	**CLO 6**	**9**
12. Mid-term examination	**-**	**1**

Teaching strategy: Lectures, Problem based learning, Interactive learning, Q/A session, Group studies and Discussion.

Assessment Strategy: MCQ Test, Written test, Quiz, Oral test, Assignment and Presentation.

Learning Resources:

1. Bond, C. E. 1996. Biology of Fishes. 2nd Edition. Sunders College Publishing. 750 pp.
2. Bone, Q. and R. Moore. 2008. Biology of Fishes. Garland Science. 450 pp.
3. Lagler, K. F., J. E. Bardach, R. R. Miller and D. R. M. Passino. 1977. Ichthyology. 2nd Edition. John Willey and Sons, Inc., New York. 528 pp.
4. Moyle, P. B. and J. J. Cech. 2003. Fishes: An Introduction to Ichthyology. 5th Edition, Benjamin Cumin. 744 pp.
5. Jhingran, V. G. 1988. Fish and Fisheries of India, Hindustan Publishing Corporation India.
6. Journal of Applied Ichthyology. http//onlinelibrary.wiley.com/journal/10-1111/.
7. Khanna, S. S. and H. R. Singh. 2003. A Text Book of Fish Biology and Fisheries. 524 pp.

8. Love, M. S. and G. M. Cailiet. 1979 (eds.). Readings in Ichthyology. Goodyear Publishing Co, U. S. 525 pp.
9. NormanJ. R 2007. A History of Fishes. Asiatic Pub. 464pp.
10. Rajiv, T. and A. N. Shukla. 2002. Adaptations in Fishes : Encyclopaedia of Fishes Series. Narendra Publications. 218 pp
11. Srivastava C. B. L.and M. Kitab. 1999. A Text Book of Fishery Science and Indian Fisheries. Narendra Publications. 527 pp.

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B. Sc. Fisheries (Hons.)

Course Profile :

Course Code: FBG 1222 **Course Title: Ichthyology**

Credit: 1 **Contact Hours: 16** **Level: 1** **Semester: 2**

Course Offering Department (s) :Department of Fisheries Biology and Genetics

Course objectives:

In order to apply the knowledge and skills necessary for classification and identification of major groups of fishes students will need to know the external morphology, anatomy of various organs, and integration systems (Nervous system, endocrine system) of different groups of fish.

Course learning Outcomes (CLOs):

CLO 1: Identify important marine and freshwater fishes and different fish scales.
CLO 2: Explain different external morphological features with internal anatomy of fishes.
CLO 3: Dissect and display digestive, circulatory blood vessels and nervous system of fishes.
CLO 4: Identify important bones of fish
CLO 5: Prepare bone album of fish.

Mapping CLO with PLO:

	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8	PLO9	PLO10
CLO1	√	√	√			√	√	√	√	√
CLO2	√	√	√			√	√	√	√	√
CLO3	√	√	√			√	√	√	√	√
CLO4	√							√	√	
CLO5	√									
CLO6										

Course contents:

Course contents	Aligned CLO	No. of Lectures
1. Identification of important marine and freshwater fishes.	**CLO 1**	**6**
2. Study of external morphology and internal anatomy of fishes.	**CLO 2**	**3**
3. Comparative study of digestive systems of fishes with different food and feeding habits.	**CLO 2**	**2**
4. Major circulatory blood vessels.	**CLO 3**	**2**
5. Identification of important bones of fish and preparation of bone album.	**CLO 4 & CLO 5**	**1**
6. Study of fish brain and pituitary gland.	**CLO 3**	**1**
7. Mid-term Examination	**-**	**1**

Teaching strategy: Lectures, Demonstration of specimens, Problem based learning, Interactive learning, Q/A session, Group studies and Discussion.

Assessment Strategy: MCQ Test, Dissection of specimens, Written test, Quiz, Oral test, Assignment and Presentation.

Learning resources

1. Jhingran, A. G. 1988. Fish and Fisheries of India, Hindustan Publishing Corporation (India), Delhi.
2. Journal of Applied Ichthyology. http//onlinelibrary.wiley.com/journal/10-1111/ (ISSN)1439-0429
3. Lagler, K. F., J. E. Bardach, R. R. Miller and D. R. M. Passino. 1997. Ichthyology. John Willey and Sons, Inc., New York.
4. Love, M. S. and G. M. Cailiet. 1979 (eds.). Readings in Ichthyology, Prentice-Hall of India Ltd. New Delhi.
5. Talwar, P. K. and A. G. Jhingran. 1991. Inland Fishes of India and Adjacent Countries. Oxford & IBH Publishing Co., Calcutta, 1158.
6. Verma, P. S. 1994. A manual of Practical Zoology Chordates. S. Chand and Company. 632 pp.

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B. Sc. Fisheries (Hons.)

Course Profile :

Course Code: **AQ 1201** **Course Title:Freshwater Aquaculture**

Credit: 3 **Contact Hours:48** **Level: 1** **Semester: 2**

Course offering department(s): **Department of Aquaculture**

Rationale:

In order to explore freshwater resources for aquaculture, a fisheries graduate ought to have knowledge on different farming practices to ensure safe and sustainable production of freshwater fish species at commercial level.

Course Learning Outcomes (CLO):

CLO 1: Illustrate site selection criteria and pond preparation strategies for freshwater aquaculture

CLO 2: Plan fish seed production methods and nursery management

CLO 3: Characterize culture systems of different commercial freshwater fish species

CLO 4: Explain aquaculture systems in open fresh water habitats

CLO 5: Design good aquaculture practices to ensure safe fish production

Mapping CLO with PLO

CLO/ PLO	PLO 1	PLO 2	PLO 3	PLO 4	PLO 5	PLO 6	PLO 7	PLO 8	PLO 9	PLO 10
CLO 1	✓	✓								
CLO 2	✓	✓		✓	✓				✓	✓
CLO 3	✓	✓	✓	✓		✓		✓	✓	✓
CLO 4		✓	✓	✓		✓		✓		✓
CLO 5		✓	✓	✓	✓		✓		✓	✓

Summary of Course Content

Content	Aligned CLO	No. of lectures
Pond aquaculture: Definition, site selection, physical and chemical properties of water, pond construction methods, drying, liming, fertilization, productivity, stocking and post stock management.	CLO 1	10
Nursery operation: Pond preparation, insect & predator control, stocking and post stocking management	CLO 2	5
Fish seed production: Hatchery production, sources of natural fish seed, bundh spawning and induced spawning, packing and transportation of fry and live fish, causes of fish mortality during transportation, use of anesthetics, antiseptics and antibiotics in live fish transport	CLO 2	8
Culture of important freshwater species: Carps, freshwater prawn, climbing perch, pangasius catfish, other catfishes, tilapia, snakeheads and small indigenous species (SIS – pabda, gulsha, mola etc), Culture of some commercially important aquatic plants	CLO 3	12
Cage and pen aquaculture: Site selection, design and construction of cages and pens, species selection, stocking, feeding and harvesting.	CLO 4	6
Concept of good aquaculture practices (GAqP's): GAqP's and food security, setting up GAqP's-for farm input and production management.	CLO 5	6
Class Test		1
Total		48

Teaching Strategy:

Lecture, chalk and talk, multi-media, video clipping, demonstration.

Assessment Strategy:

Tutorials (written examination), quiz, assignment.

Recommended books and other resources:

Text books:

1. Bardach, J. E. J. H. Ryther, and W. O. Mclarney. 1972. Aquaculture. John willey & Sone. Inc. New York. 868 pp.
2. Pillay, T. V. R. 1994. Aquaculture Development: Progress and Prospect. Fishing News Books Black well Scientific Publications Ltd. Oxford.
3. Islam, M. A. 2001. Aquaculture. Bangla Academy, Dhaka. 352 pp.
4. Axelord, H. R. 1980. Hand book of Tropical Aquarium Fishes, Neptune, New Jersey, T. F. H. Publications Inc. Ltd. 718 p 3rd rev. Edition.
5. Chondar, S. L. 1980. Hypophysation of Indian Major Carps. Shatish Book Enterprise Motikatra, Agra-3, India. 146 pp.
6. Edwards, P., D. C. Little and H. Demaine. 2002 (eds.). Rural Aquaculture, CABI Publishing, CAB international, Wallingford, Oxon OX10 8DE, U. K. 358 pp.
7. Huet, M. 1979. Textbook of Fish Culture: Breeding and Cultivation of Fish. Fishing News Books Ltd. Farnham, Surrey, England.

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B. Sc. Fisheries (Hons.)

Course Profile :

Course Code: **AQ 1222** **Course Title:Freshwater Aquaculture**

Credit: **1** **Contact Hours:** **16** **Level:** **1** **Semester:** **2**

Course offering department(s): **Department of Aquaculture**

Rationale:

In order to apply knowledge of aquafarming for enhancing fresh water fish production in a sustainable and environmentally friendly manner, students will need to acquire practical knowledge and skills on planning and operating farming using different farming components at the on-station and on-farm levels.

Course Learning Outcomes (CLO):

CLO 1: Identify common aquatic weeds and algae.

CLO 2: Categorize the seeds of commercially important fish and shrimp species.

CLO 3: Point out the steps to prepare a nursery and a stocking pond.

CLO 4: Describe the use of anesthetics in handling of fish.

CLO 5: Explain the transportation system of fry, fingerlings and live fish.

CLO 6: Develop a case study report after visiting a fish hatchery/fish farm.

Mapping CLO with PLO

CLO/ PLO	PLO 1	PLO 2	PLO 3	PLO 4	PLO 5	PLO 6	PLO 7	PLO 8	PLO 9	PLO 10
CLO 1	✓	✓	✓							
CLO 2	✓	✓	✓				✓			
CLO 3	✓	✓						✓		✓
CLO 4	✓	✓		✓		✓		✓		
CLO 5		✓	✓	✓	✓	✓	✓		✓	
CLO 6	✓		✓		✓			✓		✓

Summary of Course Content

Content	Aligned CLO	No. of lectures
Identification of common aquatic weeds and algae of aqauculture.	CLO1	2
Identification of seeds of important aquacultural fish and shrimp species.	CLO2	2
Preparation, fertilization and management of a nursery pond.	CLO3	2
Preparation, liming, fertilization and management of a stocking pond.	CLO3	3
Use of anaesthetics in handling of fish.	CLO4	1
Transportation of fry, fingerlings and live fish.	CLO5	1
Case study: Visit to hatchery and fish farms and preparation of case study report.	CLO6	4
Class Test		1
Total		16

Teaching Strategy:

Lecture, Multi-media, video clipping, Demonstration.

Assessment Strategy:

Written exam, quiz, viva-voce, group discussion, Field trip, assignment.

Recommended books and other resources:

1. Huet, M. 1979. Textbook of Fish Culture: Breeding and Cultivation of Fish. Fishing News Books Ltd. Farnham, Surrey, England.
2. Islam, M. A. 2001. Aquaculture. Bangla Academy, Dhaka. 352 pp.
3. Pillay, T. V. R. 1993. Aquaculture: Principles and practices, Fishing News Books Black well Scientific Publications Ltd. Osney Weed Oxford OX2 OEL, U.K. 592 pp.
4. Anonymous, 1997. Training on Integrated Fish Farming to the Thana Fisheries Officer, Fisheries Research Institute, Mymensingh.
5. Axelord, H. R. 1980. Schultz, L. P. 1983. Hand book of Tropical Aquarium Fishes, Neptune, New Jersey, T. F. H. Publications Inc. Ltd. 718 p 3rd rev. ed.
6. Chondar, S. L. 1980. Hypophysation of Indian Major Carps. Shatish Book Enterprise Motikatra, Agra-3, India, 146pp.

7. Edwards, P., D. C. Little and H. Demaine (eds.). 2002. Rural Aquaculture, CABI Publishing, CAB international, Wallingford, Oxon OX10 8DE, U. K.358 pp.
8. FAO (Food and Agricultural Organization) 1990. Farming Systems. Developments, Guidelines for the conduct of training course in farming systems development. FAO- United Nations.
9. Jhingran, V. G. 1977. Fish and Fisheries in India. Hindustan Publishing Delhi.
10. Jhingran, V. G. and R. S. V. Pullin 1985. A Hatchery Manual for Common, Chinese and Indian Major carps. Asian Development Bank, ICLARM, Manila, Philippines.
11. Karim, M. A. 1975. An Introduction of Fish Culture in Bangladesh, Ruby Press, Mymensingh, Bangladesh.
12. Kurian, C. V. and Sebastian, V. O. 1982. Prawns and Prawn Fisheries of India. Delhi, Hindustan Publishing Corporation (India) 186p. 2nd rev. ed.
13. Muir, J. F. and Roberts, R. J. (Eds.), Recent Advances in Aquaculture, Vol. I, II, III and IV, Croom Helm, London.
14. Pillay, T. V. R. 1994. Aquaculture Development: Progress and Prospect. Fishing News Books Black well Scientific Publications Ltd. Oxford.
15. Pullin, R. S. V. and Lowe-McConnel, R. H. 1982. The Biology and Culture of Tilapias, ICLARM Conference Proceedings 7. 432 p. International Center for Living Aquatic Resource Management, Manila, Philippines.
16. Islam, M. A. 1985. Macher Chash Babosthapana. Bangla Academy, Dhaka. 277 pp.
17. Islam, M. A. 1989. Macher Chash Babosthapana. Bangla Academy, Dhaka. 174 pp.
18. Islam, M. A. 1992. Macher Pukurer Pani. Academy, Dhaka. 229 pp.

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B. Sc. Fisheries (Hons.)

Course Profile :

Course Code: FM 1221 **Course Title: Fisheries Resources and Conservation**

Credit: 2 **Contact hours: 32** **Level: 1** **Semester: 2**

Course Offering Department (s) : Department of Fisheries Management

Rationale: To get successful fisheries production, students should have knowledge on the present status of fisheries resources in Bangladesh and their future potentials; and the necessities, strategies and policies of fish conservation.

Course Learning Outcomes (CLO)

1. Enlist the physical resources of waterbodies (both inland waterbodies and the Bay of Bengal) and institutional resources
2. Classify various kinds of biological resources in Bangladesh
3. Describe the needs of seed production of different fisheries resources, their present status and future potentials
4. Discuss the different policies and legislations and relate them in respect to the fisheries resources and conservation

Mapping CLO with PLO

	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8	PLO9	PLO10
CLO1	√	√	√		√			√	√	
CLO2	√	√		√		√		√		
CLO3	√	√	√			√		√		
CLO4	√	√	√	√	√	√		√	√	

Course Contents:

Course contents	Aligned CLO	No. of Lectures
15. Physical resources of Bangladesh: (a) waterbodies - ponds and lakes, river, canals floodplain, beels, haors, baors, paddy fields, borrow pits and the Bay of Bengal, (b) institutional resources - GOs and NGOs, educational, research, training and extension, (c) financial institutions - banks, cooperatives, NGOs and other agencies.	**CLO 1**	**6**
16. Sectoral policies: Policies and programmes for water-bodies belonging to different ministries and departments, current five-year development activities of the Ministry of Fisheries and Livestock.	**CLO 4**	**5**
17. Biological resources: Indigenous fishes, exotic fishes and non-piscine fisheries organisms of fresh, coastal and marine habitats, hilsa fisheries resources - distribution, importance, economics and conservation.	**CLO 2**	**6**
18. Seed production: Present status of seed production of fin fish, shell fish and non-conventional aquatic fauna from natural and artificial sources.	**CLO 3**	**5**
19. Aquatic conservation: Direct and indirect causes of fish decline, ecological/biological principles and concepts in fish conservation, survey, surveillance and monitoring, status and characteristics of vulnerable species, conservation strategies - habitat management, harvest/population management, protection/preservation, animal damage control, etc.	**CLO 4**	**5**
20. Legislation and conservation: Policies that influence and/or regulate fish conservation and use, legal framework for conservation - protected area and species, current practices employed in the conservation and management of aquatic habitats.	**CLO 4**	**5**

Teaching strategy: Lectures, Problem based learning, Interactive learning, Group studies and Discussion.

Assessment Strategy: MCQ Test, Written test, Oral test, Assignment and Presentation.

Text books:

1. Helfman G.S. 2007. Fish conservation: a guide to understanding and restoring global aquatic biodiversity and fishery resources. Island Press, Washington, USA. 688 pp.
2. Rahman, A.K.A. 1989. Freshwater Fishes of Bangladesh, Zoological Society of Bangladesh, Dhaka. 364 pp.
3. Tsai, C. and M. Y. Ali. 1997. Open water Fisheries of Bangladesh. Bangladesh Centre for Advanced studies. The University Press Limited, Dhaka. 212 pp.

References:

1. DOF. 1998. National Fisheries Policy. Department of Fisheries, Dhaka, Bangladesh.
2. DOF. 2008. Hilsa fisheries conservation, development and management techniques. 2nd Edition. Department of Fisheries, Dhaka, Bangladesh.
3. DOF. 2009. Fisheries Statistical Yearbook of Bangladesh 2007-2008. Volume 25, Number 1. Fisheries Resources Survey System, Department of Fisheries, Dhaka, Bangladesh.
4. DOF. 2010. Fish Acts and Regulations. Department of Fisheries, Dhaka, Bangladesh.
5. IUCN Bangladesh. 2003. BangladesherBipannoBonnoPrani, IUCN-The World Conservation Union. xiv+294 pp.
6. Khan, M. S., E. Haq,S. Haq, A. A. Rahman,S. M. A. Rashid and H. Ahmed. 1994. Wetlands of Bangladesh. Bangladesh Centre for Advanced Studies & Nature Conservation Movement. 91pp.
7. Owen, O.S. 1980. Natural Resources Conservation – An ecological Approach. Macmillan Publishing Co., Inc., New York, USA. 883 pp.
8. Rahman, A. K. A., S. M. H. Kabir, M. Ahmad, A. T. A. Ahmed, Z. U. Ahmed, Z. N. T. Begum, M. A. Hassan and M. Khondker. 2009 (eds.). Encyclopedia of Flora and Fauna of Bangladesh, Vol. 24. Marine Fishes. Asiatic Society of Bangladesh. 485 pp.
9. Siddiqui, K. U., M. A. Islam, S. M. H. Kabir, M. Ahmad, A. T. A. Ahmed, A. K. A. Rahman, E. U. Haque, Z. U. Ahmed, Z. N. T. Begum, M. A. Hassan, M. Khondker, and M. M. Rahman. 2007 (eds.) Encyclopedia of Flora and Fauna of Bangladesh, Vol. 23. Freshwater Fishes. Asiatic Society of Bangladesh, Dhaka 300 pp.
10. TARA. 2002. Fish Sanctuary. Progressive Book Corner, Dhaka, Bangladesh. 136 pp.

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B. Sc. Fisheries (Hons.)

Course Profile :

Course Code: MFS 1201 Course Title: Physical and Geological Oceanography

Credit: 2 Contact Hours: 32 Level: 1 Semester: 2

Course Offering Department (s) : Department of Marine Fisheries Science

Rationale:

The course is designed aiming to give the students an understanding of the various physical and geological aspects of the ocean including physical properties of sea water and history of marine geology.

Course Learning Outcomes:

CLO1. Understand the description, physical properties and process of the ocean.

CLO2. Describe different features of geological oceanography including formation of sea floor

CLO3. Critically analyze, present, and discuss scientific material.

CLO4. Apply concepts of oceanography as a marine scientist.

Mapping CLO with PLO:

	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8	PLO9	PLO10
CLO1	√									
CLO2	√			√						
CLO3	√	√					√		√	
CLO4	√		√		√	√		√		√

Course Contents:

	Course contents	Aligned CLO	No. of Lectures
1	Introduction to physical and geological oceanography: Definitions, historical review of oceanography; origin of ocean; current and future oceanographic research; geology of the ocean.	**CLO 1**	**2**
2	Physical properties of sea water (e.g., salinity, depth and pressure and heat budget.)	**CLO 1**	**2**
3	Distribution of temperature in ocean; Sound and light in sea water; Sea ice; Water, salt and flux; Ocean Wave; Astronomical tides; Ocean current; Ocean circulation; Dynamics of physical Oceanography.	**CLO 1, CLO 3, CLO 4**	**10**
4	Brief history of marine geology and geological time scale; Physiographic features of the Ocean and Ocean basins; Large scale features (e.g., ridge, trench, fracture zone, fault, sea mount, island arc, aseismic ridge, abyssal hill, guyot, abyssal plain and others); Features associated with continental margin (e.g., terrace, shelf, slope, rise, depressions and others); Near shore and other features (e.g., Reef, coral island, atoll, sedimentary formations and others); Earthquakes, volcanism and mountain building in the sea.	**CLO 2**	**13**
5	Topography and sediments of the Bay of Bengal floor; Deep sea deposits.	**CLO 2, CLO3, CLO 4**	**4**
6	Class test		**1**

Teaching strategy: Lectures, Field trip, Problem based learning, Interactive learning, Group studies and Discussion.
Assessment Strategy: MCQ Test, Written test, Oral test, Assignment and Presentation.

Learning Resources:

1. The Oceans, by HU Svedrup, MW Johnson and RH Flemming. Prentice-Hall, 1942.

2. General Oceanography: An Introduction (Second English Edition), by Dietrich, Kalle, Krauss and Siedler, John Wiley & Sons. 626pp. 1980.

3. Descriptive Physical Oceanography, 2nd Ed. by GL Pickard, GL. Pergamon Press. 214. 1975.

4. Introduction to Physical Oceanography, by RH Stewart. 342pp. 2002.

5. Principles of Physical Oceanography, by G Neuman, Prentice-Hall.

6. Elements of Physical Oceanography, by HJ McLellan, Pergamon Press. 151pp. 1968

7. Marine Geology, P. H. Kuenen.

8. Submarine Geology, P.P. Shepard.

9 Marine Geology, J. Kennat

10. Sea level, Land Levels and tide ganges, Emery and Aubrey.

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B. Sc. Fisheries (Hons.)

Course Profile :

Course Code: MFS 1202 Course Title: Physical and Geological Oceanography

Credit: 1 Contact Hours: 16 Level: 1 Semester: 2

Course Offering Department (s) : Department of Marine Fisheries Science

Rationale:

Physical and Geological Oceanography Practical course is designed to develop the field work, computation and measurement capability of the students. The purpose of this course is to provide experience in the data collection process using various instruments to measure the physical properties of seawater, calculate different parameters, and prepare and analyze graphs.

Course learning Outcomes:

CLO1. Develop fieldwork-based skill, various instrumentation techniques and observational methods.

CLO2. Prepare different types of maps, charts and analysis of the deep-sea sediment.

CLO3. Critically analyze, present, and discuss scientific material.

Mapping CLO with PLO:

	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8	PLO9	PLO10
CLO1	√		√		√					√
CLO2	√					√	√			
CLO3	√	√		√				√	√	

Course contents:

	Course contents	Aligned CLO	No. of Lectures
1	Acquaintance with basic oceanographic equipments		
2	Measurement of seawater properties: Salinity, Electrical Conductivity, Density, Wave, Tide, Transparency, Turbidity	**CLO1, CLO2, CLO3**	**2**
3	Calculation of various water properties from known parameters: Sound velocity, Pressure, Depth, Specific heat, Adiabatic lapse rate, Freezing point, Potential temperature, Potential density and Temperature of maximum density.	**CLO1, CLO2, CLO3**	**6**
4	Preparation of bathymetric charts and interpretation.	**CLO1, CLO2, CLO3**	**2**
5	Collection, separation and identification of heavy minerals.	**CLO1, CLO2, CLO3**	**2**
6	Simulated study of oceanic tides, waves and currents.	**CLO1, CLO2**	**1**
7	Preparation and interpretation of sediment maps and triangle coordinate diagram from analytical data.	**CLO1, CLO2, CLO3**	**2**
8	Class test		**1**

Teaching strategy: Lectures, Problem based learning, Interactive learning, Group studies and Discussion.
Assessment Strategy: MCQ Test, Written test, Oral test, Assignment, Presentation and Viva voce.

Learning Resources:

1. The Oceans, by HU Svedrup, MW Johnson and RH Flemming. Prentice-Hall, 1942.
2. General Oceanography: An Introduction (Second English Edition), by Dietrich, Kalle, Krauss and Siedler, John Wiley & Sons. 626pp. 1980.
3. Descriptive Physical Oceanography, 2nd Ed. by GL Pickard, GL. Pergamon Press. 214. 1975.
4. Introduction to Physical Oceanography, by RH Stewart. 342pp. 2002.
5. Principles of Physical Oceanography, by G Neuman, Prentice-Hall.
6. Elements of Physical Oceanography, by HJ McLellan, Pergamon Press. 151pp. 1968

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B. Sc. Fisheries (Hons.)

Course Profile :

Course Code: BMB 1205 **Course Title: Biochemistry**

Credit: 3 **Contact Hours: 48** **Level: 1** **Semester: 2**

Course offering department: Department of Biochemistry and Molecular Biology

Rationale:

The students need to have a proper knowledge on the physical, chemical and metabolic aspects of biomolecules for understanding physiological phenomena of fishes and fisheries, and their improvement.

Course Learning Outcomes (CLO):

1. Classify various biomolecules and discuss their metabolic fates.
2. Compare and contrast among various biomolecules and metabolic processeswith energetics.
3. Construct structural forms of unknown biomolecules and make relationship among the various metabolic processes.
4. Enrich knowledge of molecular biology and make skill to construct recombinant DNA and clones for development of new variety.

Mapping CLO with PLO

CLO/PLO	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8	PLO9	PLO10
CLO1	××	××								
CLO2	××	××	××							
CLO3	××	××	××				××			
CLO4	××	××	××		××		××			

Summary of Course Content

Sl No.	Content	Aligned CLO	No. of Lectures
1	*Introduction to Biochemistry:* Scope and importance. Cell organization and biological function of different organelles. Cell signaling and role of transporters. Concept of metabolism Water and aquatic life.	CLO1	2
2	*Chemistry and Metabolism of Carbohydrates:* Classification, biological function and structural features. Cell wall polysaccharides. Glycolysis. Fermentation. Shuttle system. TCA Cycle. Electron Transport Chain. Hexose Monophosphate Shunt and Gluconeogenesis.	CLO1, CLO2 & CLO3	9
3	*Chemistry and Metabolism of Proteins:* Classification and function of amino acids and proteins. Reactions in protein chemistry. Nutritive value of fish protein concentrate. Food protein quality evaluation. Chemistry of antifreezing active principle in polar aquatic animal. Organization levels. Denaturation. Basic processes of amino acid catabolism. Nitrogen excretory products in aquatic animals. Fixation of nitrogen by aquatic plants.	CLO1, CLO2 & CLO3	10
4	*Chemistry and Metabolism of Lipids:* Classification and biological functions. Fatty acids, their classification and distribution. Importance of polyunsaturated fatty acids. Chemistry of fish oil. Rancidity. Role of free radicals in lipid oxidation. Antioxidant. Lipoproteins. Fatty acid oxidation. Biosynthesis of fatty acids and cholesterol.	CLO1, CLO2&CLO3	12
5	*Chemistry and Metabolism of Nucleic acids:* Composition, structural features and physicochemical functions. Replication, transcription and translation. Biological function of restriction enzymes. Concept of recombinant DNA and cloning.	CLO1, CLO2, CLO3 & CLO4	6
6	*Enzymes:* Classification. Elements of kinetics. Mode of action and inhibition. Coenzyme and prosthetic groups. Allosteric enzyme. Lysozymes. Enzyme immobilization.	CLO1, CLO2 &CLO3	4
7	*Bioenergetics:* Concept of free energy, entropy and enthalpy. Exergonic and endergonic reactions. ADP-ATP cycle. Bioluminescence.	CLO2	3
	Hormones: Characteristics and classification. Mode of action and biological functions of pituitary, hypothalamus, adrenal cortex and sex hormones.	CLO1 &CLO2	2
Total No. of Lectures			48

Teaching Strategy

- Lecture
- Group discussion
- Exercise
- Assignment
- Video clip

Assessment Strategy

- Multiple Choice Question
- Short question
- Essay type question
- Assignment
- Gap filling

Books Recommended:

1. Lehninger Principles of Biochemistry by David L. Nelson, 2008. 5th edition. W. H. freeman and company. New York.
2. Elliot, W.H. and Elliot, D.C. 1997. Biochemistry and Molecular Biology.
3. Textbook of Biochemistry by Thomas M. Devlin, 2002. 5th edition. John Wiley and Sons, Inc. Printed in USA
4. Biochemistry by Donald Voet, 1995. 2nd edition, John Wiley and Sons, New York
5. Outlines of Biochemistry by Eric E. Conn and Paul K. Stumpf, 1987. 5th edition. John Wiley and Sons, New York
6. Biochemistry by Albert L Lehninger, 1982. 2nd edition Kalyani Publishers. Ludhiana, New Delhi.
7. Harper's Biochemistry by Robert K Murray, 2002. 25th edition. McGraw Hill. Printed in Singapore.
8. Biochemistry by Lubert Stryer, 1995. 4th edition. W. H. freeman and company. New York.
9. Watson, D. 1987. Molecular Biology of Gene. Bengamin, Inc.

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B. Sc. Fisheries (Hons.)

Course Profile :

Course Code: BMB 1206 **Course Title: Biochemistry**

Credit: 1 **Contact Hours: 16** **Level: 1** **Semester: 2**

Course offering department: Department of Biochemistry and Molecular Biology

Rationale:

This course will develop the practical skill on identification and quantification of various biomolecules of animals for their improvement.

Course Learning Outcomes (CLO):

1. Prepare various types of biochemical solutions.
2. Determine the pH of a solution.
3. Identify unknown biomolecules in animal specimens.
4. Characterize animal fats.
5. Quantify various unknown biomolecules in animal samples.
6. Assess the potentiality of enzyme action to select substrate.

Mapping CLO with PLO

CLO/PLO	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8	PLO9	PLO10
CLO1		××		××						
CLO2		××		××						
CLO3		××		××			××			
CLO4		××		××			××			
CLO5		××		××			××			
CLO6		××		××			××			

Summary of Course Content

Sl No.	Content	Aligned CLO	No. of Lectures
1	Preparation of solutions and their standardization	CLO1	1
2	Qualitative analysis of carbohydrates and proteins	CLO3	3
3	Determination of isoelectric pH of proteins	CLO2	1
4	Quantification of proteins: Kjeldahl and biuret method	CLO3& CLO5	2
5	Qualitative evaluation of fish oils: saponification value, acid value and iodine value	CLO4	2
6	Assay of enzyme action on polysaccharide	CLO6	1
7	DNA isolation and characterization	CLO3	1
8	Proximate analysis of fish and fishery products	CLO5	1
Total No. of Lectures			12

Teaching Strategy

- Lecture
- Group discussion
- Demonstration
- Assignment
- Practice

Assessment Strategy

- Multiple Choice Question
- Short question
- Assignment
- Gap filling
- Viva-Voce

Books Recommended:

1. David Glick, 1995. Methods of Biochemical Analysis. Interscience Publishers, Inc. N.Y.
2. Litwack, G. 1960. Experimental Biochemistry. John Wiley and Sons. Inc. N.York.
3. Malhotra, V.K. 1968. Practical Biochemistry for students. Lypee brothers, N.Y.
4. Plummer, D.T. 1995. An Introduction to Practical Biochemistry. Tata Mcgraw-Hill. Delhi.
5. Segel, I.H. 1968. Biochemical Calculations. John Wiley and Sons. New York.

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B. Sc. Fisheries (Hons.)

Course Profile :

Course Code: FBG 1223 **Course Title: Biology of Farmed Fish and Shellfish**

Credit: 2 **Contact Hours: 32** **Level: 1** **Semester: 2**

Course Offering Department (s) :Department of Fisheries Biology and Genetics

Rationale:
In order to develop their carrier and research in fisheries science student will knowledgeable with thelife history of important farmed fishes and shellfishes. Upon successful completion of the course, the students will be able to understand the biology of important farmed fishes and shellfishes in relation to their culture and management.

Course learning Outcomes:

CLO1. Delinate asic biological aspects in the selection of species for farming, cultivable fishes and shellfishes

CLO2. Illustrate life history of important groups of farmed fishes and shellfishes having commercial importance.

CLO3. Describe behavioural manipulation of farmed fishes for domestication.

CLO4. Explain stress response and recent development of farmed fishin the field of biology.

Mapping CLO with PLO:

	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8	PLO9	PLO10
CLO1	√								√	√
CLO2		√		√				√	√	√
CLO3		√	√	√		√	√	√	√	√
CLO4	√	√	√	√	√	√	√	√	√	√

Course Contents:

Course contents	Aligned CLO	No. of Lectures
1. Introduction: Basic biological considerations in the selection of species for farming, cultivable fishes and shellfishes.	CLO1	**2**
2. Life history of important groups of farmed fishes and shellfishes with special references to food and feeding habits, digestion, growth, reproduction, embryonic and larval developments: **Fishes**-cyprinids, cichlids, catfishes, climbing perch, snakeheadsand, exotic fishes; **Shellfishes**-freshwater giant prawn, marine shrimp, mud crab, octopus and oyster.	CLO2	**13**

3. Behavioural manipulation of farmed fishes for domestication: Environmental control through Pond/Cage/Tank/Pen design, photoperiod, dominance regulation and suppression of aggressive behaviour, maturation control, cannibalism and its control.	CLO3	**6**
4. Stress response in farmed fish: Role of hormones in stress tolerance, impact of stress on performance, defense system, behaviour, growth, reproduction, and product quality.	CLO4	**6**
5. Recent developments in the field of biology of farmed fishes.	CLO5	**4**
6. Class Test Examination	**-**	**1**

Teaching strategy: Lectures, Problem based learning, Interactive learning, Group studies and Discussion.

Assessment Strategy: MCQ Test, Written test, Oral test, Assignment and Presentation.

Learning resources:

1. Black, K. D. and A. D. Pickering. 1998 (eds.) Biology of Farmed Fishes**.** Sheffield Academic Press, England. 415 pp.
2. Chakrabarty, N. M. 1998. Biology, Culture and Production of Indian Major Carps- A Review. Narendra Publishing House, Delhi, India. 175 pp.
3. Kosinski, R. J. 1999. Fish Farm: A Simulation of Commercial Aquaculture. Benjamin-Cummings Publishing Company. 98 pp.
4. Billard, R. 1999. Carp: Biology and Culture. Springer (in association with Praxis Publishing, UK). 342 pp.
5. Chakrabarty, N. M., P. P. Chakraborty and S. C. Mondal. 2010. Biology Breeding and Farming of Important Food Fishes. Narendra Publishing House. 98 pp
6. Green, J. 1961. A Biology of Crustacea. Quadrangle Books Inc. 180 pp.
7. Jordan, E. L. and P. S. Verma. 1985. Invertebrate Zoology. S. Chand & Company, Ramnagar, New Delhi.
8. Kotpal, R. L. 1997. Phylum Mollusca. Rastogi Publication, Shivaji.Rd. Meerut. India.
9. Nash, C. E. and A. J. Novotny. 1995 (eds.). Production of Aquatic Animals. Fishes. Elsevier, Amstetdam, The Netherlands.
10. Nash, C. E. 1991. Production of Aquatic Animals: Crustaceans, Molluscs, Amphibians and Reptiles. Elsevier. 244 pp.
11. Pillay, T. V. R. and M. N. Kutty. 2005. Aquaculture: Principle and Practice. Wiley-Blackwell. 640 pp.
12. Rath, R. K. 1993. Freshwater Aquaculture. Scientific publishers. 493 pp.

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B. Sc. Fisheries (Hons.)

Course Profile:

Course Code: AQ 1203 **Course Title: Industrial Aquaculture and Certification**

Credit: 2 **Contact Hours: 32** **Level: 1** **Semester: 2**

Course offering department(s): Department of Aquaculture

Rationale:

Aquaculture industry has already been proved to be enterprise whereby along with fish production and financial benefits, a large number of people became entrepreneurs who employed thousands of people. Having this curse, students will learn how to develop aquaculture industry with a business plan that ultimately will make them able to self-employed and to employ other unemployed people.

Course Learning Outcomes (CLO):

CLO 1:	Describe growth of aquaculture industry and enterprises
CLO 2:	Describe industrial aquaculture systems and their operational procedures applicable in the context of Bangladesh
CLO 3:	Planning business of aquaculture industry and financing
CLO 4:	Describe industrial aquaculture certifications for international trade

Mapping CLO with PLO

CLO/PLO	PLO 1	PLO 2	PLO 3	PLO 4	PLO 5	PLO 6	PLO 7	PLO 8	PLO 9	PLO 10
CLO 1	✓	✓			✓					
CLO 2	✓	✓	✓	✓	✓	✓		✓		
CLO 3		✓	✓	✓	✓			✓	✓	✓
CLO 4	✓	✓	✓				✓		✓	

Summary of Course Content

Content	Aligned CLO	No. of lectures
1. **An introduction to aquaculture industry:** Concept of aqua-entrepreneurship and industry; small and medium enterprise (SME), public-private partnership (PPP) in industry development, organizational structures, and micro-economic impacts of aquaculture industry in Bangladesh.	CLO1	4
2. **Industrial aquaculture systems and operation:** Recirculatory Aquaculture System (RAS), Raceway System, Aquaponics, Integrated Multi-Trophic aquaculture (IMTA), Integrated Floating Cage Aaquageoponics System (IFCAS), and their operation (the mass balance approach, estimating water flow rates, estimating flows for dissolved oxygen maintenance, estimating flows for ammonia-nitrogen control, estimating flow rates for nitrate-nitrogen control, estimating system carrying capacity, and use of nanotechnology in feeding and disease treatment)	CLO2	15
3. Business planning and financing: The business planning process, using the plan to obtain finance, bankers and other financial institutions' perspective, banking relationships, venture capital institutions and business agents, and marketing of aquaculture produces	CLO3	6
4. **Aquaculture certification and standards:** Concept of aquaculture certification and standards, importance of growing aquaculture certifications for industrial aquaculture, certification for domestic fish consumption and export, adoption of aquaculture certification, etc.	CLO4	6
Class Test		1
Total		**32**

Teaching Strategy:

Lecture, Multi-media, video clipping, group discussion, Demonstration.

Assessment Strategy:

Written exam, quiz, viva-voce, Field trip, assignment.

Recommended books and other resources:

Textbook

1. Nelson R., Nelson and Pade. 2008. Aquaponic Food Production, Raising fish and plants for food and profit. Inc., ISBN: 978-0-9779696-1-6.
2. S. Bernstein. 2011. Aquaponic Gardening: A Step-By-Step Guide to Raising Vegetables and Fish Together. ISBN: 978-0-86571-701-5.
3. Dr. Yoram Avnimelech *et al*., 2009. Biofloc Technology-A practical Guide Book, 3rd Edition. Published by World Aquaculture Society, 258 Pp, ISBN: 978-188880-7226.
4. Burns, P. 2007. Entrepreneurship and Small Business, Second Edition, Palgrave Macmillan, UK, pp. 537.
5. Engle, C. R. and K. Quagrainie. 2006. Aquaculture Marketing Handbook, Blackwell Publishing.
6. Palfreman A. 1999. Fish Business Management: Strategy, Marketing and Development. Blackwell Publishing.
7. Michael B. Timmons, Todd Guerdat and Rain J. Vinci. 2018. Recirculating Aquaculture. Ithaca Publishing Company LLC; 4th edition. Language: English, ISBN-10: 0971264678
8. Murty, B.S., Shankar, P., Raj, B., Rath, B.B. and Murday, J. 2013.Textbook of Nanoscience and Nanotechnology, ISBN 978-3-642-28030-6.2013.
9. Gary Cooper,. 2014. The Ultimate Guide to Home Aquaponics System: How to build your own aquaponic system in less than a week- like the pros.

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B. Sc. Fisheries (Hons.)

Course Profile :

Course Code: FM 1203 **Course Title: Management of Aquatic Plants**

Credit: 2 **Contact hours: 32** **Level: 1** **Semester: 2**

Course Offering Department (s) :Department of Fisheries Management

Rationale: To become successful fisheries professionals, students should know the salient features of the basic taxonomy of commonly available aquatic plants in Bangladesh, their habitats, control and management of aquatic plants in both natural and man-made ecosystems.

Course Learning Outcomes (CLO)

1. Define the aquatic vascular plants and enlist them
2. Describe the biology and ecology of aquatic vascular plants collected from marshes (freshwater and salt water), riparian and estuarine ecosystems
3. Explain the importance of aquatic plants on developing constructed wetlands, habitat restoration, aquaculture, agricultural/human uses
4. Identify the impacts of invasive aquatic plants on fish and other aquatic animals
5. Discuss the control and management of different aquatic plants

Mapping CLO with PLO

	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8	PLO9	PLO10
CLO1	√									
CLO2	√									
CLO3	√	√			√	√	√			
CLO4		√				√				
COL5	√	√				√	√			

Course Contents:

Course contents	Aligned CLO	No. of Lectures
1. An introduction to aquatic plants of Bangladesh.	**CLO 1**	**3**
2. Biology and ecology of aquatic vascular plants from freshwater marsh and riparian ecosystems.	**CLO 1**	**6**
3. Biology and ecology of aquatic vascular plants from salt marshes and estuarine ecosystems.	**CLO 1**	**5**
4. Use of aquatic plants in developing constructed wetlands; use of aquatic plants for habitat restoration, aquaculture and other agricultural/human uses. 5. Long-term and short-term management of aquatic plants including harmful algae; mechanical, biological and chemical control of aquatic plants.	**CLO 2**	**5** **4**
6. Invasive aquatic plants, their utilization and management.	**CLO 2**	**4**
7. Impacts of aquatic invasive plants on fish and other aquatic animals.	**CLO 4**	**3**
8. Field trips to a local riparian zones and/or a constructed wetland.		**2**

Teaching strategy: Lectures, Problem based learning, Interactive learning, Group studies and Discussion, Field Trip

Assessment Strategy: MCQ Test, Written test, Oral test, Assignment and Presentation

Text books:

1. Caffrey, J., Barrett, P.R.F., Ferreira, M.T., Moreira, I.S., Murphy, K. and P.M. Wade (Eds.). 1999. Biology, Ecology and Management of Aquatic Plants, Springer Science, The Netherlands.
2. Mitsch, W.J. and J.G. Gosselink JG. 2015. Wetlands. 5th ed. Hoboken, NJ:John Wiley & Sons, Inc.
3. Riemer, D.N. 1993. Introduction to Freshwater Vegetation. Krieger Publishing Company, Melbourne, Florida, USA.

References:

1. Alam, A.B.M.S., Chowdhury, M.S.M. and Sobhan, I. 2012. Biodiversity ofTanguar Haor: A Ramsar Site of Bangladesh Volume I: Wildlife, IUCN Bangladesh, Dhaka,Bangladesh, Pp. xi+234
2. Gettys, L.A., Haller, W.T., and D.G.Petty (Eds.) 2008. Biology and Control of Aquatic Plants: A Best Management Practices Handbook, 3rd Edition. Aquatic Ecosystem Restoration, Georgia, USA.
3. Hossain, M. 2015. Handbook of selected plant and species of the Sundarbans and the embankment ecosystem. Sustainable Development and Biodiversity Conservation in Coastal Protection Forests, Bangladesh (SDBC-Sundarbans) Project implemented by GIZ GmbH on behalf of the German Federal Ministry for Economic Cooperation and Development (BMZ), Dhaka, 116 pp.
4. Little, E.C.S. 1979. Handbook of utilization of aquatic plants. FAO Fish. Tech. Pap., (187): 176 p.
5. Roy, A.B., D. Roychaudhury and Ray L. 2014. Common Mangroves of Sundarbans. Sundarban Biosphere Reserve, West Bengal, Kolkata, India.
6. Uddin, S.A. 2019. Seaweeds of Bangladesh. Institute of Marine Science, University of Chittagong, Bangladesh.

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B. Sc. Fisheries (Hons.)

Course profile :

Course Code: FT 1201 Course Title: Handling and Preservation of Fish and Shellfish

Credit: 2.0 Contact Hours: 32 Level: 1 Semester: 2

Course offering department (s) : Department of Fisheries Technology

Rationale:

Familiarize students with different aspects of proper handling and preservation of fish and shellfish to retain the quality and nutritional attributes, and increase the shelf life of inland and marine fishes.

Course Learning Outcomes (CLOs)

1. Explain the principles of adequate handling and preservation of fish and shellfish for better quality and shelf life.
2. Discuss onboard and onshore handling practices and techniques of fish and shellfish preservation.
3. Develop good handling practices and improved preservation methods of fish and shellfish.

Mapping CLO with PLO

CLO/PLO	PLO 1	PLO 2	PLO 3	PLO 4	PLO 5	PLO 6	PLO 7	PLO 8	PLO 9	PLO 10
CLO 1	✓			✓						
CLO 2		✓			✓					
CLO 3		✓			✓	✓				✓

Course Content	Aligned CLO(s)	No of Lectures
1. **Introduction:** Fish as food, physical structure of fish, spoilage of fish and delaying spoilage.	CLO 1 & CLO 2	6
2. **Fundamentals of commercial handling of fish and shellfish:** Good handling practices of fish onboard, onshore and in plant. Good handling during transportation for domestic consumption and export.	CLO 2 & CLO 3	6
3. **Wet fish preparation premises:** Layout and design, equipment, sanitation and cleaning.	CLO 1, CLO 2 & CLO 3	4
4. **Washing and grading:** Importance and methods of washing, sorting and grading, quality maintenance during sorting and grading	CLO 2 &CLO 3	3
5. **Live fish handling and transportation:** Factors and principles, types and methods, treatment of fish (food fish, experimental fish, brood fish, aquarium fish and fry), container for live fish, water recharge and constraints of live fish transportation.	CLO 1 & CLO 2	5
6. **Preservation of fish:** General principles and methods of fish preservation, chilling, by icing, RSW, CSW, distribution of chilled fish, preservation by freezing, glazing and stowage, irradiation of fish	CLO 1, CLO 2 & CLO 3	7
Class test		1
Total		32

Teaching Strategy

Class lectures, problem based learning, interactive learning, group discussion, web based learning

Assessment Strategy

Strategic questioning, MCQ test, written test, oral test, assignment, presentation

Books Recommended:

1. Bogstrom, G. 1965 (ed.). Fish as Food. Vol. I-IV, Academic press, London. Vol. I 725 pp. Vol. II 777 pp. Vol. III 489 pp. and Vol. IV 581 pp.
2. Clucas, I. J. and A. R. Ward. 1996. Post-harvest Fisheries Development: A Guide to Handling, Preservation, Processing and Quality. Natural Resource Institute, UK. 443 pp.
3. Nowsad, A. K. M. A. 2005. Handling and Preparation of Wet Fish for Marketing (In Bengali). BGD/97/017 Field Doc. 2/2005 FAO, Bangladesh. 44 pp.
4. Sikorski, Z. E. 1990 (ed.). Seafood: Resources, Nutritional Composition and Preservation. CRC Press, Canada. 230 pp.

References:

1. Berka, R. 1986. The transport of live fish. A review. European Inland Fisheries Advisory Commission Technical Paper (48):52 pp.
2. Balachandran, K. K. 2001. Post-harvest Technology of Fish and Fish Products. Daya Publishing House, Delhi – 110035. India. 440 pp.
3. Donald, K. T., W. B. Van Arsdel and M. J. Copley. 1968 (ed.). The Freezing Preservation of Foods. 4th Edition. The Avi Publishing Company, Westport, Conn.
4. FAO Fisheries Reports. 1975. Ice in Fisheries. Food and Agriculture Organization of the United Nations, No. 59.
5. Hall, G. M. 1997 (ed.). Fish Processing Technology. 2nd Edition. Blackie Academic & Professional, London, Weinheim, New York, Melbourne, Madras. 309 pp.
6. Madakia, H. 1985. Fish Handling. ASEAN-CIDA-SEAFDEC Regional Training Course in Fish Handling and Processing, Samutprakarn: 6-30 March 1985.
7. Nowsad, A. K. M. A. 2007. Participatory Training of Trainers: A New Approach Applied in Fish Processing. Bangladesh Fisheries Research Forum. Bangladesh. 326 pp.
8. Stansby, M.E. 1963. Industrial Fishery Technology. Krieger Publ. Co., Hunligton, New York.
9. Wiryanti, J. and H. Madakia. 1997 (eds.). Improved Quality Control for the Handling and Processing of Fresh and Frozen Tuna at sea and on shore. ASEAN-CANADA Fisheries Post-harvest Technology Project-Phase II.

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B. Sc. Fisheries (Hons.)

Course Profile :

Course Code: MFS 1203 **Course Title: Marine Literacy: The Bay of Bengal**

Credit: 2 **Contact Hours: 32** **Level: 1** **Semester: 2**

Course Offering Department (s) : Department of Marine Fisheries Science

Rationale:

This course is aimed to gather knowledge about physical, chemical, biological, geological oceanography of the Bay of Bengal (BoB). This course is designed to provide learning on resources, and trades of BoB.

Course Learning Outcomes:

CLO1. Understand the seasons and natural calamities in BoB**.**

CLO2. Familiar about the physical, chemical, biological, geological oceanography of BoB.

CLO3. Communicate and facilitate the need to work in a coordinated and integrated manner to address BoB issues.

Mapping CLO with PLO:

	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8	PLO9	PLO10
CLO1	√		√		√					√
CLO2	√					√	√			
CLO3	√	√		√				√	√	

Course Contents:

Sl. No.	Course contents	Aligned CLO	No. of Lectures
1	History of study of the ocean with special reference to BoB.	**CLO1, CLO2**	**4**
2	Introduction to the Bay of Bengal: geographical location, area coverage, Exclusive Economic Zone and its negotiation.	**CLO1, CLO2**	**6**
3	Unique features of the Bay of Bengal: Physical, chemical, geological, biological and climate conditions, Hydrological dynamics.	**CLO1, CLO2**	**12**
4	Acquaintance with the resources of the Bay of Bengal, economic and social values.	**CLO1, CLO2**	**3**
5	Oceanographic features of Islands in the Bay of Bengal: St. Martins, Sonadia and Nijhum Dwip.	**CLO1, CLO2**	**5**
6	Limitations of the Bay of Bengal resource utilization.	**CLO1, CLO2**	**1**
7	Class test	**CLO3**	**1**

Teaching strategy: Lectures, Problem based learning, Interactive learning, Group studies and Discussion.

Assessment Strategy: MCQ Test, Written test, Oral test, Assignment and Presentation.

Recommended Books:

1. Regional Oceanography by M. Tomszack

2. Marine Geology by Erickson and Timothy

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B. Sc. Fisheries (Hons.)

Course Profile :

Course Code: FBG 2121 **Course Title: Fish Systematics and Taxonomy**

Credit: 2 **Contact Hours: 32** **Level: 2** **Semester: 1**

Course Offering Department (s) :Department of Fisheries Biology and Genetics

Rationale:

The aim of this course is to provide students with a basic understanding the systematics and taxonomy concepts of different conventional and newer aspects in biosystematics, classification of fish and the relationships between different organisms.

Course Learning Outcomes (CLO):

CLO1. Describe systematics and taxonomy to compute classification, identification and make relationships among species.

CLO2. Identify the defining characteristics and history of relationships of the major fish groups.

CLO3. Differentiate, compare, identify and name representatives of those groups from elsewhere.

CLO4. Summarize life history and ecological characteristics of fishes covered in lectures.

Mapping CLO with PLO:

	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8	PLO9	PLO10
CLO1	√	√	√	√	√	√	√	√	√	√
CLO2	√	√	√	√			√		√	√
CLO3	√	√	√	√	√		√	√	√	√
CLO4	√	√	√	√	√	√	√	√	√	√

Course Contents:

Course contents	Aligned CLO	No. of Lectures
1. Suitability of fishes to systematic studies, Historical background, Tasks of the systematist, its scope and relations with other branches of biology.	**CLO 1**	**5**
2. Fish taxonomy: General taxonomy of fishes, importance of taxonomy, problems of taxonomists, aims and tasks of a taxonomist, taxonomic keys.	**CLO 1**	**5**
3. Zoological nomenclature: History, ICZN and Rules of nomenclature.	**CLO 1**	4
4. Speciation: Concept of species and implications; Speciation types: Mechanism of genetic differentiation; Allopatric speciation sympatric speciation, Phyletic speciation; Species selection: Process of species selection, Example of species selection; Speciation through Geological time scale.	**CLO 1**	**7**
5. Zoogeography of Fishes: Clues to geographical history of fishes, geography of freshwater and marine fishes, continental patterns.	**CLO 1**	**4**
6. List of common and representative Families of living fishes with special reference to those of Bangladesh. - Classification of commercially important crustaceans and mollusks.	**CLO 1, CLO 2, CLO 3, CLO 4**	**6**
7. Class test	-	**1**

Teaching strategy: Lectures, Problem based learning, Interactive learning, Group studies and Discussion.

Assessment Strategy: MCQ Test, Written test, Oral test, Assignment and Presentation.

Learning Resources:

1. Gaston, K. J. and J. I. Spicer. 1998. Biodiversity - An Introduction. Wiley-Blackwell. 133 pp.
2. Helfman, G. E., B. B. Collette, D. E. Facey and B. W. Bowen. 2009. The Diversity of Fishes. Wiley-Blackwell.736 pp.
3. Mayr, E. and P. D. Ashlock. 1991. Principles of Systematic Zoology. McGraw Hill College. 416 pp.
4. Patro, L. R. 2010. Aquatic Biodiversity, Discovery Publishing House Pvt. Ltd. 216 pp.
5. Day, F. 1971. The Fishes of India. Today and Tomorrows Book Agency, New Delhi.
6. Hickman, L.,S. Roberts and A. Larson. 2002. Animal Diversity, McGraw-Hill Science/Engineering/ Math; 3rd edition.4 64 pp.
7. IUCN. 1996. The Multiple Dimension of Biodiversity. The World Conservation Union, Gland, Switzerland.
8. Kapoor, D., R. Dayal and A. G. Ponniah. 2002. Fish Biodiversity in India. NBFGR.
9. Mayr, E. 1963. Animal Species and Evolution. Belknap Press. 811 pp.

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B. Sc. Fisheries (Hons.)

Course Profile :

Course Code: FBG 2122 **Course Title: Fish Systematics and Taxonomy**

Credit: 1 **Contact Hours: 16** **Level: 2** **Semester: 1**

Course Offering Department (s) :Department of Fisheries Biology and Genetics

Rationale:

In the laboratory, students will gain hands-on experience with fish taxconomy core concepts such as methods of identification and morphometric and meristic analysis of fishes. Students will conduct activities and experiments in a laboratory setting where they will apply the scientific method for invention.

Course Learning Outcomes (CLO):

CLO 1: Techniques of identification of fishes and some important aquatic fauna of Bangladesh.

CLO 2: Morphometric and meristic analysis of fishes.

CLO 3: A brief report of the local fauna, their abundance, occurrence and ecological conditions.

CLO 4: Apply taxonomical concepts in laboratory and field.

Mapping CLO with PLO:

	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8	PLO9	PLO10
CLO1	√							√		√
CLO2	√									√
CLO3	√					√				√
CLO4	√	√	√	√	√	√	√	√	√	√

Course contents:

Course contents	Aligned CLO	No. of Lectures
1. Collection and preservation of aquatic animals	**CLO 1**	**1**
2.Characterization and identification of collected specimens.	**CLO 1**	**2**
3. Study of basic fish taxonomy and keys of major group of fishes and some important aquatic fauna	**CLO 2, CLO 3, CLO 4**	**2**
4. Study of morphometric and meristic characters of fishes.	**CLO 2, CLO 3, CLO 4**	**6**
5. Class test		**1**

Teaching strategy: Lectures, Problem based learning, Interactive learning, Group studies and Discussion.

Assessment Strategy: MCQ Test, Written test, Oral test, Assignment, Presentation and Viva voce.

Learning Resources:

1. Kapoor, VC 1994. Theory & practice of animal taxonomy. Oxford & IBH Publishing Co. PVT. Ltd. New Delhi.
2. Mayer, E 1969. Principles of Systematic Zoology. McGraw Hill Book Co., New York.
3. Rahman, A. K. A. 1989. Freshwater Fishes of Bangladesh. The Zoological Society of Bangladesh. Dhaka 1000.
4. Shafi, M. and M. M. A. Kuddus. 1982. Bangladesher Matsya Sampad (Bangla) Bangla Academy, Dhaka.
5. Talwar, P. K. and A. G. Jhingran. 1991. Inland Fishes of India and Adjacent Countries. Vol. I and II. Oxford & IBH Publishing Co., Calcutta. 1158 pp.

Bangladesh Agricultural University
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B. Sc. Fisheries (Hons.)

Course Profile :

Course Code: **AQ 2121** **Course Title:** **Coastal Aquaculture and Mariculture**

Credit: 2 **Contact Hours: 32** **Level: 2** **Semester: 1**

Course offering department(s): **Department of Aquaculture**

Rationale:

For proper utilization of coastal and marine water resources through aquaculture, fisheries graduates ought to have knowledge on different culture techniques to ensure safe and sustainable production of brackish and marine fish and shellfish species at commercial level.

Course Learning Outcomes (CLO):

CLO 1: Justify the importance of coastal and marine resources for aquaculture

CLO 2: Identify suitable sites for coastal and marine aquaculture considering physico-chemical and environmental parameters

CLO 3: Characterize culture techniques of different commercial brackish and marine fish and shellfish species

CLO 4: Design seaweed farming with available local species

CLO 5: Explain mangrove ecosystem and its impact on aquaculture

Mapping CLO with PLO

CLO/ PLO	PLO 1	PLO 2	PLO 3	PLO 4	PLO 5	PLO 6	PLO 7	PLO 8	PLO 9	PLO 10
CLO 1	✓	✓								
CLO 2	✓	✓			✓	✓				✓
CLO 3	✓	✓	✓			✓		✓		✓
CLO 4	✓	✓	✓	✓		✓		✓		✓
CLO 5	✓	✓			✓		✓		✓	

Summary of Course Content

Content	Aligned CLO	No. of lectures
Introduction: Definition, history and present status, global and national importance of coastal aquaculture and mariculture.	CLO 1	2
Site selection: General consideration, Physico-chemical properties of soil and water.	CLO 2	2
Culture of finfish: Acquaintance of coastal and marine fishes, breeding behavior, larval rearing and culture techniques of Seabass (*Lates calcarifer*), milkfish, mullets, seabream, tuna, salmon.	CLO 3	10
Culture of Shellfish: Breeding behavior, larval rearing and culture techniques of Crabs, shrimp and prawn, oysters, mussels, lobsters.	CLO 3	8
Culture of seaweeds: Types, importance, prospects, present status, culture techniques.	CLO 4	6
Mangrove forest and aquaculture: Mangrove ecosystem, energy flow in mangrove swamps, detritus formation, acid sulphate soil, impact of deforestation and management of mangroves for sustainable aquaculture and fisheries.	CLO 5	3
Class Test		1
Total		32

Teaching Strategy:

Lecture, chalk and talk, multi-media, video clipping, demonstration.

Assessment Strategy:

Tutorials (written examination), quiz, assignment, class response.

Recommended books and other resources:

Text books and references:

1. Bardach, J. E. J. H. Ryther, and Mclarney, W. O. 1972. Aquaculture. John willey & Sone. Inc. New York.
2. Imai, T. 1977. Aquaculture in shallow seas: Progress in shallow sea culture. Oxford. IBH Publishing Co. New Delhi, Bombay, Calcutta. 615 pp.
3. Anonymous. 1985. Shrimp culture in the semisaline zone of the Delta. Final Report, Technical Report No. 13, Vol. 1. Aruhem. The Hague 60 pp.
4. Islam, A. 1988. Samudra Upakula Matsya Chash. Bangla Academy, Dhaka. 115 pp.
5. Kurian C. V. and V. O. Sehastian 1978. Prawn and Prawn Fisheries of India, Hindustan Publishing Corporation, Delhi.

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B. Sc. Fisheries (Hons.)

Course Profile :

Course Code: **AQ 2122** **Course Title:** **Coastal Aquaculture and Mariculture**

Credit: **1** **Contact Hours:** **16** **Level:** **2** **Semester:** **1**

Course offering department(s): **Department of Aquaculture**

Rationale:

In order to apply knowledge of aquafarming for enhancing coastal and marine water fish production in a sustainable and environmentally friendly manner, students will need to acquire practical knowledge and skills on planning and operating farming using different farming components at the on-station and on-farm levels.

Course Learning Outcomes (CLO):

CLO 1: Design of a coastal shrimp and fish farm

CLO 2: Plan collection, transportation and nursing of larvae and PL of shrimp

CLO 3: Demonstration of culture techniques for shrimp, oysters, mussels and clams.

CLO 4: Characterize culture of algae and rotifer in laboratory condition.

CLO 5: Choose decapsulation and hatching procedures of Artemia in laboratory condition.

Mapping CLO with PLO

CLO/ PLO	PLO 1	PLO 2	PLO 3	PLO 4	PLO 5	PLO 6	PLO 7	PLO 8	PLO 9	PLO 10
CLO 1	✓	✓					✓			✓
CLO 2	✓	✓			✓					
CLO 3	✓	✓		✓	✓					
CLO 4		✓				✓		✓		
CLO 5		✓	✓	✓				✓	✓	✓

Summary of Course Content

Content	Aligned CLO	No. of lectures
Designing of a coastal shrimp and fish farm.	CLO 1	4
Collection and transportation and nursing of larvae and PL of shrimp	CLO 2	4
Demonstration of culture techniques for shrimp, oysters, mussels and clams.	CLO 3	3
Culture of algae and rotifer in laboratory condition	CLO 4	2
Decapsulation and hatching of Artemia in laboratory condition.	CLO 5	2
Class Test		1
Total		16

Teaching Strategy:

Lectures, Problem based learning, Q/A session, Group studies and Discussion.

Assessment Strategy:

MCQ Test, Written test, Quiz, Oral test, Assignment and Presentation, Field trip.

Recommended books and other resources:

Text books and references:

1. Bardach, J. E. J. H. Ryther, and Mclarney, W. O. 1972. Aquaculture. John willey & Sone. Inc. New York.

2. Imai, T. 1977. Aquaculture in shallow seas: Progress in shallow sea culture. Oxford. IBH Publishing Co. New Delhi, Bombay, Calcutta. 615 pp.

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B. Sc. Fisheries (Hons.)

Course Profile :

Course Code: FM 2121 **Course Title: Physico-Chemical Limnology**

Credit: 2.0 **Contact hours: 32** **Level: 2** **Semester: 1**

Course Offering Department (s) :Department of Fisheries Management

Rationale: To become successful fisheries professionals, students should know the salient features of the inland lentic and lotic habitats, their origin and the different physical, chemical and biological parameters of water those govern the biological productivity of these water bodies.

Course Learning Outcomes (CLO)

1. Define the different types of inland water bodies and characterize their origin.
2. Classify the various kind of physical and chemical parameters of inland waterbodies and explain their importance on aquatic ecosystems
3. Explain the water cycle, distribution of water and physical and chemical properties of water
4. Illustrate the biogeochemical cycle of different macro- and micro-nutrients

Mapping CLO with PLO

	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8	PLO9	PLO10
CLO1	√							√		
CLO2	√	√		√		√		√		
CLO3	√	√						√		
CLO4	√	√				√		√		

Course Contents:

Course contents	Aligned CLO	No. of Lectures
1. Limnology: Definition and objectives, history, introduction to inland waters, origin of lakes, ponds and reservoirs, lakes of Bangladesh and the world, swamps and marshes.	**CLO 1**	**6**
2. Rivers: Definition, significance, types, origin, sources of water, rivers of Bangladesh and the world.	**CLO 1**	**5**
3. Estuaries: definition, types and description. Estuaries of Bangladesh.	**CLO 1**	**3**
4. Water: Water distribution, water cycle, physico-chemical characteristics of water and their limnological significance.	**CLO 3**	**4**
5. Physical parameters of inland waters: Form of basin, water movement, light, transparency and turbidity, temperature, thermal classification of lakes, heat budget of lake.	**CLO 2**	**5**
6. Chemical parameters of inland waters: Dissolved gases- oxygen, carbon dioxide, and other gases, dissolved solids- nitrogen, phosphorus, calcium, magnesium, sodium, potassium, iron, silicon etc. and trace nutrients, total alkalinity and total hardness, pH and its effects on aquatic organisms.	**CLO 2**	**5**
7. Biogeochemical cycles: Definition, biogeochemical cycles of nitrogen, phosphorus, calcium, carbon, silicon, sulfur, iron etc.	**CLO 4**	**4**

Teaching strategy: Lectures, Problem based learning, Interactive learning, Group studies and Discussion.

Assessment Strategy: MCQ Test, Written test, Oral test, Assignment and Presentation.

Text books:

1. Rahman, M.S. 1992. Water quality management in aquaculture. BRAC Prokashana. Dhaka-1212.
2. Reid G.K. and Wood. 1976. Ecology of Inland waters and Estuaries. Reinhold Publishing Co., New York.
3. Welch, P.S. 1952. Limnology. McGraw-Hill Book Co. New York.

References:

1. Boyd, C.E. 1979. Water Quality in Warmwater Fish Ponds. Auburn University, Alabama.
2. Coker, R.E.1954.StreamsLakes Ponds. Chapel Hill, The University of North Carolina Press.
3. Cole, G.A. 1979.Textbook of Limnology.2nd Edition. The C.V.Mosby Company St. LouisMissouri63141.
4. Goldman, C.R. and A.J. Horne. 1983. Limnology. McGraw-Hill Book Company, New York.
5. Jorgensen, S.E. 1980. LakeManagement. Pergamon Press Ltd., Oxford.
6. Kalff, J. 2002. Limnology-Inland Water Ecosystem. Prentice- Hall, Upper Saddle River, New Jersey07458
7. Lecren, E.D. and R.H. Low-McConnel. 1980. The Functioning of Freshwater Ecosystems. IBP 22. CambridgeUniversity Press. Cambridge, London.
8. Schwoerbel, J. 1987. Handbook of Limnology. Ellis Horwood Limited. New York.
9. Serruya, C. and U. Pollinger. 1983.Lakes of Warm Belt. CambridgeUniversity Press, Cambridge,London.
10. Wetzel, R.G. 1983. Limnology, CBS College Publishing, The Dryden Press.

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B. Sc. Fisheries (Hons.)

Course Profile :

Course Code: FM 2122 **Course Title: Physico-Chemical Limnology**

Credit: 1 **Contact hours: 16** **Level: 2** **Semester: 1**

Course Offering Department (s) :Department of Fisheries Management

Rationale: For the successful fisheries production in lentic and lotic water bodies, students should identify the major inland waterbodies and the physical, chemical parameters of water that can affect the biological production of inland waters.

Course Learning Outcomes (CLO)

2. Enlist various kinds of lotic and lentic water bodies in Bangladesh and the world and draw and label the major inland water bodies with their description
3. Demonstrate the determination of physical and chemical parameters of inland waters
4. Analyze the optimum physico-chemical parameters of different waterbodies for maximum fisheries production
5. Measure the physical characteristics of water bodies

Mapping CLO with PLO:

	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8	PLO9	PLO10
CLO1	√	√						√		
CLO2	√	√				√		√		
CLO3	√	√		√		√		√		
CLO4	√	√						√		

Course Contents:

Course contents	Aligned CLO	No. of Lectures
10. Map of Bangladesh and the world: drawing and labeling with brief descriptions of important lakes and rivers.	**CLO 1**	**2**
11. Determination of area, depth and water volume of ponds, lakes and reservoirs.	**CLO 4**	**2**
12. Determination of physical factors: temperature, transparency, turbidity, and water flow.	**CLO 2, 3**	**3**
13. Determination of chemical factors: water sampling and determination of dissolved oxygen, free carbon dioxide, pH, total alkalinity, total hardness, phosphate phosphorus, nitrate nitrogen, ammonia, iron, etc.	**CLO 2, 3**	**5**
14. Determination of salinity.	**CLO 2**	**2**
15. Field visit to study water quality parameters of a fish farm.	**CLO 4**	**2**

Teaching strategy: Lectures, Field visits,Demonstration, Practical note book, Problem based learning, Interactive learning, Group studies and Discussion.

Assessment Strategy: MCQ Test, Written test, Identification of samples, Oral test, Assignment and Presentation.

References:

1. APHA. 1980. Standard methods for the examination of water and wastewater. 15th Edition. Washington, D.C. American Public Health Association. 1134 pp.
2. Boyd, C. E. and C. S. Tucker. 1992. Water Quality and Pond Soil Analyses for Aquaculture. Agricultural Experiment Station, Auburn University, Alabama, USA. 183 pp.
3. Stirling, H. P. 1985 (ed.). Chemical and Biological Methods of Water Analysis for Aquaculturists. Institute of Aquaculture, University of Stirling, Scotland, UK. 119 pp.
4. Wetzel, G. W. and G. E. Likens. 1991. Limnological Analyses. 2nd Edition. Springr-Verlag, New York, Berlin, Heilberg, London, Paris, Tokyo, Hong Kong, Barcelona. 391 pp.

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B. Sc. Fisheries (Hons.)

Course Profile :

Course Code: **FT 2101** **Course Title:Fisheries Microbiology**

Credit: **3** **Contact Hours:** **48** **Level:** **2** **Semester:** **1**

Course offering department(s): **Department of Fisheries Technology**

Rationale:

The students will be equipped with knowledge on the morphology, structure, physiology and reproductive characteristics of microorganism, microbial growth patterns and the role of microorganism in food spoilage through this course so that they can ensure safety of fish and fishery products.

Course Learning Outcomes (CLO):

CLO 1:		Describe the scope, historical development and classification of microorganisms.
CLO 2:		Describe different microorganisms (especially those are related to food microbiology) with their morphology, structure, growth, reproduction, cultural and physiological characteristics.
CLO 3:		Apply the knowledge of Fisheries Microbiology in ensuring the safety and quality of fish and fish products.
CLO 4:		Adopt good handling practices and good manufacturing practices in harvesting, marketing and processing of fish and fish products.
CLO 5:		Participate in policy making of different fields for safe and quality products development of the country.

Mapping CLO with PLO

CLO/PLO	PLO 1	PLO 2	PLO 3	PLO 4	PLO 5	PLO 6	PLO 7	PLO 8	PLO 9	PLO 10
CLO 1	✓			✓						
CLO 2	✓			✓						
CLO 3		✓		✓		✓		✓		
CLO 4		✓		✓	✓	✓	✓	✓		
CLO 5		✓	✓	✓	✓	✓	✓		✓	✓

Summary of Course Content

Content	Aligned CLO	No. of lectures
1. Introduction: Scope, historical development and taxonomic classification of microorganisms- mold, yeast, bacteria, mycoplasma, chlamydia, virus and rickettsia, general characteristics of prokaryotes and eukaryotes, microorganisms of freshwater and marine environment.	CLO 1 & CLO 2	6
2. **Molds and yeasts:** General morphology, structural, reproductive, cultural and physiological characteristics, distinguishing characters of important genera, industrial importance.	CLO 1 & CLO 2	8
3. **Bacteria and viruses:** Morphology, structure and reproduction, cultural and physiological characteristics of bacteria, characteristics of genera important in food bacteriology.	CLO 1 & CLO 2	9
4. **Microbial growth and nutrition:** Growth curve, factors affecting microbial growth- water activity aw, pH, temperature, redox-potential, nutrient, microbial interactions, antimicrobial agents.	CLO 2	5
5. **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.	CLO 3 & CLO 4	5
6. **Food borne illness:** Bacterial food poisoning and infection-botulism, staphylococcal intoxication, salmonellosis, shigellosis, Clostridium perfringens infection.	CLO 4 & CLO 5	6
7. **Immunity:** Antigen, antibody, antigen-antibody reactions, agglutination, precipitation, complement fixation, cytolysis, phagocytosis, hypersensitivity, immunological methods-FAT, ELISA.	CLO 3, CLO 4 & CLO 5	5
Class test		1
Total		**45**

Teaching Strategy:

Methods of teaching:

- Classroom lectures using multimedia projector, white board, discussions
- Group work, self-study, assignments, practical demonstrations
- Field trips or visits

Assessment Strategy:

3. Continuous assessments: (will contribute 20% of final examination mark)
   - Written tests, Written assignment, Oral tests and, Practical tests
4. Final examination:
   - Written tests, Oral tests and, Other assessments

Recommended books and other resources:

14. Alcamo, I. E. 1984. Fundamentals of Microbiology. Addison-Wesley Publishing Company. USA. 834 pp.
15. Burrows, W. 1985. Textbook of Microbiology. 22nd Edition. W. B. Saunders Co., Philadelphia and London. 1038 pp.
16. Frazier, W. C. and D. C. Westhoff. 1990. Food Microbiology. 3rd Edition. McGraw Hill Book Co., New York, London. 502 pp.
17. Ward, D. R. and C. Hackney. 1991. Microbiology of Marine Food Products. Van Nostrand Reinhold, New York. 438 pp.
18. Adam, M. R. and N. O. Moss. 2008. Food Microbiology. 3rd Edition. RSC Publishing Co., Cambridge, U.K.
19. Chichester, C. O. and H. D. Graham. 1973 (eds.). Microbiological Safety of Fishery Products. Academic Press, NY, London.
20. Franklin, T. J. and G. A. Snow. 1971. Biochemistry of Antimicrobial Action. Chapman and Hall, London.
21. Mansur, M. A. 2010. Microbiology In "Fisheries Studies": Part-I. Botomul (Publisher), Dhaka. 234-312 pp.
22. Michel, P. D. and R. B. Larry. 2007. Food Microbiology: fundamentals and frontiers. ASM Press, Washington, D.C.
23. Nickerson, J. T. and A. J. Sinskey. 1993. Microbiology of Food and Food Processing. Elsevier, New York, Oxford, Amsterdam.
24. Ravindran, K. N., I. A. Nair, P. A. Perigreen, Paniker and M. Thomas. 1985. Harvest and Post-harvest Technology of Fish. Society of Fisheries Technologists, India.
25. Reinheimer, G. 1985. Aquatic Microbiology. John Wiley & Sons. New York, Brisbane, Toronto.
26. Thomas, J. M. and R. M. Karl. 2008. Food Microbiology: an introduction. ASM Press, Washington, D.C.

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B. Sc. Fisheries (Hons.)

Course Profile :

Course Code: **FT 2122** **Course Title: Fisheries Microbiology**

Credit: **1** **Contact Hours:** **16** **Level:** **2** **Semester:** **1**

Course offering department(s): **Department of Fisheries Technology**

Rationale:

In order to ensure safety of fish and fishery products, the morphology, structure, physiology and reproductive characteristics of microorganism, microbial growth patterns and the role of microorganism in food spoilage be studied at laboratory and field levels.

Course Learning Outcomes (CLO):

CLO 1:		Isolate and identify different microorganisms from fish, fish products and aquatic environments.
CLO 2:		Describe the qualitative and quantitative properties of microorganisms related to fish/ sea-foods spoilage, safety and quality.
CLO 3:		Apply the knowledge of Fisheries Microbiology in ensuring the safety and quality of fish and fish products.
CLO 4:		Adopt good handling practices and good manufacturing practices in harvesting, marketing and processing of fish and fish products.
CLO 5:		Participate in policy making of different fields for safe and quality products development of the country.

Mapping CLO with PLO

CLO/PLO	PLO 1	PLO 2	PLO 3	PLO 4	PLO 5	PLO 6	PLO 7	PLO 8	PLO 9	PLO 10
CLO 1	✓			✓						
CLO 2	✓			✓						
CLO 3		✓		✓		✓		✓		
CLO 4		✓		✓	✓	✓	✓	✓		
CLO 5		✓	✓	✓	✓	✓	✓		✓	✓

Summary of Course Content

Content	Aligned CLO	No. of lectures
1. Important terminology and guideline for exercises in the practical classroom.	CLO 1 & CLO 2	1
2. Study of different types of microscopes- principles and operation.	CLO 1 & CLO 2	
3. Study of different sterilization techniques: Autoclaving, dry heat sterilization, tyndallization, gaseous sterilization and filtration.	CLO 1 & CLO 2	1
4. Study of culture media: Ingredients, types, and preparation of culture media.	CLO 1 & CLO 2	
5. Culture of microorganisms: Broth culture, pour plate culture, spread plate culture, streak plate culture, stab culture and shake culture.	CLO 1, CLO 2& CLO 3	2
6. Microscopic observation of bacteria:Gram's stain, spore stain, flagella stain, Ziehl-Neelsen's stain, Hiss's methods and Albert's staining.	CLO 1, CLO 2& CLO 3	2
7. Isolation and identification of bacteria**:** Morphological, biochemical, physiological and serological study.	CLO 2, CLO 3, CLO 4 & CLO 5	1
8. Quantitative estimation of bacteria: Consecutive decimal dilution method and most probable number method.	CLO 2, CLO 3, CLO 4 & CLO 5	1
9. Field visit for sample collection from selected fish landing centers, fish markets and processing plants- bacteriological analysis and preparation of report.	CLO 2, CLO 3, CLO 4 & CLO 5	1
Class test		1
Total		**10**

Teaching Strategy:

Methods of teaching:

- Classroom lectures using multimedia projector, white board, discussions
- Group work, self-study, assignments, practical demonstrations
- Field trips or visits

Assessment Strategy:

1. Continuous assessments: (will contribute 20% of final examination mark)
   * Written tests, Written assignment, Oral tests and, Practical tests
2. Final examination:
   * Written tests, Oral tests and, Other assessments

Recommended books and other resources:

1. American Public Health Association. 1998. Standard Methods for the Examination of Water and Wastewater, 20th Edition. APHA, Washington, D. C.
2. Barrow, G. L. and R. K. A. Feltham. 1993 (ed.). Cown and Steel's Manual for the Identification of Medical Bacteria, Cambridge University Press.
3. Burrows, W. 1985. Textbook of Microbiology. 22nd Edition. W. B. Saunders Co., Philadelphia and London.
4. Collins, C. H. and P. M. Lyne. 1976. Microbiological Methods. 4th Edition. Butterworths & Co. Ltd., London.
5. Downes, F. P. and K. Ito. 2001. Compendium of Methods for the Microbiological Examination of Foods. American Public Health Association, 800 I St., NW, Washington, D.C. 20001-3710.
6. Frazier, W. C. and D. C. Westhoff. 1990. Food Microbiology. 3rd Edition. McGraw Hill Book Co., New York, London.
7. Holt, G. J. 1986. Bergey's Manual of Systematic Bacteriology, Williams and Wilkins, Baltimore.
8. Miwa, K. and S. J. Low. 1992. Laboratory Manual on Analytical Methods and Procedures for Fish and Fish Products. 2nd Edition. Marine Fisheries Research Department, SEAFDEC, Singapore.
9. Ward, D. R. and C. Hackney .1991. Microbiology of Marine Food Products. Van Nostrand Reinhold, New York.

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B. Sc. Fisheries (Hons.)

Course Profile :

Course Code: MFS 2101 **Course Title: Chemical Oceanography**

Credit: 2 **Contact Hours: 32** **Level: 2** **Semester: 1**

Course Offering Department (s) :Department of Marine Fisheries Science

Rationale:

The aim of this course is to give knowledge about chemical oceanography-its introduction, composition and various factors affecting them.

Course Learning Outcomes:

CLO1. Understand the general distribution of the chemical properties of the ocean**.**
CLO2. Familiar about the cycling of key components, which processes influences the cycling.
CLO3. Describethe effect of organic matter and nutrient on water chemistry and marine life.
CLO4. Analyze, present, and discuss different issues of chemical oceanography.

Mapping CLO with PLO:

	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8	PLO9	PLO10
CLO1	√									
CLO2	√									
CLO3	√	√							√	
CLO4	√		√		√	√		√		√

Course Contents:

Sl. No.	**Course contents**	**Aligned CLO**	**No. of Lectures**
1.	Chemistry of water and sea water (elements in sea water, composition of sea water), Inorganic agencies effecting the composition of sea water	CLO1	9
2.	Chemistry of air-sea interface	CLO2	4
3.	Dissolved gasses and dissolved organic material in sea water, Eutrophication, ocean acidification	CLO1	6
4.	Nutrients in the sea, trace elements and their biological roles	CLO1, CLO4	5
5.	Solubility of salts in seawater, preparation of artificial sea water	CLO1, CLO4	5
6.	Chemical features of Indian Ocean and Bay of Bengal	CLO3	2
7.	Class test		1

Teaching Strategy: Lectures, Problem based learning, Interactive learning, Group studies and Discussion.

Assessment Strategy: MCQ Test, Written test, Oral test, Assignment, Presentation and Viva voce.

Learning Resources:

1. Pilson, M.E.Q., 1998. An Introduction to the Chemistry of the Sea Prentice Hall New Jersey. 2. Millero F. J 2002. Chemical Oceanography CRC press.
3. Grasshoff, Klaus 1999. Methods of Sea water Analysis. Wiley VCH New York
4. Riley, J.P. and Skirrow, 1975-1984. Chemical Oceanography Vols. 1 to 8. Academic Press, London.
5. Hill, M.N. 1963. The Sea Vols. 1 to3. Inter science Publishers, New York.
6. Strickland J.D.H and T.R Parson 1972. A Practical handbooks of seawater analysis. Fisheries Research Board of Canada, Ottawa, Bulletin 167.

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B. Sc. Fisheries (Hons.)

Course Profile :

Course Code: MFS 2102 **Course Title: Chemical Oceanography**

Credit: 1 **Contact Hours: 16** **Level: 2** **Semester: 1**

Course Offering Department (s) : Department of Marine Fisheries Science

Rationale:

The course covers practical quantitative and analytical process in marine chemistry.

Course Learning Outcomes:

CLO1. Analyze the composition of seawater and determine amount of various substances dissolved in seawater.
CLO2. Understand the practical knowledge on the influences of different chemical parameters on the oceanic system.
CLO3. Analyze, present, and discuss different issues of chemical oceanography.

Mapping CLO with PLO:

	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8	PLO9	PLO10
CLO1	√				√			√		
CLO2	√		√							√
CLO3	√	√		√		√	√		√	

Course contents:

Sl. No.	**Course contents**	**Aligned CLO**	**No. of Lectures**
1.	Volumetric analysis (Acid base titrations, Oxidation Reduction titrations).	CLO1, CLO2, CLO3	4
2.	Preparation of standard for sea water.	CLO1, CLO2, CLO3	2
3.	Estimation of pH, alkalinity, minor, trace and major elements of sea water and sediments.	CLO1, CLO2, CLO3	5
4.	Determination of Nitrate, phosphate, silicate, carbonate, bicarbonate, DO,	CLO1, CLO2, CLO3	4
5.	Class test		1

Teaching strategy: Lectures, Problem based learning, Interactive learning, Group studies and Discussion, practical.

Assessment Strategy: MCQ Test, Written test, Assignment, Viva voce.

Learning Resources:

1. Marine Chemistry, by Martin.

2. Chemical Oceanography, by Horne.
3. Chemistry and fertility of sea water, by Harvey.
4. Aquatic Environmental Chemistry, by Haward
5. The Oceans, by HU Svedrup, MW Johnson and RH Flemming. Prentice-Hall, 1942.
6. General Oceanography: An Introduction (Second English Edition), by Dietrich, Kalle, Krauss and Siedler, John Wiley & Sons. 626pp. 1980.

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B. Sc. Fisheries (Hons.)

Course profile :

Course code: AE 2107 **Course title: Fisheries Economics**

Credit: 2 **Contact hours: 32** **Level: 2** **Semester: 1**

Course Offering Department (s) : Department of Agricultural Economics

I. Rationale

The fisheries sub-sector plays a vital role in the economy of Bangladesh. Fish is the second most important staple food after rice. Thousands of Bangladeshi go fishing each year putting more and more pressure on the resource. When we combine the effects of recreational, commercial and customary fishers on our fisheries, we can see the need for an effective management system to ensure the resource is maintained. Sufficient detail in basic economic theories and fisheries resource management is needed for students to manage inland and open water aquaculture farms, or carryout research in fisheries socio-economics.

II. Course Learning Outcomes (CLO)

CLO1: Understand the basic concepts of economics and fisheries economics

CLO2: Illustrate consumer's choices, preferences and behavior.

CLO3: Illustrate producer's choices, preferences and behavior.

CLO4: Describe and analyze contribution of fisheries sub-sector in the economy and its environmental aspects.

III. Mapping CLO with PLO

CLO/ PLO	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8	PLO9	PLO10
CLO1	√	√	√	√	√				√	√
CLO2	√	√			√			√		√
CLO3		√				√	√	√		√
CLO4		√	√	√	√	√	√	√	√	√

IV. Course Content

Course Content	Alignment CLO	No. of lectures
1. **Concepts and principles of fisheries economics**: Definition and basic concepts as it relates to fisheries and aquaculture, relationship of economics with other social sciences, rationale of studying economics for the students of fisheries sciences.	CLO 1	**5**
2. **Consumer behaviour:** Utility analysis, law of diminishing marginal utility and law of equi-marginal utility, indifference curve analysis, law of demand and supply, elasticity of demand.	CLO 2	**5**
3. **Factors of Production**: Definition, relative importance of the factors, land, peculiarities of land, efficiency of labour, theory of population, capital and capital formation, importance of capital, steps of capital formation.	CLO 3	**14**
4. **Theory of Production**: Definition, production function, law of diminishing return, production efficiency, improving production efficiency.		
5. **Cost and Revenue Concepts**: Definition, different cost concepts, cost curves, revenue and revenue curves, equilibrium of firm.		
6. **Economics of Aquaculture and Open-water Fisheries**: Fish production and its economic importance, contribution of fisheries sub-sector in the economy of Bangladesh, small-scale, subsistence and commercial fisheries, capture and culture fisheries, economic and bio-economic models of fisheries management.	CLO 4	**8**
7. **Environmental aspects in fisheries** and aquaculture management		

V. Teaching strategy

Interactive lectures, classroom based exercise, home works, group discussion

VI. Assessment strategy

Quiz, class room presentation, written test

Text books :

1. Dewett, K. K. and A. Chand. 2001. Modern Economic Theory. S. Chand & Company Ltd., New Delhi.
2. Hill, B. 1980. An Introduction to Economics for Students of Agriculture. Pergamon Press, London.
3. Samuelson, P. A. 2005. Economics. 18th Edition. McGraw Hill, New York.
4. Mankiw, N. G. (2004). Principles of economics (3rd ed., Mason OH: Thomson / South-Western,). ISBN: 0-324-20309-8.

References :

1. Bell, F. W. 1978. Food from the Sea: The Economics and Policies of Ocean Fisheries. Westview Press, Boulder.
2. Bjorndal, T., D. V. Gordon, R. Arnason, U. R. Sumaila. 2007. Advances in Fisheries Economics. Blackwell Publishing Limited.
3. Bowers, J. 1997. Sustainability and Environmental Economics; an Alternative Text. Prentice Hall.
4. Chapman, D. 2000. Environmental Economics – Theory, Application and policy. Mass: Addison Wesley, reading, UK.
5. Clark, C. W. 1985. Bioeconomic Modeling and Fisheries Management. John Willey & Sons, New York.
6. Dillon, J. L. and J. B. Hardaker. 1993. Farm Management Research for Small Farmer Development, 2nd Edition, Farm Systems Management Series, FAO, Rome.
7. Gittinger, J. P. 1996. Economic Analysis of Agricultural Projects. 2nd Edition. John Hopkins University press, Baltimore.
8. Goodstein, E. S. 2010. Economics and the Environment. John Wiley and Sons Limited.
9. Hanley, N., J. F. Shogren and B. White. 2007. Environmental Economics in Theory and Practice. Palgrave Macmillan, New York.
10. Jolly, C. M. and H. A. Clonts. 1993. Economics of Aquaculture. Food Products Press, New York.
11. Lecomber, R. 1979. The Economics of Natural Resources. McMillan, London.
12. Panayotou, T. 1987. Small-scale Fisheries in Asia: Approach to Natural Resource and Environmental Policy, Wiley, New York.
13. Shang, Y. C. 1981. Aquaculture Economics: Basic Concepts and Methods of Analysis. Westview Press, London.

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B. Sc. Fisheries (Hons.)

Course Profile :

Course Code: FBG 2103 **Course Title: Evolutionary Biology**

Credit: 2 **Contact Hours: 32** **Level: 2** **Semester: 1**

Course Offering Department (s) :Department of Fisheries Biology and Genetics

Rationale:

In order to develop their carrier and research in fisheries science student will knowledgeable with the patterns and processes of evolution, adaptation, speciation, extinction and phylogenetics.

Course learning Outcomes:

CLO1. Define various terms of evolution

CLO2. Describe mechanisms of evolutionary change and extinction, speciation and adaptation.

CLO3. Illustrate genetics of evolution, multicellularity and development, diversity of body plans and phylogenetic tree.

CLO4. Prepare phylogenetic tree and make a relationship on the evolutionary history of traits

Mapping CLO with PLO:

	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8	PLO9	PLO10
CLO1	√								√	√
CLO2	√	√		√				√	√	√
CLO3	√	√	√	√		√	√	√	√	√
CLO4	√	√	√	√	√	√	√	√	√	√

Course Contents:

Course contents	Aligned CLO	No. of Lectures
1. Introduction: An overview; evolution - definitions, history, evidence and objectives, evolution and genetics.	CLO1	**3**
2. Patterns and processes of evolution, mechanisms of evolution, microevolution versus macroevolution.	CLO2, CLO3	**4**
3. Natural selection, Darwin's theory for mechanism of evolutionary change, sexual selection, kin selection.	CLO2, CLO3	**4**
4. Evolution of life histories, mechanism of extinction	CLO2	**5**
5. Species and speciation: Defining species, the genetics of speciation, mechanisms of speciation, the geography of speciation	CLO2, CLO3	**4**
6. The origin and diversification of eukaryotes, multicellularity	CLO2, CLO3	**5**

and development, diversity of body plans.		
7. Phylogenetics: Cladistics, parsimony; characters and adaptation in fishes.	CLO3, CLO4	**6**
8. Class test	**-**	**1**

Teaching strategy: Lectures, Problem based learning, Interactive learning, Group studies and Discussion.

Assessment Strategy: MCQ Test, Written test, Oral test, Assignment and Presentation.

Learning Resources:

1. Futuyma, D. J. 1997. Evolutionary Biology. Sunderland, Mass. Sinauer Associates. 751 pp.
2. Graur, D. and W. H. Li. 2000. Fundamentals of Molecular Evolution. Sunderland, Mass. Sinauer Associates. 439 pp.
3. Ridley, M. 2003. Evolution. Boston: Blackwell Scientific.
4. Darwin, C. 1859. On the Origin of Species. 502 pp.
5. Cowen, R. 2004. History of life. Boston: Blackwell Scientific. 464 pp.
6. Endler, J. A. 1986. Natural selection in the wild. Princeton, N.J.: Princeton Univ. Press.
7. Gillespie, J. H. 1997. The Causes of Molecular Evolution. New York: Oxford Univ. Press.
8. Helfman, G. 2009. The Diversity of Fishes: Biology, Evolution, and Ecology.
9. Hilis, D. M., C. Moritz and B. K. Mable. 1996. Molecular Systematics. 2nd Edition. Sinauer Associates Inc. 655 pp.
10. Lewontin, R. C. 1974. The genetic basis of evolutionary change. New York: Columbia Univ. Press.
11. Long, J. A. 2010. The Rise of Fishes: 500 Million Years of Evolution.Johns Hopkins University Press. 287 pp.
12. Tyagi, R. and Shukla, A. N. 2002. Adaptations in Fishes: Encyclopedia of Fishes Series. Narendra Publishing House. 218 pp.
13. Wilson, E. O. 1992. The diversity of life Cambridge, Mass.: Harvard Belknap.

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B. Sc. Fisheries (Hons.)

Course Profile *(Profile of xx Number of Courses)*

Course Code: **AQ 2103** **Course Title:** **Environmental Management for Aquaculture**

Credit: **2** **Contact Hours:** **32** **Level:** **2** **Semester:** **1**

Course offering department(s): **Department of Aquaculture**

Rationale:

In order to ensure aqua-production in hazards free environment students should have knowledge about environmental changes occurring due to aquaculture activities and their mitigation measures.

Course Learning Outcomes (CLO): *(Max 5)*

CLO 1: State environmental consequences of aquaculture

CLO 2: Describe impacts of various chemicals used in aquaculture

CLO 3: Explain waste minimization as well as waste water treatment methods

CLO 4: Illustrate socio economic impacts of aquaculture environment

CLO 5: Develop various systems for the management of environment

Mapping CLO with PLO

CLO/ PLO	PLO 1	PLO 2	PLO 3	PLO 4	PLO 5	PLO 6	PLO 7	PLO 8	PLO 9	PLO 10
CLO 1	✓	✓								
CLO 2	✓	✓								
CLO 3	✓	✓					✓			
CLO 4	✓	✓								
CLO 5		✓		✓		✓		✓		

Summary of Course Content

Content	Aligned CLO	No. of lectures
Environmental impact of aquaculture: Introduction, aquaculture wastes, environmental consequences of hypernutrification and eutrophication, conflict with other users.	CLO 1	5
Environmental impact of chemicals in aquaculture: Chemicals used in aquaculture, administration of treatments, environmental concerns and their effects on microbial community and environment.	CLO 2	4
Waste minimization: Waste minimization and aquaculture planning, environmental impact assessment (EIA), operational management for waste reduction.	CLO 3	5
Waste water treatment: Physicochemical methods – screening, sedimentation, hydroclones, flotation, dewatering and disposal, pathogen elimination of waste water, UV sterilization, ozonation, oxygenation, biological method – biofilters biofilm, seeding, startup, different types and application of biofilters in aquaculture.	CLO 3 CLO 4	9
Socio-economic impacts: Impacts of aquaculture environment on socio-economics of associated community.	CLO 4	3
Environmental management systems: Environmental policy, environmental management and pollution control, environmental management system and organizational ethics, waste minimization, systems optimization and chemical usage, a strategic frame work for environmental management in aquaculture.	CLO 5	5
Class Test		1
Total		32

Teaching Strategy:

Lecture, Multi-media, Video clipping, Demonstration.

Assessment Strategy:

Written exam, Quiz, Viva-voce, Field trip, Assignment.

Recommended books and other resources:

1. European commission. 1995. Aquaculture and the Environment in the European Community, office for official publications of the European Communities, Brussels.
2. Milden, A. and T. A. Redding. 2000. Environmental Management for Aquaculture. Kluwer Academic Publishers, London. 223 pp.
3. Pillay, T. V. R. 2004. Aquaculture and the environment. Fishing News Books Lmt., Onsey Mead, oxford, England. 189 pp.

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B. Sc. Fisheries (Hons.)

Course Profile :

Course Code: FM 2103 **Course Title: Water Quality Management in Fisheries**

Credit: 2 **Contact Hours: 32** **Level: 2** **Semester: 1**

Course Offering Department (s) :Department of Fisheries Management

Rationale:

In order to be a quality graduate in fisheries the students need to know the water quality parameters of natural ecosystems and production systems for effectively manage the water resources for sustainable production and conservation.

Course learning Outcomes:

CLO1: Explain various water quality parameters and their importance in fisheries and aquaculture.

CLO2: Describe causes and impacts of water quality deterioration on the flora and fauna in the open water systems.

CLO3: Relate various water quality parameters with different freshwater and coastal aquaculture production systems.

CLO4: Suggest solution for problems of water quality deterioration for fish culture and management.

Mapping CLO with PLO:

	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8	PLO9	PLO10
CLO1	√	√	√			√		√		√
CLO2	√							√		
CLO3	√	√	√					√		
CLO4	√	√			√			√		

Course Contents:

Course contents	**Aligned CLO**	**No. of Lectures**
1. Concept on water quality, goal of water quality management and importance in fisheries and aquaculture.	**CLO 1**	**5**
2. Water quality deterioration: Causes and impacts on the flora and fauna in the open water systems.	**CLO 2**	**5**
3. Water quality and culture systems: Water quality characteristics in different freshwater production systems – ponds, cages, pens, integrated systems, re-circulatory and other systems.	**CLO 3**	**5**
4. Water quality requirements of cultured species: Requirements for carps, catfishes, perch, eel, snakeheads and others in hatchery and grow-out	**CLO 3**	**3**

conditions.		
5. Water quality in fertilized and fed systems: DO, pH, total alkalinity, nitrogenous (NH3, NO2, NO3) and phosphatic compounds (PO4- P, TP) in semi-intensive and intensive systems.	**CLO 4**	**3**
6. Eutrophication and algal management: Inputs used and carrying capacity, algal assemblages, distribution, seasonal fluctuations, algal blooms, toxins, control measures.	**CLO 4**	**3**
7. Water quality and secondary production: Zooplankton and benthos – abundance, biology, distribution, utilization, biomanipulation.	**CLO 1**	**3**
8. Water quality problems in coastal aquaculture: Shrimp and prawn ghers/ponds, crab/mollusks, seaweed, finfish, polyculture and integrated systems, special problems in coastal aquaculture and management measures.	**CLO 3**	**4**

Teaching strategy: Lectures, Problem based learning, Interactive learning, Group studies and Discussion.

Assessment Strategy: MCQ Test, Written test, Oral test, Assignment and Presentation.

Learning Resources:

1. Boyd, C. E. 1982. Water Quality Management for Pond Fish Culture. Elsevier, Scientific and Publishing Company, Amsterdam, Oxford, New York. 318 pp.
2. Egna, H. S. and C. E. Boyd. 1997. Dynamics of Pond Aquaculture. CRC Press. Boca Raton, New York. 437 pp.
3. Wetzel, R. G. 1983. Limnology. 2nd Edition. Saunders Coll. Philadelphia. 858 pp.
4. Alabaster, J. S. and R. Lloyd. 1982. Water Quality Criteria for Freshwater Fish. 2nd Edition. Butterfly Scientific Publisher. London.
5. APHA. 1980. Standard methods for the examination of water and wastewater. 15th Edition. Washington, D.C. American Public Health Association. 1134 pp.
6. Azim, M. E., M. C. J. Verdegem, A. A. van Dam and M. C. M. Beveridge. 2005. Periphyton: Ecology, Exploration and Management. CABI Publishing. London. 319 pp.
7. Boyd, C. E. 1979. Water Quality in Warmwater Fish Ponds. Agricultural Experiment Station, Auburn University, Alabama, USA. 359 pp.
8. Carmichael, W. W. 1981 (ed.). The Water Environment: Algal Toxins and Health. Plenum Press, New York. 491 pp.
9. Kaff, J. 2002. Limnology. Prentice Hall, New Jersey, USA. 591 pp.
10. Moss, B. 1988. Ecology of Fresh Waters: Man and Medium. 2nd Edition. Blackwell Scientific Publications. 417 pp.
11. Stirling, H. P. 1985 (ed.). Chemical and Biological Methods of Water Analysis for Aquaculturists. Institute of Aquaculture, University of Stirling, Scotland, UK. 119 pp.
12. Wahab, M. A. 2003 (ed.). Environmental and Socioeconomic Impacts of Shrimp Farming in Bangladesh. Technical Proc. BAU-NORAD Workshop, 5 March, 2002, BRAC Centre, Dhaka. Bangladesh Agricultural University, Mymensingh, Bangladesh. 101 pp.
13. Wetzel, G. W. and G. E. Likens. 1991. Limnological Analyses. 2nd Edition. Springr-Verlag, New York, Berlin, Heilberg, London, Paris, Tokyo, Hong Kong, Barcelona. 391 pp.

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B. Sc. Fisheries (Hons.)

Course Profile :

Course Code: FT 2103 Course Title:Biosecurity and Occupational Safety in Fisheries

Credit: 2 Contact Hours: 32 Level: 2 Semester: 1

Course offering department(s): Department of Fisheries Technology

Rationale:

In order to supply high quality safe and sound fish and fish products to consumers' of home and abroad, it essential to learn the biosecurity and bio-contamination and, biosecurity control measures. It is also important to study the methods of risk assessment, risk analysis and risk management as well as occupational guidelines, surveillance and monitoring.

Course Learning Outcomes (CLO):

CLO 1:		Describe the biosecurity and bio-contamination in production, during fishing at sea and others, during handling and transportation in processing plants, in storage and marketing.
CLO 2:		Implement biosecurity programmes for farms, fishing, supply chain, processing plants through biosecurity control methods.
CLO 3:		Analyze risk factors through identification of hazards, complete assessment, taking risk management measures and documentation.
CLO 4:		Plan occupational safety through guidelines, surveillance, monitoring, examination and diagnosis of ill persons, treatments.

Mapping CLO with PLO

CLO/PLO	PLO 1	PLO 2	PLO 3	PLO 4	PLO 5	PLO 6	PLO 7	PLO 8	PLO 9	PLO 10
CLO 1	✓			✓						
CLO 2	✓	✓		✓	✓					✓
CLO 3	✓	✓		✓		✓		✓	✓	✓
CLO 4	✓	✓	✓	✓		✓	✓	✓	✓	✓

Summary of Course Content

Content	Aligned CLO	No. of lectures
16. Introduction: Goals, Scopes and Objectives.	CLO 1 & CLO 2	3
17. **Biosecurity information and bio-contamination:** Zoonotic disease, bacteria, virus, yeast, mold, natural toxins, pollutants, chemical contaminants, etc.	CLO 1, CLO 2 & CLO 3	5
18. **Biosecurity planning:** Developing biosecurity programmes for farms, fishing, supply chain, processing plants	CLO 2 & CLO 4	4
19. **Biosecurity control:** Quarantine, intensifying disinfecting	CLO 2	4

measures, monitoring and surveillance and audit, sampling out/depopulation, bio-exclusion.		
20. **Risk assessment, risk analysis and risk management:** Identifying hazards, complete risk assessment, identifying risk management measures and documentation of risk analysis process	CLO 3 & CLO 4	5
21. **Biosecurity measures:** In production, during fishing at sea and others, during handling and transportation in processing plants, in storage and marketing.	CLO 3 & CLO 4	5
22. Occupational guidelines, surveillance and monitoring of workers, examination and diagnosis of ill persons, treatments. Training for improved occupational safety management. Emergency procedures.	CLO 5	4
23. **Field visit**		1
Class test		1
Total		**32**

Teaching Strategy:

Methods of teaching:

- Classroom lectures using multimedia projector, white board, discussions
- Group work, self-study, assignments, practical demonstrations
- Field trips or visits

Assessment Strategy:

24. Continuous assessments: (will contribute 20% of final examination mark)
25. Written tests, Written assignment, Oral tests and, Practical tests
26. Final examination:
    - Written tests, Oral tests and, Other assessments

Recommended books and other resources:

27. Banrie. 2013. Biosecurity in Aquaculture, Part 1: An Overview Biosecurity. Husbandry Hatcheries Education & academia.
28. Bonnell, A. D. 1994. Quality Assurance in Seafood Processing: A Practical Guide. Chapman & Hall, London. 208 pp.
29. Connell, J. J. 1980. Control of Fish Quality. Fishing News Books Ltd. (2nd Edition). England. 222 pp.
30. Kramer, A. and B. A. Twigg. 1966. Fundamentals of Quality Control for the Food Industry. The Avi. Publishing Co. Inc., Westport. 541 pp.
31. Kreuzer, R. 1971 (ed.). Fish Inspection and quality control. Fishing News Books. Ltd. London. 290 pp.
32. Botta, J. R. 1995. Evaluation of Seafood Freshness Quality. VCH Publishers, Inc. New York.
33. Bremer, H. A. 2002. Safety and Quality Issues in Fish Processing. CRC Press, 2002 - Technology & Engineering. 507 pp.
34. Clucas, I. J. and A. R. Ward. 1996. Post-harvest Fisheries Development: A Guide to Handling, Preservation, Processing and Quality. Natural Resource Institute, UK. 443 pp.
35. Fish Inspection, Quality Control, and HACCP: A Global Focus. Proceedings of the Conference. Held May 19-24, 1996, Arlington, Virginia, USA.
36. Hasegawa, H. 1987. Laboratory Manual on Analytical Methods and procedures for Fish and Fishery Products. Marine Fisheries Research Department, SEAFDEC, Singapore.

37. Huss, H. H., L. Ababouch and L. Gram 2003. Assessment and Management of Seafood Safety and Quality. Food and Agriculture Organization of the United Nations, Nature. 230 pp.
38. Proceeding of Conference on-Handling, Processing and Marketing of Tropical Fish. 1976. Tropical Product Institute, London.
39. Seafood HACCP Alliance. 2001. HACCP: Hazard Analysis and Critical Control Point. Training Curriculum. 4th Edition.
40. Shahidi, F. and B. K. Simpson 2004. Seafood Quality & Safety: Advances in the New Millennium. Science Tech Publishing Company, St. John's NL, Canada.

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B. Sc. Fisheries (Hons.)

Course Profile :

Course Code: MFS 2103 **Course Title: Marine Hydrophytes**

Credit: 2 **Contact Hours: 32** **Level: 2** **Semester: 1**

Course Offering Department (s) : Department of Marine Fisheries Science

Rationale:

This subject will focus on algae and plants of both marine submerged and emerged environments and particularly on marine microalgae, macroalgae and seagrasses belonging to costal vegetation.

Course Learning Outcomes:

CLO1. Describethe diversity of species and structures of costal vegetation and marine algae and plants.
CLO2. Understand the role of costal vegetation and marine algae and plants in their own ecosystems.
CLO3. Acquire basic concepts about the applications of marine algae and plants.

Mapping CLO with PLO:

	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8	PLO9	PLO10
CLO1	√				√			√		
CLO2	√		√							√
CLO3	√	√		√		√	√		√	

Course contents:

Sl. No.	**Course contents**	**Aligned CLO**	**No. of Lectures**
1.	Introduction to costal and marine botany: - Plant evolution and biodiversity (from Cyanobacteria to Angiosperms). - Main taxonomic groups of algae and plants living in costal and marine environments.	CLO1	4
2.	Systematics of marine algae and plants in terms of evolution: - Microalgae: Chrysophyceae, Dinoflagellata, Bacillariophyceae, Chlorophiceae, Pelagophiceae. - Macroalgae: Rhodophyta, Ulvophyceae, Phaeophyceae. - Tracheophyta.	CLO1, CLO2	9
3.	Coastal vegetation and flora: - Salt and brackish marshes.	CLO1, CLO2	8

	- Sand dunes. - Mangrove swamps and forests. - Coastal cliffs - Seagrass bed		
4.	Problems related to marine algae and plants: - Alien species and biological invasions. - Harmful algal blooms. - Toxic algae.	CLO1, CLO2,	6
5.	Uses of marine plants : - Bio-indicators. - Phytoremediation. - Biofuel. - Fertilizers. - Food/pharmacy.	CLO3	4
6.	Class test		1

Teaching strategy: Lectures, Problem based learning, Interactive learning, Group studies and Discussion, practical.

Assessment Strategy: MCQ Test, Written test, Assignment, Viva voce.

Learning Resources:

1. Marine Botany by Dawes C.J., John Wiley & Sons, Inc.
2. Diatoms: Biology and Morphology of the Genera by Round et al., Cambridge
3. Marine Benthic Dinoflagellates: Unveiling Their Worldwide Biodiversity by Horiguchi et al., Schweizerbart
4. Chrysophyte algae: ecology, phylogeny and development by Sandgren et al., Cambridge
5. An Introduction to Phytoplanktons: Diversity and Ecology by Pal & Choudhury, Springer
6. Seaweed Ecology and Physiology by Hurd et al., Cambridge
7. Global Seagrass Research Methods by Short & Coles, Elsevier
8. Alghe e Fanerogame del Mediterráneo by Rodríguez-Prieto et al., Il Castello (edizione italiana);
9. Mangrove Ecosystems: A Global Biogeographic Perspective. Structure, Function and Ecosystem Services. by Rivera-Monroy V.H., Springer

Bangladesh Agricultural University
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B. Sc. Fisheries (Hons.)

Course Profile :

Course Code: FBG 2201 **Course Title: Fish Physiology**

Credit: 3 **Contact Hours: 48** **Level: 2** **Semester: 2**

Course Offering Department (s) :Department of Fisheries Biology and Genetics

Rationale:

This course will provide a detailed overview of the physiology of fishes and generate students with an outstanding knowledge in physiological characteristics and adaptations that allow fish to survive and thrive in an aquatic environment.

Course learning Outcomes:

CLO1. Describe major concepts of fish physiology (e.g. thermal regulation system, digestive system, metabolism, respiratory system, circulatory system, osmoregulatory system and reproductive system)

CLO2. Illustrate the relationships between different systems of fish body (e.g. digestivesystem, metabolism, respiratory system, circulatory system, osmoregulatory system, reproductive system etc.).

CLO3. Assess various environmental changes and conditions that affect fish and their response.

CLO4. Organize their knowledge in fish culture and breeding program.

Mapping CLO with PLO:

	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8	PLO9	PLO10
CLO1	√	√								√
CLO2	√	√		√						√
CLO3	√	√			√	√	√	√		√
CLO4	√	√	√	√				√		√

Course Contents:

Course contents	Aligned CLO	No. of Lectures
9. Introduction to fish Physiololgy	**CLO 1**	**1**

10. Temperature regulation: Classification of fish based on thermal regulation, low and high thermal effect, temperature regulation in homeotherms, fish as poikilotherms, endothermic fishes.	**CLO 1**	**2**
11. 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.	**CLO 1, CLO 2**	**6**
12. Metabolism: Metabolism and its phases, classification of metabolic rate based on activity levels, factors controlling metabolism in fish	**CLO 1, CLO 2, CLO 3, CLO4**	**3**
13. Physiology of blood circulation: Mechanism of blood circulation, components of circulatory system, cardiovascular parameters and controlling factors.	**CLO 1, CLO 2, CLO 3, CLO4**	**4**
14. Physiology of respiration: External and internal respiration, mechanism of gas transport and exchange, factors affecting O_2 and hemoglobin affinity, respiratory volume.	**CLO 1, CLO 2, CLO 3, CLO4**	**3**
15. Physiology of excretion and osmoregulation: Excretory products in different groups of fishes, mechanism of excretion, osmoregulatory mechanisms in hagfish, lamprey, elasmobranches, marine and freshwater teleosts and migratory fishes	**CLO 1, CLO 2, CLO 3, CLO4**	**6**
16. Reproductive physiology: Reproductive cycle, gonadal maturation environmental and hormonal interplay in controlling reproduction, hypothalamic-pituitary-gonadal axis in fishes, viviparity in fishes, reproductive behaviour.	**CLO 1, CLO 2, CLO 3, CLO4**	**6**
17. Class test	**-**	**1**

Teaching strategy: Lectures, Problem based learning, Interactive learning, Group studies and Discussion.

Assessment Strategy: MCQ Test, Written test, Oral test, Assignment and Presentation.

Learning Resources:

1. Evans, D. H. and J. B. Claiborne. 2006. The Physiology of Fishes, 3rd Edition CRC Press: Boca Ration, Florida. 616 pp.
2. Hoar, W. S. and D. J. Randall. 1969-1997 (eds.). Fish physiology. Academic Press Inc. 559 pp.
3. Hoar, W. S. 1983. General and Comparative Physiology. 3rd Edition. New Jersey Prentice-Hall Inc., Eaglewood Cliffs.

4. Ayala, A. G., J. M. Penalver and E. C. Pozo. 2011. Recent Advances in Fish Reproductive Biology. Research Signpost. 200 pp.
5. Bond, C. E. 1996. Biology of Fishes. 2nd Edition. Sunders College Publishing. 750 pp.
6. Brown, M. E. 1957 (ed.). The Physiology of Fishes. Vol. I and II. Academic Press New York and London.
7. Moyle, P. B. and J. J. Cech, Jr. 2000. Fishes: An Introduction to Ichthyology, 4th Edition. Prentice Hall Inc. 744 pp.
8. Wootton, R. J. 2002. Reproductive Biology of Fishes. Iowa State Press. 368 pp.

Bangladesh Agricultural University
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B. Sc. Fisheries (Hons.)

Course Profile :

Course Code: FBG 2222 **Course Title: Fish Physiology**

Credit: 1 **Contact Hours: 16** **Level: 2** **Semester: 2**

Course Offering Department (s) :Department of Fisheries Biology and Genetics

Rationale:

In the laboratory, students will gain hands-on experience with fish physiology core concepts such as histology of different organs, hematology, bioenergetics, and reproductive physiology. Students will conduct activities and experiments in a supervised laboratory setting where they will apply the scientific method for discovery.

Course learning outcomes:

CLO 1: Identify different parts of the basic fish anatomy.

CLO 2: Dissect the different organs/system of selected fish.

CLO 3: Analyze interactions between different organs/systems to perform a physiological function.

CLO 4: Apply physiological concepts in laboratory and field.

Mapping CLO with PLO:

	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8	PLO9	PLO10
CLO1	√							√		
CLO2	√									
CLO3	√					√				
CLO4		√						√	√	√

Course contents:

Course contents	Aligned CLO	No. of Lectures
1. Histological study of fish gill, kidney, and gonads	**CLO 1, CLO 2**	**4**
2. Study of oxygen consumption rate under different metabolic levels.	**CLO 3**	**1**
3. Preparation of blood smear and study on different types of blood cells.	**CLO 3**	**1**
4. Counting of RBC and WBC by haemacytometer.	**CLO 3**	**1**

5. Test of pepsin enzyme in stomach.	**CLO 3**	**1**
6. Studies on ammonia excretion in fishes.	**CLO 3**	**1**
7. Study of the effects of salinity changes on different species of fish	**CLO 3**	**1**
8. Studies on developmental stages of fish gonads.	**CLO 3**	**1**
9. Class –test examination	**-**	**1**

Teaching strategy: Lectures, Problem based learning, Interactive learning, Group studies and Discussion.

Assessment Strategy: MCQ Test, Written test, Oral test, Assignment, Presentation and Viva voce.

Learning Resources:

1. Chandra, K. J. 2009. Fish Parasitology (2nd Edition). Published by Krishna Ray Choudhury. 34/A/2 Ram Babu Road, Mymensingh. Printer-Chaudhury Printing and Publication. 16 G.K.M.Saha Road, Chhoto Bazar, Mymensingh, Bangladesh. 183 pp.
2. Dogiel, V. A. 1962. General Parasitology. Oliver and Boyd, Edinburgh, U.K. 516 pp.
3. Woo, P. T. K. 1995 (ed.). Fish Diseases and Disorders. Vol. I. Protozoa and Metazoa infections. CAB, International Publishing. Oxon, U.K. 808 pp.

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B. Sc. Fisheries (Hons.)

Course Profile :

Course Code: AQ 2221 Course Title: Fish Parasitology and Pathology

Credit: 3 Contact Hours: 48 Level: 2 Semester: 2

Course Offering Department (s) :Department of Aquaculture

Rationale:

In order to reduce the impacts of various infestations and infections in the aquaculture systems, students will need to become knowledgeable and skilled regarding various fish parasites, microbial pathogens and associated diseases with their diagnosis.

CLO 1: To explain fish parasites and their relationship with hosts
CLO 2: To characterize different parasitic groups and illustrate their life cycles
CLO 3: To categorize infectious and non-infectious diseases of fish
CLO 4: To classify and compare systemic pathologies of diseased fish

Mapping CLO with PLO:

	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8	PLO9	PLO10
CLO 1	√	√		√						√
CLO 2		√						√		
CLO 3	√			√		√				
CLO 4	√			√	√			√		

Course contents:

Course contents	Aligned CLO	No. of Lectures
1. **Introduction and host-parasite relationship:** Definition related to fish parasitology and pathology, Infestation, Symbiosis, parasitism, Infection, transformation of stress into diseases. Parasites' effects on hosts, Hosts' reactions to parasites.	**CLO 1**	**4**
2. **Parasitic fauna of freshwater and marine fish and shellfish:** Major groups of parasites and their characteristics, classification of protozoan, helminthes, copepod and annelid parasites of fishes.	**CLO 2**	**6**
3. **Life cycle of protozoan and metazoan parasites of fishes and zoonotic diseases of fishes**	**CLO 2**	**8**
4. **Parasitic diseases of fishes:** Protozoan and metazoan parasitic diseases.	**CLO 3**	**8**
5. **Microbial diseases of fishes:** Viral, bacterial and fungal diseases with their etiology, epizootiology, clinical signs, pathology diagnosis and distribution.	**CLO 3**	**12**
6. **Non-infectious diseases of fish:** Environmental, nutritional and hereditary diseases of fishes**.**	**CLO 3**	**4**
7. **Systemic pathology of diseased fish:** Circulatory, respiratory, musculo-integumental, gill, digestive and renal pathologies.	**CLO 4**	**5**
8. Class-test Examination	**-**	**1**

Teaching strategy: Lectures, Discussion, Problem based learning, Interactive learning, Q/A session, e-learning, Vide- footage and Group studies.

Assessment Strategy: MCQ Test, Written test, Quiz, Oral test, Assignment and Presentation.

Recommended books and other resources:

Text books :

4. Chandra, K. J. 2009. Fish Parasitology (2nd Edition). Published by Krishna Ray Choudhury. 34/A/2 Ram Babu Road, Mymensingh. Printer-Chaudhury Printing and Publication. 16 G.K.M.Saha Road, Chhoto Bazar, Mymensingh, Bangladesh. 183 pp.
5. Dogiel, V. A. 1962. General Parasitology. Oliver and Boyd, Edinburgh, U.K. 516 pp.
6. Woo, P. T. K. 1995 (ed.). Fish Diseases and Disorders. Vol. I. Protozoa and Metazoa infections. CAB, International Publishing. Oxon, U.K. 808 pp.

References :

1. Amlacher, E. 1970. Text Book of Fish Diseases. T.F.H. Publications, Inc. U.S.A.
2. Cheng, T. C. 1982. General Parasitology. Academic Press Inc. N.Y.
3. Davis, H. S. 1961. Culture and Diseases of Game Fishes. University of California Press, Berkeley and Los Angeles.
4. Kabata, Z. 1985. Parasites and Diseases of fish cultured in the tropics. Taylor and Francis, London.
5. Kenndy, C. R. 1975. Ecological Animal Parasitology. Blacwell Scientific Publications, Oxford, London, Edinburgh and Melburne.
6. Roberts, R. J. 1989. Fish Pathology 2nd Edition. Baillere Tindal, London, U.K.
7. Schaperclaus, W. 1991. Fish Diseases. Vol. 1 & 2. Oxonian Press Pvt. Ltd. New Delhi, India.
8. Van Duijn, J. C. 1973. Diseases of Fishes. Butterworth & Co. Ltd. London.

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B. Sc. Fisheries (Hons.)

Course Profile :

Course Code: AQ 2222 Course Title: Fish Parasitology and Pathology

Credit: 1 Contact Hours: 16 Level: 2 Semester: 2

Course Offering Department (s) : Department of Aquaculture

Rationale:

In order to reduce the impacts of various infestations and infections in the aquaculture systems, students will need to become knowledgeable and skilled regarding the practical aspects of various fish parasites, microbial pathogens and associated diseases with their diagnosis.

CLO 1: To demonstrate museum specimens of fish parasites with their characters and to calibrate the microscope for measurements of parasites
CLO 2: To investigate fish host for collection of parasites, classify the parasites and preserve them permanently using standard protocols
CLO 3: To explain overall histopathological techniques along with microscopic observation
CLO 4: To analyze histopathological changes of different tissues and organs of diseased fish
CLO 5: To organize field trips to public and private fish farms for practical exposure.

Mapping CLO with PLO:

	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8	PLO9	PLO10
CLO 1	√	√		√						√
CLO 2		√		√		√		√		
CLO 3	√	√		√				√		
CLO 4	√	√		√	√		√	√		√
CLO 5	√	√	√			√		√		

Course contents:

Course contents	Aligned CLO	No. of Lectures
1. Study of museum specimens of fish parasites	**CLO 1**	**3**
2. Calibration of the microscope for measurements of parasites or other microscopic organisms	**CLO 1**	**2**
3. Investigation of fish host for collection of parasites	**CLO 2**	**2**
4. Permanent preservation of parasites-staining, dehydration, clearing and mounting	**CLO 3**	**2**
5. Histopathological techniques: Sampling, tissue processing, microtomy, staining, mounting and microscopic observation	**CLO 4**	**2**

6. Observation of histopathological changes of different tissues and organs of diseased fish	**CLO 4**	**2**
7. Field trips to public and private fish farms for practical exposure	**CLO 5**	**2**
8. Class-test Examination	**-**	**1**

Teaching strategy: Lectures, Problem based learning, Interactive learning, Q/A session, Group studies, Discussion, Practical demonstration, Laboratory sessions and Field visit.

Assessment Strategy: Practical work,MCQ Test, Written test, Quiz, Oral test, Assignment, Practical Notebook and Presentation.

Recommended books and other resources:

References:

1. Bykhovskaya-Pavloskaya, I. E., S. V. Gussev, M.N. Dubinina, N. A. Izymova, T. S. Smiruova, I. L.Sokolovskaya, G. A.Shtein, S. S. Shul'man and V. M. Epshtein. 1964. Key to Parasites of Freshwater fishes of the U.S.S.R. Israel Programme for Scientific T
2. Cable, R. M. 1943. Illustrated Laboratory Manual of Parasitology. Burgess Publ. Co. Minneapolis, New York, San Francisco, London.ranslation, Jerusalem.
3. Chandra, K. J.2008. A Practical Text book of Fish Parasitology and Health Management. Published by theBangladesh University Grants Commission, Dhaka.
4. Tonguthai, K., S. Chinabut, T. Somsiri, P. Chandratchakool and S. Kanchanakhan. 1999. Diasnostic Proceddures for Fin fish Diseases. AAHRI, Department of Fisheries,
5. Yamaguti, S. 1958, 1959, 1961, 1962, 1963. Systema Helminthum. Vol. I-V. Interscience Publishers Inc.

Bangladesh Agricultural University
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B. Sc. Fisheries (Hons.)

Course Profile :

Course Code: FM 2221 **Course Title: Biological Limnology**
Credit: 2 **Contact Hours: 32** **Level: 2** **Semester: 2**
Course Offering Department (s) :Department of Fisheries Management

Rationale:
To become a successful fisheries professional the students need to know the primary and secondary production of inland lentic and lotic habitats and their various physical, chemical and biological parameters those govern the lives and productivity of different ecosystems.

Course learning Outcomes:

CLO1: Explain primary production and secondary productionof natural waterbodyand their role in fish production.

CLO2: Describe morphology, life history, flotation, cosmopolitanism of freshwater plankton, their distribution, seasonal succession.

CLO3: Relate eutrophication and phytoplankton bloom- factors influencing phytoplankton bloom, biological effects of phytoplankton bloom.

CLO4: Describe morphology, life history, flotation, cosmopolitanism of freshwater zooplankton and benthos, their distribution and seasonal succession.

CLO5: Explain different groups of bacteria and their role in bio-geochemical cycles.

Mapping CLO with PLO:

	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8	PLO9	PLO10
CLO1	√	√	√			√		√		√
CLO2	√							√		
CLO3	√	√	√					√		
CLO4	√	√			√			√		
CLO5	√	√						√		

Course Contents:

Course contents	**Aligned CLO**	**No. of Lectures**
1. Biological relations in inland waters; influence of physical and chemical factors on aquatic biota; classification of freshwater aquatic organisms of both lotic and lentic habitats.	**CLO 1**	**3**
2. Aquatic primary production: Factors affecting primary production; estimation of primary production, variations in primary productions in different habitats.	**CLO 1**	**3**
3. Phytoplankton: Characteristics of major groups; morphology, life history, flotation; cosmopolitanism of freshwater plankton, distribution; seasonal succession; eutrophication and phytoplankton bloom- factors influencing phytoplankton bloom, biological effects of phytoplankton bloom, dinoflagellates and red tides, interactions with other organisms. Control of phytoplankton bloom. Relations between producers and consumers.	**CLO 2, CLO3**	**8**

Culture of phytoplankton.		
4. 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.	**CLO 1**	**3**
5. 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	**CLO 1**	**3**
6. Zooplankton: Characteristics of major groups, seasonal variations in abundance. Food and feeding habits, reproduction biology, diurnal vertical migrations, cosmopolitanism, cyclomorphosis, relations with other organisms, phytoplankton-zooplankton relations. Culture of zooplankton.	**CLO 1, CLO4**	**3**
7. Benthos: Significance, benthic regions, qualitative and quantitative distribution, factors affecting distribution. Life cycle of some common benthic fauna.	**CLO 1, CLO4**	**3**
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.	**CLO 5**	**3**
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.	**CLO 1**	**2**

Teaching strategy: Lectures, Problem based learning, Interactive learning, Group studies and Discussion.

Assessment Strategy: MCQ Test, Written test, Oral test, Assignment and Presentation.

Learning Resources:

1. A.P.H.A., 1976. Standard methods for the examination of water and wastewater including bottom sediments and sludge. 14th Ed. APH, New York.
2. Barber, H.G. and Haworth E.Y., 1981. A Guide to the Morphology of the Diatom Frustule. Freshwater Biological Association; Publication No. 4. Scientific Publication. Wilson & Son Ltd., Britain.112 pp.
3. Bellinger, E.G., 1992. A Key to Common Algae. The Institute of Water and Environmental Management. John Street, London. 138 pp.
4. Boney, A.D., 1975. Phytoplankton, Institute of Biology Study. 52, Crane, Russak Co, New York. 116 pp.
5. Boyd, C. E., 1979. Water quality in Warmwater Fish Ponds. Auburn University Agricultural Experiment Station, Auburn, Alabama, 359 pp.
6. Downing J.A. and Rigler, F.H., 1984. A Manual of Methods for the assessment of secondary productivity in freshwater. IBP Publication no. 17. Blackwell Scientific Publications.
7. Goldman G.R and Horne, A.J., 1983. Limnology. McGraw-Hill Book Co.
8. Hutchinson G. E., 1967. A Treatise on Limnology Vol. 2. Introduction to Lake Biology and Limno plankton. John Willey & Sons., Inc., New York.
9. Jeffrey, S.W., Mantoura R.F.C. and Wright S.W., 1997. Phytoplankton Pigments in Oceanography: guidelines to modern methods. Sponsored by SCOR and UNESCO, pp. 19-445.
10. LeCren, E.D., Lowe-MxConnel, R.H., 1980. The Function of freshwater ecosystems. IBP publication No. 22. Cambridge University Press.
11. Moss B., 1988. Ecology of freshwater: Man and Medium. 2nd Ed. Blackwell Scientific Publications.
12. Needham, J.G. and Lloyd, J.T. The life of Inland waters.
13. Pennak. R.W., 1978. Freshwater Invertebrates of the United States. 2nd Ed. Wiley, New York.
14. Pinder, L.C.V., 1978. A Key to Adult Males of British Chironomidae. Freshwater Biological Association; Publication No. 37. Scientific Publication. Wilson & Son Ltd., Britain.
15. Pontin, R.M., 1978. A Key to British Freshwater Planktonic Rotifera. Publication No. 38. Scientific Publication. Wilson & Son Ltd., Britain. 178 pp.
16. Prescott G.W., 1962, Algae of the Western Great Lakes Area. 2nd Ed., William C. Brown Co., Dubuque, Lowa.
17. Rahman M. S., 1992. Water Quality Management in Aquaculture. BRAC prokashana, Dhaka –1212

Bangladesh Agricultural University
Mymensingh-2202

B. Sc. Fisheries (Hons.)

Course Profile :

Course Code: FM 2102 Course Title: Biological Limnology

Credit: 1 Contact hours: 16 Level: 2 Semester: 2

Course Offering Department (s) :Department of Fisheries Management

Rationale:

To become successful fisheries professional, students should identify phytoplankton, zooplankton, periphyton and benthos along with their systematic classification for explaining the interactions within and between abiotic and biotic components and their role in fish production.

Course Learning Outcomes (CLO)

CLO1:Explain **c**ollection and preservation of phytoplankton, zooplankton, periphyton and benthos from different freshwater habitats

CLO2: Identify and describe the systematic classification of important phytoplankton, zooplankton, periphyton and benthos

CLO3: Estimate primary productivity of freshwater habitats and plankton standing crop through determination of Chlorophyll-*a*

CLO4: Demonstrate plankton culture techniques

CLO5: Analyze the structure and function of lentic and lotic habitats

Mapping CLO with PLO:

	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8	PLO9	PLO10
CLO1	√	√					√	√	√	
CLO2	√	√	√		√	√	√	√	√	
CLO3	√	√	√		√	√	√	√	√	
CLO4	√	√			√	√	√	√	√	
CLO5	√	√							√	

Course Contents:

Course contents	Aligned CLO	No. of Lectures
1. Collection, preservation, identification, enumeration and estimation of phytoplankton, zooplankton, periphyton and benthos from different freshwater habitats.	**CLO 1, CLO 2**	**4**
2. Quantitative study of phytoplankton, zooplankton, periphyton and benthos.	**CLO 2**	**4**
3. Estimation of primary productivity using light and dark bottle method.	**CLO 3**	**2**
4. Phytoplankton pigments analysis. Estimation of plankton standing crop through determination of Chlorophyll-*a*.	**CLO 3**	**2**
5. Demonstration of plankton culture techniques: Isolation of plankton, culture media preparation, inoculation, incubation; maintenance of stock.	**CLO 4**	**2**
6. Field visit to lentic and lotic habitats.	**CLO 5**	**2**

Teaching strategy: Lectures, Field visits, Demonstration, Practical note book, Problem based learning, Interactive learning, Group studies and Discussion.

Assessment Strategy: MCQ Test, Written test, Identification of samples, Oral test, Assignment and Presentation.

Learning Resources:

1. APHA. 1980. Standard methods for the examination of water and wastewater. 15th Edition. Washington, D.C. American Public Health Association. 1134 pp.
2. Boyd, C. E. 1979. Water Quality in Warmwater Fish Ponds. Agricultural Experiment Station, Auburn University, Alabama, USA. 359 pp.
3. Boyd, C. E. 1982. Water Quality Management for Pond Fish Culture. Elsevier, Scientific and Publishing Company, Amsterdam, Oxford, New York. 318 pp.
4. Boyd, C. E. and C. S. Tucker. 1992. Water Quality and Pond Soil Analyses for Aquaculture. Agricultural Experiment Station, Auburn University, Alabama, USA. 183 pp.
5. Egna, H. S. and C. E. Boyd. 1997. Dynamics of Pond Aquaculture. CRC Press. Boca Raton, New York. 437 pp.
6. Kaff, J. 2002. Limnology. Prentice Hall, New Jersey, USA. 591 pp.
7. Stirling, H. P. 1985 (ed.). Chemical and Biological Methods of Water Analysis for Aquaculturists. Institute of Aquaculture, University of Stirling, Scotland, UK. 119 pp.
8. Wetzel, G. W. and G. E. Likens. 1991. Limnological Analyses. 2nd Edition. Springr-Verlag, New York, Berlin, Heilberg, London, Paris, Tokyo, Hong Kong, Barcelona. 391 pp.
9. Wetzel, R. G. 1983. Limnology. 2nd Edition. Saunders Coll. Philadelphia. 858 pp.

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B. Sc. Fisheries (Hons.)

Course profile :

Course Code: AAS 2203 **Course Title: Statistics**

Credit: 3 **Contact Hours: 48** **Level: 2** **Semester: 2**

Course Offering Department(s): Department of Agricultural and Applied Statistics

Rationale:

Students with necessary knowledge on statistics will be able to plan, design and execute experiment for making better decision in the disciplines of fisheries.

Course Learning Outcomes (CLO):

1. Identify different types of variable and draw appropriate diagram.
2. Compute different measures of location, dispersion and shape characteristics of a frequency distribution.
3. Define basic terminology, laws and distributions of probability, sampling technique and distribution ,
4. Measure linear relationship between two or more variables and test of hypotheses regarding the parameters of the population.
5. Explain appropriate experimental data and conduct analysis of variance.

Mapping CLO with PLO

CLO/PLO	PLO 1	PLO 2	PLO 3	PLO 4	PLO 5	PLO 6	PLO 7	PLO 8	PLO 9	PLO 10
CLO 1		✓						✓		
CLO 2		✓						✓		
CLO 3		✓						✓		
CLO4		✓						✓		
CLO5		✓						✓		

Course content

Course Content	Aligned CLO	No of Lectures
Variable and frequency distribution: Definition of Statistics and scope of Statistics in Fisheries. Different types of variables. Frequency distribution and graphical representation.	1	3
Measures of location and dispersion: Measures of location, variation and shape characteristics of frequency distribution.	2	7
Probability distribution: Elementary theory of probability. Probability distributions: Binomial, Poisson and Normal.	3	5
Sampling: Population and sample. Basic idea on sampling techniques and determination of sample size. Preliminary idea on sampling distribution.	3	5
Correlation and regression: Simple and multiple correlation and regression. Fitting linear regression to observed data. Regression with dummy dependent variables.	4	10
Test of hypothesis: Test of hypothesis, type I and type II errors and level of significance. Idea on t-test, F-test, chi-square test. Testing hypothesis regarding population mean, equality of two means, population variance, equality of two population variances, independence of two attributes in contingency table, test of significance of correlation coefficient and regression coefficient(s).	4	8
Design of experiment: Principles of experimental design. Field layout and analysis of variance in completely randomized design, randomized block design and latin square design. Multiple comparison test. Concept and method of analysis of factorial experiments and split-plot design.	5	10

Teaching Strategy

Lectures, problem-based learning, interactive learning, group studies and discussion.

Assessment Strategy

MCQ test, written test, oral test and assignments.

Books recommended

Ahmed A. R., M. A. A. Bhuiyan, Z. A. Reza and M. Z. Hossain (2007). *Methods of Statistics*. 6th edition, S. Ahmed & Associates, Manikgonj.

Gomez, A. K. & A. A. Gomez (2010). *Statistical Procedures for Agricultural Research*. 2nd edition. Wiley-India.

Gupta, S. C. and V. K. Kapur (2007). *Fundamentals of Mathematical Statistics*. 12th edition, Sultan Chand & Sons, New Delhi.

Islam, M. N. (2011). *An Introduction to Statistics and Probability*, 3rd edition, Mullick & Brothers, Dhaka.

Montogomery, D. C. (2012). *Design and Analysis of Experiments*, 8th Edition, John Wiley & Sons.

Mood, A. M., F. A. Graybill, and D. C. Boes, (1974). *Introduction to the Theory of Statistics*, 3rd edition. McGraw-Hill.

Rangaswamy, R. (2013). *A Textbook of Agricultural Statistics*, 2nd edition, New Age International (P) Limited, Publishers, India.

Steel, R. G. D. and J. H. Torrie (1980). *Principles and Procedures of Statistics*, McGraw-Hill International Book Company, New York.

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B. Sc. Fisheries (Hons.)

Course profile :

Course Code: AAS 2204 **Course Title: Statistics**

Credit: 1 **Contact Hours: 16** **Level: 2** **Semester: 2**

Course Offering Department(s): Department of Agricultural and Applied Statistics

Rationale

With necessary knowledge on statistics, students will be able to practise of different statistical tools and techniques and conduct researches in the disciplines of fisheries.

Course Learning Outcomes (CLO):

1. Calculate and interpret the coefficients of correlation and regression.
2. Execute different statistical tests regarding the population parameters.
3. Analyze categorical data.
4. Conduct analysis of variance (ANOVA) and multiple comparison tests.

Mapping CLO with PLO

CLO/PLO	PLO 1	PLO 2	PLO 3	PLO 4	PLO 5	PLO 6	PLO 7	PLO 8	PLO 9	PLO 10
CLO 1		✓						✓		
CLO 2		✓						✓		
CLO 3		✓						✓		
CLO4		✓						✓		

Course content

Course Content	Aligned CLO	No of Lectures
Correlation: Calculation of simple and multiple correlation coefficients.	1	1

Regression: Fitting simple and multiple linear regression models.	1 & 2	2
Test of hypothesis: Testing hypothesis regarding population mean, testing significance of correlation coefficient and regression coefficient(s), Test of independence of attributes in a contingency table.	2 & 3	6
Analysis of variance: Field layout, analysis of variance and interpretation of results in completely randomized design, randomized block design and latin square design. Application of least significance difference test (lsd) and Duncan's Multiple Range Test (DMRT).	4	7
Use of statistical packages (Excel and SPSS).	1, 2, 3 &4	

Teaching Strategy

Lectures, problem-based learning, interactive learning, group studies and discussion.

Assessment Strategy

MCQ test, written test, oral test and assignments.

Books recommended

Ahmed A. R., M. A. A. Bhuiyan, Z. A. Reza and M. Z. Hossain (2007). *Methods of Statistics*. 6th edition, S. Ahmed & Associates, Manikgonj.

Gomez, A. K. and A. A. Gomez (2010). *Statistical Procedures for Agricultural Research.* 2nd edition. Wiley-India.

Gupta, S. C. and V. K. Kapur (2007). *Fundamentals of Mathematical Statistics*. 12th edition, Sultan Chand & Sons, New Delhi.

Islam, M. N. (2011). *An Introduction to Statistics and Probability*, 3rd edition, Mullick & Brothers, Dhaka.

Montogomery, D. C. (2012). *Design and Analysis of Experiments*, 8th Edition, John Wiley & Sons.

Mood, A. M., Graybill, F. A. and D. C. Boes (1974). *Introduction to the Theory of Statistics*, 3rd edition. McGraw-Hill.

Rangaswamy, R. (2013). *A Textbook of Agricultural Statistics*, 2nd edition, New Age International (P) Limited, Publishers, India.

Steel, R. G. D. and J. H. Torrie (1980). *Principles and Procedures of Statistics*, McGraw-Hill International Book Company, New York.

Zaman, S. M. H., K. Rahim and M. Howlader (1982). Simple Lessons from Biometry. Joydebpur, Dacca, Bangladesh.

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B. Sc. Fisheries (Hons.)

Course profile :

Course No. CSM 2207 **Course Title: Computer Science**

Credit: 2 **Contact Hours: 32** **Level: 2** **Semester: 2**

Course Offering Department (s) : Department of Computer Science and Mathematics

Course objectives :

The students will develop a comprehensive understanding of the basic concepts and uses of computer and will be able to efficiently apply the knowledge in practical fields.

Course contents :

1. Introduction to computers and number system: History and generation of computer, stages of data processing, computer hardware, computer software, classification of computer and number system.
2. Computer component organization: Logical organization of computer, memory, input-output devices, secondary storage devices, data representation, assembly language instructions and classification of software.
3. Human computer interface: User interface with the operating system.
4. Introduction to networking and internet: Introduction to networking- communication channel, modem, mode of transmission, type of network, internet- type of internet access, introduction to TCP/IP, domain, ISP, telnet, web browsing, web search engine, e-mail, computer virus detection and its removal.
5. Introduction to database management system (DBMS): Data types, relational databases, tables, attribute, primary and foreign keys, data normalization, interface with databases, introduction structured query language (SQL).

Text books :

1. Balaguruswamy, E. Computer for Beginners.
2. Hunt, R. and J. Shelly. Computers and Commonsense. Prentice Hall of India.
3. Leon, A., M. Leon and L. Vikas. Fundamentals of Information Technology.

References :

1. Microsoft Office – Complete Reference. BPB Publication.
2. Stultz, R. A. Learn Microsoft Office. BPB Publication.

Bangladesh Agricultural University
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B. Sc. Fisheries (Hons.)

Course profile :

Course No. CSM 2208 **Course Title: Computer Science**

Credit: 1 **Contact Hours: 16** **Level: 2** **Semester: 2**

Course Offering Department (s) : Department of Computer Science and Mathematics

Course objective	*To acquaint students with the proper procedures to create documents, worksheets, databases, programming and presentations suitable for coursework, professional purposes, and personal use.*

Course CLOs *[3-5 CLOs for each course; Students' perspective]*
At the end of the course the student should be able to:

1. Work effectively with a range of current, standard, Office Productivity software applications.
2. Solve a range of problems using office productivity applications, and adapt quickly to new software releases.
3. Use MATLAB software for numerical computations and in particular familiarizing with the Matlab Desktop, basic commands through the Command window and output through the Graph window.
4. Work independently with SPSS on their own data and provide a solid foundation for advanced data analysis work.

Course content *[Mention specific topics. Select topics to achieve the stated course objective and course CLOs]*	**Course CLO(s) to be addressed**	**No. of lectures/ practical session for each topic]**
1. Apply Input Methods: Speed/Accuracy, Proper Technique, and Ergonomics. Execute Basic Computer Operations: File management, Use Resources to Obtain Help.	1	1
2. Use Spreadsheet Applications: Formatting, Using Basic Formulas, Interpreting Data, Creating Graphs/Charts, Integrated with Word Processing.	1, 2	1
3. Use Word Processing Applications: Creating, Formatting, Proofreading/Editing, Enhancing Documents.	1	2
4. Use Database Applications: Create and Edit Database, Process Materials, Generate and Format Reports.	1, 2	2
5. Use Presentation Software: Produce and Edit Presentations, Use Sound and Animation, Apply Design and Layout Principles.	1	1
6. MATLAB: MATLAB Fundaments, MATLAB for Data Processing and Visualization, MATLAB Programming Techniques.	2, 3	3
7. SPSS interface and features: Data storage types,	2, 4	4

measures & data management in SPSS, Creating & editing quantitative & categorical graphs/charts, and advanced data tabulation.		
Teaching methods	*Lecture, Question & answer, Exercise, Demonstration, Practice, Brainstorming*	
Assessment method	*Quiz, short questions and demonstration.*	
Books recommended	1. MATLAB Guide by Desmond J. Higham, Nicholas J. Higham, Third Edition, 3rd Edition. 2. Using SPSS: An Interactive Hands-On Approach by James B. Cunningham, James O. Aldrich. 3. MS-Office by Dr. S.S. Srivastava.	

Bangladesh Agricultural University
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B. Sc. Fisheries (Hons.)

Course Profile :

Course Code: FBG 2203 **Course Title: Reproductive Physiology**

Credit: 2 **Contact Hours: 32** **Level: 2** **Semester: 2 Course**

Offering Department (s) : Department of Fisheries Biology and Genetics

Rationale: Acquiring knowledge of Fish reproduction is crucial for Fisheries students because artificial production of fish seed is one of the most important areas of work a Fisheries graduate will do in the field. Through this course, students will identify the major hormones involved in reproduction and describe their role in sexual differentiation, maturation and regulation of reproduction in males and females. Thus, this theoretical course will be very much useful for the applied course Broodstock and Hatchery management to be taught at Level-4, Semester-2.

Mapping CLO with PLO

	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8	PLO9	PLO10
CLO1	√	√	√			√		√		
CLO2	√	√	√			√		√		
CLO3	√	√	√			√		√		
CLO4	√	√	√			√	√	√		√

Course Learning Outcomes

1. Demonstrate knowledge of anatomy and histology of the reproductive system and its functions in fish and aquatic animals.

2. Demonstrate knowledge of the key steps in sexual differentiation at gonadal and external levels.Describe gametogenesis and the anatomical; structures of gametes and relate it to its functions.

3. Demonstrate knowledge of key principles of reproductive endocrinology including: a) biosynthesis of the different classes of reproductive hormones, b) mechanisms of action of hormones and c) endocrine and neuroendocrine regulation of reproduction.

4. Describe relationships between reproduction and environmental factors and factors causing reproductive dysfunction.

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Course Contents	Aligned CLO	No. of Lectures
1. Functional morphology of fish gonads: Primordial germ cells and sex differentiation. Morphology and composition of eggs and sperm; gonadal development.	CLO1	5
2. Puberty: regulation of onset of puberty, regulation of gonadal recrudescence and regulation of ovulation and spermiation.	CLO1	5
3. Gametogenesis: Oogenesis and folliculogenesis; vitellogenesis; Spermatogenesisand biology of sperm: sperm production, biochemistry of sperm, sperm motility, sperm survival and maturation. Hormonal control of gametogenesis: inducing hormones and maturation promoting factors.	CLO2	8
4. Factors regulating reproductive activity: Environmental factors and social factors. Environmental influences- photoperiod, temperature and feeding on gonadal activity and timing of reproductive cycle	CLO3	8
5. Aquatic pollution and fish reproduction: Action of pollutants on reproductive processes- hormonal control, egg production, oocyte and embryo energy metabolism. Changes in pollutant sensitivity and hatching time.	CLO4	6

Teaching strategy: Lectures, problem based learning, interactive learning, group studies and discussion.

Assessment strategy: MCQ Test, Written Test, Oral Test, Assignment and presentation.

Learning Resources

Text and Reference Books:

1. Hoar, W.S. and Randall, D.J., 1984. Fish Physiology Vols. IXA and IXB. Academic Press.
2. Potts, G.W. and Wootton, R.J. (eds), 1984. Fish Reproduction: Strategies and Tactics. Academic Press, London.
3. Hoar, W.S., Randall, D.J., and Donaldson, E.M. (eds.), 1983. Fish Physiology Vol. IXA and IXB. Academic Press.
4. Hoar, W.S. and Randall, D.J., 1969. Fish Physiology Vol. III. Academic Press.
5. Heath, A.G., 1987. Water Pollution and Fish Physiology. CRC Press.
6. Rocha, M. R., Arukwe, A. and B.G. Kapoor, 2008. Fish Reproduction. 1st Edition CRC Press. 632p.
7. Wootton, R. J. and Smith, C., 2014. Reproductive Biology of Fishes Wiley-Blackwell Paperback: 368p.
8. Bernier, N., Kraak, G.V.D., Farrell, A., and Brauner, C. (eds.) 2009. Fish Physiology, Volume 28 Fish Neuroendocrinology. Elsevier. 560p.
9. Heath, A. G., 1995. Water Pollution and Fish Physiology 2nd Edition. CRC Press Boca Raton. 384p.
10. Thomas, P C., 2018. Breeding and Seed Production of Fin Fish and Shell Fish. Daya Publishing House, India. 402p.
11. Hoar, W.S. and Randall, D.J., 1988. Fish Physiology Vol. XI (B).
12. Matty, A.J., 1985. Fish Endocrinology. Croom Helm, London, Sydney. TIMBER PRESS Portland, Oregon.

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B. Sc. Fisheries (Hons.)

Course Profile *(Profile of xx Number of Courses)*

Course Code: **AQ 2203** **Course Title:** **Live Food Culture**

Credit: **2** **Contact Hours:** **32** **Level:** **2** **Semester:** **2**

Course offering department(s): **Department of Aquaculture**

Rationale:

In order to address organic aquaculture, aquaculturists ought to have expertize on mass culture of live food.

Course Learning Outcomes (CLO): *(Max 5)*

CLO 1: Develop knowledge about different types of microalgae, its role and importance as live food

CLO 2: Prepare different types of media to culture yeast, mold and bacteria

CLO 3: Characterize culture systems of freshwater and marine water algae

CLO 4: Explain different culture techniques of important rotifers, cladocerans, copepods, annelids, maggot of house fly, larvae of chironomus, cluex flies larvae and brine shrimp

CLO 5: Choose low cost spirulina production method for various purpose

Mapping CLO with PLO

CLO/ PLO	PLO 1	PLO 2	PLO 3	PLO 4	PLO 5	PLO 6	PLO 7	PLO 8	PLO 9	PLO 10
CLO 1	✓	✓								
CLO 2	✓	✓				✓				
CLO 3	✓	✓				✓		✓		
CLO 4		✓		✓		✓		✓		
CLO 5		✓	✓		✓		✓		✓	

Summary of Course Content

Content	Aligned CLO	No. of lectures
Importance, present status, and prospect of live food in aquaculture, types of live food organisms: Phytoplankton, zooplankton, microcrustaceans and other food organisms; their nutritive values.	CLO 1	6
Culture of microrganisms: Preparation of media, isolation and culture techniques of yeast, mold and bacteria	CLO 2	4
Culture of algae: Freshwater and sea water representative algae culture in sterilized media. Culture technique - batch culture, and continuous culture, culture in cheap media prepared from agroindustrial wastes, techniques of instant marine algae production.	CLO 3	10
Culture techniques of important freshwater and marine rotifers, cladocerans, copepods, annelids, maggot of house fly, larvae of chironomus, cluex flies larvae and brine shrimp	CLO 4	8
Low cost spirulina production for various purpose	CLO 5	3
Class Test		1
Total		32

Teaching Strategy:

Lecture, Multi-media, Video clipping, Demonstration.

Assessment Strategy:

Written exam, Quiz, Viva-voce, Field trip, Assignment.

Recommended books and other resources:

1. Fulks, W and Main, K. L. (eds) (1992). Rotifer and microalgae culture systems. Argent Laboratory Press. 364 pp.
2. Lavens and Sorgeloos (eds). 1996. Manual on the production and use of live food for Aquaculture. 295 pp.
3. Stottrup (2002) Live feed for fish. (in press) 336 pp

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B. Sc. Fisheries (Hons.)

Course Profile :

Course Code: FM 2203 **Course Title: Aquatic Pollution and Ecotoxicology**

Credit: 2 **Contact hours: 32** **Level: 2** **Semester: 2**

Course Offering Department (s) : Department of Fisheries Management

Rationale: To get the pollution free aquatic environment, students should know the salient features of the causes/sources of aquatic pollution and their impacts on the flora and fauna; and mitigation measures of reducing/avoiding aquatic pollution.

Course Learning Outcomes (CLO)

1. Define the basic terminologies and key concepts of aquatic pollution and ecotoxicology
2. Discuss the different inputs used in agriculture and industry and their adverse impacts on the aquatic environment and mitigation measures
3. Classify the water and sediment treatment compounds used in semi-intensive aquaculture and their negative environmental impacts
4. Describe the causes of coastal and marine environmental degradation and make recommendation to reduce the pollution

Mapping CLO with PLO

	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8	PLO9	PLO10
CLO1	√	√						√		
CLO2	√	√	√	√		√		√		
CLO3	√	√		√		√		√		
CLO4	√	√				√		√		

Course Contents:

Course contents	**Aligned CLO**	**No. of Lectures**
1. Aquatic environment and pollution**:** Key concepts, importance of aquatic environmental maintenance, sensitivity of aquatic biota on environmental changes (DO, pH, NH_3& NO_2, harmful gases, turbidity, salinity), aquatic pollution, sources of pollution, impacts of pollution on aquatic plants, animals and human health.	**CLO 1**	**5**
2. Agricultural development and pollution**:** Trends in agricultural development and HYV, inputs used in agriculture (fertilizers,	**CLO 2**	**6**

insecticides & pesticides), pollution due to agricultural wastes and pesticides, impacts on aquatic resources.		
3. Industrial development and pollution**:** Types of industries, location, raw materials used, sources and types of industrial byproducts and pollution,toxic effects of pollutants from tannery, pharmaceutical, dying and textiles, fertilizers, and chemical industries on freshwater and marine ecosystems.	**CLO 2**	**6**
4. Aquaculture development and environment**:** Culture practices and related problems, land and water use, materials and inputs used (feeds, fertilizers, chemicals and therapeutants), nutrient accumulation and eutrophication, drainage effect on the adjacent areas and water bodies, loss of natural habitats - mangroves, agricultural lands, livestock pastures etc., suggestions for sustainable growth of aquaculture industries.	**CLO 3**	**5**
5. Algal toxins**:** Toxic algal blooms, ecological implications of algal toxins in 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, domoic acid, links between algal toxin, biological changes and productivity,control strategies.	**CLO 4**	**5**
6. Coastal and marine environment degradation**:** Causes and nature of degradation of coastal and marine environment (urbanization, tourisms, shrimp farming, sewages, municipal wastes, disposal of solid wastes, industrial wastes, ship breaking activities, oil spillage etc.), impact on coastal and marine fisheries, measures for maintenance of coastal and marine environment for all living organisms.	**CLO 4**	**5**

Teaching strategy: Lectures, Problem based learning, Interactive learning, Group studies and Discussion.

Assessment Strategy: MCQ Test, Written test, Oral test, Assignment and Presentation.

Text books:

1. Alabaster, J.S. and R. Lloyd. 1982. Water Quality Criteria for Freshwater Fish. 2nd Ed. Butterfly Scientific Publisher, London. 361 pp.
2. Lloyd, R. 1992. Pollution and Freshwater Fish. Fishing News Books, Oxford, UD. 176 pp.
3. Moriarty, F. 1993. Ecotoxicology: The Study of Pollutants in Ecosystems. Second Edition. T. J. Press (Padstow) Ltd., Padstow, Cornwall, Great Britain. 289 pp.

References:

1. Boyd, C. E. 1988. Water Quality Management for Pond Fish Culture. Elsevier Scientific Publisher B. V., Amsterdam. 318 pp.
2. Calhoun, Y. 2005. Water Pollution. Chelsea House Publishers. 164 pp.
3. Calow, P. 1993 (ed.) Handbook of Ecotoxicology. Volume One. T.J. Press (Padstow) Ltd., Padstow, Cornwall, Great Britain. 289 pp.
4. Carmichael, W.W. 1981 (ed.). The Water Environment: Algal Toxins and Health. Plenum Press.New York. 491 pp.
5. Chorus, I. 2001 (ed.).Cyanotoxins – Occurrence, Causes, Consequences. Springer. 357 pp.
6. Falconer, I.R. 1993. Algal Toxins in Sea Food and Drinking Water. Academic Press. 224 pp.
7. Laws, E.A. 2000. Aquatic Pollution: An Introductory Text. 3rd Ed. Wiley. 639 pp.
8. Saxena, M.M. 1990. Environmental Analysis: Water, Soil and Air. Second Edition. Agro Botanical Publishers (India). 186 pp.
9. Smol, S. 2005. Pollution of Lakes and Rivers. A Hodder Arnold Publication.
10. Ulrich, F. 1981. Metal Pollution in the Aquatic Environment. Springer Verlag.

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B. Sc. Fisheries (Hons.)

Course Profile :

Course Code: FT2221 Course Title: Fisheries Chemistry

Credit: 2 Contact Hours: 32 Level: 2 Semester: 2

Course offering department: Department of Fisheries Technology

Rationale:
To equip the students on different aspects of chemistry of aquatic foods by addressing the chemical composition and nutritive value of body constituents, nature of body structure, characteristics and interactions among different components to have a thorough understanding on quality, processability and shelf life of aquatic products.

Course Learning Outcomes (CLOs)

CLO 1: Describe the composition and chemical interactions among the components of fish or other aquatic foods.

CLO 2: Analyze the chemical interactions of body elements to determine quality, processability and shelf life of aquatic foods.

CLO 3: Outline the nutritional benefits of aquatic foods and propose useful aids to extend shelf life and maintain quality.

Mapping CLO with PLO

CLO/PLO	PLO 1	PLO 2	PLO 3	PLO 4	PLO 5	PLO 6	PLO 7	PLO 8	PLO 9	PLO 10
CLO 1	✓			✓						
CLO 2		✓			✓					
CLO 3		✓			✓	✓				✓

Course Content

Course Content	Aligned CLO	No of Lectures
1. **Major groups of aquatic food:** Fish, crustaceans, mollusks and marine algae (macro and micro algae)	CLO 1	5
2. **Protein in aquatic food:** Protein content, protein groups, protein structure, denaturation of protein, characteristics of muscle proteins, polymerization of proteins, principles and methods of analysis of proteins, amino acid profile gelation properties of muscle proteins, changes of protein during processing and preservation of fish and shellfish	CLO 1, 2 & 3	7

3. **Lipid in aquatic food:**Lipid types and their variations, characteristics of fatty acids, polyunsaturated and essential fatty acids, principles and methods of analysis of fatty acids, fatty acid profile, rancidity and its control measures,	CLO 1, 2 & 3	5
4. **Macro and trace elements:** Inorganic components in aquatic food, effect of processing and preservation on mineral composition	CLO 1, 2 & 3	3
5. **Vitamins:** Fat- and water-soluble vitamins, vitamin content in small fish, farmed fish and marine fish, effect of processing and preservation on vitamin content.	CLO 1, 2 & 3	3
6. **Flavour compounds:**Nitrogenous and volatile compounds.	CLO 1 & 2	4
7. **Bio-toxins:** Toxin in aquatic vertebrates, invertebrates, seaweed and plankton, bioaccumulation of toxins, pharmacology of bio-toxins, preventive/control measures	CLO 1, 2 & 3	4
Class test		1
Total		**32**

Teaching Strategy

Class Lectures, Problem based learning, Interactive learning, Group discussion, Web based learning.

Assessment Strategy

Strategic Questioning, MCQ test, Written test, Oral test, Assignment, Presentation

Text books:

1. Hall, G. M. 1997 (ed.). Fish Processing Technology. 2nd Edition. Blackie Academic & Professional, London, Weinheim, New York, Melbourne, Madras. 309 pp.
2. Huss, H. H., M. Jakobsen and J. Liston. 1992. Quality assurance in Fish Industry. In Development in Food Science, Elsevier, Amsterdam, London, New York, Tokyo. 587 pp.
3. Noguchi, T. and K. Hashimoto. 1997. A Pictorial Handbook of the Toxic Fishes Related to Food Hygiene. Midori-Shobou, Tokyo.
4. Ruiter, A. 1995. Fish and Fishery Products: composition, nutritive properties and stability, Cab International, Oxon, UK. 387 pp.

References:

1. Balachandran, K. K. 2001. Post-harvest Technology of Fish and Fish Products. Daya Publishing House, Delhi – 110035. India. 440 pp.
2. Gopakumar, K. 2002 (ed.). Textbook of Fish Processing Technology. Indian Council of Agricultural Research, New Delhi.
3. Govindan, T. K. 1985. Fish Processing Technology. Oxford & IBH publishing Co., New Delhi.
4. Hashimoto, Y. 1979. Marine Toxins and Other Bioactive Marine Metabolites. Japan Scientific Society Press, Japan.
5. Martin, A. M. 1994 (ed.). Fisheries Processing: Biotechnological Applications. Chapman and Hall, London. 494 pp.
6. Motohiro, T., K. Hashimoto, H. Kadota and T. Tokunaga. 1992. Science of Processing Marine Products, Vol. I & II. Kanagawa International Fisheries Training Center. Japan International Cooperation Agency.
7. Nowsad, A. K. M. A. 2007. Participatory Training of Trainers: A New Approach Applied in Fish Processing. Bangladesh Fisheries Research Forum, Dhaka. 326 pp.
8. Stansby, M.E. 1963. Industrial Fishery Technology. Krieger Publ. Co., Hunligton, New York.

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Course Profile :

Course Code: MFS 2201 Course Title: Meteorology and Ocean Forecasting

Credit: 2 Contact Hours: 32 Level: 2 Semester: 2

Course Offering Department (s) : Department of Marine Fisheries Science

Rationale:

The purpose of this course is to provide knowledge about forecasting marine weather phenomena, variables and parameters, continuously analyzing and monitoring marine weather conditions and warning of dangerous phenomena.

Course learning outcomes:

CLO1. Understand on tropical weather and different weather data sources of oceans.
CLO2. Identify characteristics of waves and swell and monitor sea ice characteristics.
CLO3. Use forecasting model outputs in hazardous conditions.

Mapping CLO with PLO:

	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8	PLO9	PLO10
CLO1	√					√				
CLO2	√			√	√			√		
CLO3	√	√							√	√

Course contents:

Sl. No.	**Course contents**	**Aligned CLO**	**No. of Lectures**
1.	Introduction to meteorology: The causes of weather, raw materials of weather studies	CLO1	2
2.	Air-Mass: Properties and types, Clouds as Air-Mass characteristics, Different geographic Air- Masses	CLO1, CLO2	4
3.	Atmospheric Circulation: Pressure and winds, Forces of balance, The Mechanisms of lows and highs, Thermal system, early circulation model	CLO1, CLO2	6
4.	World weather types: Equatorial, Tropical, Desert, Mediterranean, Temperate and Polar weather. Tropical Monson weather and tropical cyclone (BoB & Indian ocean weather)	CLO1, CLO2, CLO3	6
5.	The processing of weather information: Weather station devices, weather station at sea, weather information from the satellite. Weather Forecasting: Conventional forecasting methods, Numerical models, Cyclone	CLO1, CLO2,	7

	forecasting and warning system		
6.	Tropical meteorology: data sources (Oceanographic data, Satellite data, weather data, radar data); Pressure and winds; Temperature and water vapor; Clouds and rainfall	CLO2, CLO3	6
7.	Class test		1

Teaching strategy: Lectures, Problem based learning, Interactive learning, Group studies and Discussion.

Assessment Strategy: MCQ Test, Written test, Assignment.

Learning Resources:

1. Moses, L L & Tomikel (1981) Basic Meteorology: An Introduction to the Science. Allegheny Press, ISBN 091004203.

2. Miller, A & M Parry (1975) Everyday Meteorology. Hutchinson of London.

3. Kendrew, W G (1943) Weather: An Introductory Meteorology. Oxford University Press.

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B. Sc. Fisheries (Hons.)

Course Profile :

Course Code: FBG 3101 **Course Title: Fundamentals of Genetics**

Credit: 3 **Contact Hours: 48** **Level: 3** **Semester: 1**

Course Offering Department (s) : Department of Fisheries Biology and Genetics

Rationale:

In order to apply knowledge of genetics for improving fish population, students will need to acquire basic knowledge in terms ofnature and structure of genetic materials, principles of heredity, gene interactions and alterations, the mechanisms of sex determination and phenotypic expression of genes.

Course learning Outcomes (CLO):

CLO1. Illustrate the cell mechanics, genetic materials and chromosome number of fish species having economic importance.
CLO2. Explain Mendelian genetics and gene interaction, linkage and crossing over.
CLO3. Classify fish based on sex determining systems and sex related traits.
CLO4. Discuss transcription and translation of gene controlling the phenotypic traits of fish.
CLO5. Describe mutation, and mutagenic effects on gene expression.

Mapping CLO with PLO:

	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8	PLO9	PLO10
CLO1	√	√	√							
CLO2	√	√				√		√		
CLO3	√	√				√		√		
CLO4	√	√					√	√		
CLO5	√	√				√	√	√		

Course contents:

Course contents	Aligned CLO	No. of Lectures
13. Introduction: Milestones, branches, scope and significance of genetics.	**CLO 1, CLO 2**	**2**
14. Cell mechanics: Introduction to prokaryotic and eukaryotic cells, constituents of eukaryotic cells and their functions, cell division and gametogenesis.	**CLO 1**	**8**
15. Genetic material: Composition of eukaryotic chromosomes,	**CLO 1**	**10**

packaging DNA molecule into chromosomes,variation in chromosome number, organization of a eukaryotic gene, DNA and RNA structure, DNA replication.		
16. Mendelian genetics: Mendel and his works,Mendel's laws of inheritance, interaction of genes, complete and incomplete dominant gene action, additive gene action, epistasis, epistatic and non-epistatic interaction, multiple allelism, lethal genes, pleiotropy; penetrance and expressivity, linkage and crossingover.	**CLO 2**	**13**
17. Sex determination and sex chromosome: Different sex determining systems, sex-linked traits, sex-influenced and sex-limited traits.	**CLO 3**	**5**
18. Phenotypic expression of genes: Transcription and translation, the genetic code and its properties.	**CLO 4**	**4**
19. Mutation: Types of mutation and chromosomal aberration, practical application of mutations.	**CLO 5**	**5**
20. Mid-term Examination	**-**	**1**

Teaching strategy: Lectures, Problem based learning, Interactive learning, Q/A session, Group studies and Discussion.

Assessment Strategy: MCQ Test, Written test, Quiz, Oral test, Assignment and Presentation.

Learning Resources:

1. Gardner, E.J, Simmons,M. J. and Snustad, D. P. 1991. Principles of Genetics (8th Edition), John Willey and Sons, Inc. 736 pp.
2. Strickberger, M. W. 1990. Genetics (3rd Edition), Macmillan Publishing Co, NY.
3. Tave, D. 1993. Genetics for Fish Hatchery Managers, 2nd Edition. Van Nostrand Reinhold, New York. 415 pp.
4. Verma, P.S. and V. K. Agarwal. 1989. Genetics. S. Chand and Company Ltd. Ram Nagar, New Delhi-110055.
5. Alberts, B., A. L. Johnson, J. Raff, M. Roberts and P. Walter. 2008. Molecular Biology of the Cell. 5th Edition. Garland Science (Taylor and Francis Group).
6. Lewis. B. 1997. Genes. Oxford University Press.
7. Purdom, C. E. 1992. Genetics and Fish Breeding. Chapman and Hall, London, UK.
8. Book from BAU Professor

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Course Profile :

Course Code: FBG 3122 **Course Title: Fundamentals of Genetics**

Credit: 1 **Contact Hours: 16** **Level: 3** **Semester: 1**

Course Offering Department (s) : Department of Fisheries Biology and Genetics

Rationale:

In order to apply knowledge of genetics forimproving fish population, students will need to acquire basic knowledge on cell division, chromosome preparation and DNA extraction, mathematical interpretation of Mendelian inheritance and sex ratio analysis.

Course learning Outcomes (CLO):

CLO1. Illustrate and identify the cell divisional stages, prepare chromosome from fish tissue.
CLO2. Analyze qualitative and quantitative phenotypes of fish through Chi-square test.
CLO3. Prepare and isolate DNA from fish tissue for further genetic analysis.

Course contents:

Course contents	Aligned CLO	No. of Lectures
8. Study of cell division, chromosome preparation from tissue or embryo.	**CLO 1**	**6**
9. Exercise on inheritance of qualitative phenotypes; pedigree analysis and chi-square test.	**CLO 2**	**4**
10. Sex ratio analysis from crosses of fish with pre-determined sex chromosome.	**CLO 2**	**2**
11. Techniques of genomic DNA isolation from fish tissue or embryos.	**CLO 3**	**3**
12. Mid-term Examination	**-**	**1**

Teaching strategy: Lectures, Problem based learning, Interactive learning, Q/A session, Group studies and Discussion.

Assessment Strategy: MCQ Test, Written test, Quiz, Oral test, Assignment and Presentation.

Learning Resources:

1. Krauter, K. and M. Winey.2012. Practical Genetics for the 21st Century. Flat world Knowledge.
2. Tave, D. 1993. Genetics for Fish Hatchery Managers, 2nd Edition. Van Nostrand Reinhold,New York.

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Course Profile :

Course Code: AQ 3121 **Course Title: Aquafarm Design and Construction**

Credit: 2 **Contact Hours: 32** **Level: 3** **Semester: 1**

Course offering department(s): Department of Aquaculture

Rationale:

Having this course, students will be acquainted with the basic principles of aquaculture engineering for fish farm design and construction. They will gain knowledge on different aquaculture systems, site selection process as per system characteristics, farm planning, design, construction, and project management aspects.

Course learning Outcomes (CLO):

CLO1. Design various aquaculture systems based on the principles of aquaculture engineering.
CLO2. Discuss and illustrate the cconstruction process of various aquaculture systems.
CLO3. Explain/demonstrate aeration and hydraulic systems of a fish farm.
CLO4. Plan a farm layout including nurseries and grow out units for carp, catfish, tilapia and shellfish farms and estimate the construction and operating cost.
CLO5. Describe waste water treatment and disposal techniques.

Mapping CLO with PLO:

	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8	PLO9	PLO10
CLO1	√	√	√				√		√	
CLO2	√	√		√	√					
CLO3	√	√				√				
CLO4	√	√			√			√	√	√
CLO5							√			

Course contents:

Course contents	Aligned CLO	No. of Lectures
21. Introduction: Definition, scope, application of the principles of aquaculture engineering, aquaculture systems: land based, water based and specialized systems and their site selection process	**CLO1**	**6**
22. Basic hydraulic systems: Basic relationships in hydraulic systems, types of pumps and its installation procedures. Water flow through channel, pipe, sluice gate, monk, tidal gate and pen stock gate.	**CLO 3**	**4**
23. Design, construction and operation of fish hatcheries: Basic data, calculation of water requirement, temperature requirement, and technological design and connecting facilities.	**CLO 4**	**5**
24. Project planning and designing, farm layout including nurseries and grow out units for carp, catfish, tilapia and shellfish farms.	**CLO 4**	**4**
25. Design of specialized aquaculture systems: Cages, raceways, tanks, recirculatory system, on-bottom and off-bottom culture systems.	**CLO 1**	**4**
26. Aeration systems: Oxygen budget; types of blowers, aerators, compressors and oxygenation systems.	**CLO 3**	**2**
27. Construction process: Contract, tender and bid; bill of quantity, project costing, project site management, project monitoring and project ancillaries.	**CLO2**	**3**
28. Wastewater treatment and disposal: Types of wastes in aquaculture farms, waste management and wastewater treatment by physical, chemical and biological methods. Sterilization and disinfection of farm units by different physical and chemical methods.	**CLO5**	**3**
29. Mid-term Examination		**1**
Total		**32**

Teaching strategy: Lectures, Problem based learning, Q/A session, Group studies and Discussion.

Assessment Strategy: MCQ Test, Written test, Quiz, Oral test, Assignment and Presentation.

Learning Resources:

Text Books

1. Tidwell, J. H. 2012. Aquaculture Production Systems, Willy-Blackwell and World Aquaculture Society. USA. pp. 440.
2. Lawson, T. B. 1995. Fundamentals of Aquaculture Engineering. Chapman and Hall. An International Thomson Publishing Company, New York, USA.
3. FAO. 1884. Inland Aquaculture Engineering, Food and Agricultural Organizations of the United Nations, Rome, Italy.

References

1. Hochleithner, M. 2012. Aquaculture Technology: Fishfarming and Equipment, AquaTech, USA.
2. Lekang, O. 2007. Aquaculture Engineering, Wiley-Blackwell. pp. 352.
3. Coche, A. G. and J. F. Muir. 1992. FAO Training Service, Simple Methods for Aquaculture, FAO, UNO, Rome, Italy.
4. Gray, C.W. 1990. A Guide to Shrimp and Prawn Hatchery Techniques in Bangladesh. BAFRU, IOA, University of Stirling, Scotland, UK.
5. Breverage, M.C.M. 1987. Cage Aquaculture Fishing News Book, Surry, UK.
6. Pillay, T.V.R. 1993 Aquaculture Principles and Practices. Fishing News Books, London, UK.

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Course Profile :

Course Code:	**AQ 3122**		**Course Title: Aquafarm Design and Construction**				
Credit:	**1**	**Contact Hours:**	**16**	**Level:**	**3**	**Semester:**	**1**
Course offering department(s): Department of Aquaculture							

Rationale:

In order to apply knowledge of aquafarm design and construction for enhancing fish production, students will need to acquire practical knowledge and skills on planning, designing and construction of aquaculture systems using different materials, and their operational procedures in the laboratory and in the field context.

Course learning Outcomes (CLO):

CLO1. Analyze water quality parameters for developing water quality index for fish farming
CLO2. Illustrate and explain different land, and water based aquaculture and specialized aquaculture systems and their associated systems components
CLO3. Explain a typical earthen pond construction
CLO4: Auditing aquaculture farm standard through visit and direct observations

Course contents:

Course contents	Aligned CLO	No. of Lectures
13. Water quality determination and developing an index for standard aquaculture	**CLO 1**	**1**
14. Types of water pumps and different water supply system in aquaculture farms	**CLO 2**	**2**
15. Oxygenation and aeration in intensive aquaculture system, oxygen demand determination, and setting aeration devices	**CLO 2**	**2**
16. Determining ammonia context in the water of intensive aquaculture system	**CLO 2**	**1**
17. Designing earthen pond complex and planning through plane table and counter survey	**CLO 3**	**1**

18. Designing cage farm and construction, cost-effective analysis of a cage farm	**CLO 2**	**2**
19. Recirculatory aquaculture system (RAS) design and its operation	**CLO 2**	**1**
20. Investigation on raceway aquaculture system	**CLO 2**	**1**
21. Studies on biofloc aquaculture system	**CLO 2**	**1**
22. Design and planning a typical fish hatchery complex	**CLO 2**	**1**
23. Studies on basic civil engineering materials and calculation of the materials and cost required to design and construct an unit area	**CLO 2**	**1**
24. Visiting an aquaculture farm and make an audit using a standard certification checklist	**CLO 4**	**1**
25. Mid-term Examination		**1**
Total		**16**

Teaching strategy: Lectures, Problem based learning, Interactive learning, Q/A session, Group studies and Discussion.

Assessment Strategy: MCQ Test, Written test, Quiz, Oral test, Field visit, Assignment and Presentation.

Learning Resources:

1. Coche, A. G. and J. F. Muir. 1992. FAO Training Service, Simple Methods for Aquaculture, FAO, UNO, Rome, Italy.
2. Coche, A. G. and T. Laughlin. 1998. Training Series, Topographic Tools. FAO, Rome, Italy.
3. Coche, A. G., J. F. Muir and T. Laughlin. 1995. Training Series, Pond Construction. FAO, Rome, Italy.
4. Giovannini, P. 1991. Aquaculture Systems Engineering. American Society of Agricultural Engineers, USA.
5. Wheaton, F. W. 1985. Aquaculture Engineering. Robert E. Kriger Publications, Florida, USA.

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Course Profile :

Course Code: AQ 3103 **Course Title: Fish Nutrition**

Credit: 3 **Contact Hours: 48** **Level: 3 Semester:1**

Course offering department(s): Department of Aquaculture

Rationale:

In order to produce healthy, high quality aquaculture products at commercial level in an economically sustainable way the fisheries graduates ought to have a clear understanding about the essentiality/importance of nutrition in aquaculture.

Course Learning Outcomes (CLO):

CLO 1: Assess the role of nutrition to boost up the aquaculture production

CLO 2: Interpret the classifications, functions and requirements of individual nutrients

CLO 3: Relate different energy producing pathways

CLO 4: List disorders due to deficiency of individual nutrients

CLO 5: Execute the knowledge to enhance the overall aquaculture production

Mapping CLO with PLO

CLO/ PLO	PLO 1	PLO 2	PLO 3	PLO 4	PLO 5	PLO 6	PLO 7	PLO 8	PLO 9	PLO 10
CLO 1	✓	✓	✓							✓
CLO 2	✓	✓	✓	✓		✓				
CLO 3	✓	✓				✓		✓		
CLO 4		✓		✓						
CLO 5	✓	✓	✓		✓		✓		✓	

Summary of Course Content

Content	Aligned CLO	No. of lectures
Introduction: Feed and nutrients, role of nutrition in aquaculture practices, terminology used in fish nutrition, nutrition of larval, growout and brood fish.	CLO 1	4
Protein: Quantitative dietary protein requirements for fish and crustaceans, amino acid requirement, factors affecting amino acid requirement, amino acid availability, importance of amino acid profile in fish nutrition, protein digestion and absorption, protein metabolism, evaluation of protein quality.	CLO 2, CLO 5	10
Lipid: Classification and function of lipids, dietary lipid requirement of fish and shellfish, essential fatty acid requirement of fish and shellfish, digestion and absorption of lipid, biosynthesis and metabolism of fatty acids, importance of fatty acid profile in fish nutrition.	CLO 2 CLO 5	8
Carbohydrates: Classification and functions of carbohydrate, digestion and absorption, metabolism, utilizations of dietary carbohydrates and fibre.	CLO 2 CLO 5	6
Vitamins and minerals: Classification and general functions, dietary sources and requirement of vitamins and minerals for fish.	CLO 2 CLO 5	8
Energy metabolism in cultivable fish and crustaceans: Partitioning of biological energy, specific dynamic action, energy requirement, energy balance equation and its use in aquaculture, factors affecting energy requirements, dietary energy sources, protein-energy ratio.	CLO 3	6
Nutritional disorders in fish and shellfish: Disorders due to deficiency/excess of protein, lipid, carbohydrate, vitamins and minerals in fish and shellfish.	CLO 4	5
Class Test		1
Total		48

Teaching Strategy:

Lecture, Multi-media, Video clipping, Demonstration.

Assessment Strategy:

Written exam, Quiz, Viva-voce, Field trip, Assignment.

Recommended books and other resources:

Text books:

1. De Silva, S.S. And Anderson, T.A. 1995. Fish nutrition in aquaculture. Chapman & Hall, London, 319 pp.
2. Halver, J.E. 1988. Fish Nutrition. Academic Press, New York, 798 pp.
3. Hepher, B. 1990. Nutrition of Pond Fishes. Cambridge University Press, Cambridge, 388 pp.
4. Lovell, T., 1998. Nutrition and Feeding of Fish. Kluwer Academic Publishers, 3300 AH Dordrecht, The Netherlands, 267 pp.
5. AOAC, 1990. Official Methods of Analysis-15th Edition, Association of Official Analytical Chemists, Washington DC.
6. Goddard, S., 1996. Feed Management in Intensive Aquaculture, Chapman & Hall, Dept. BC, 115 Fifth Avenue, New York, NY 10003, 194 pp.
7. Guillaume, J., Kaushik, S., Bergot, P. and Metailler, R., 2001. Nutrition and Feeding of Fish and Crustaceans. Praxis Publishing, Chichester, UK, 408 pp.
8. New, M.B., 1987. Feed and Feeding of Fish and Shrimp. ADCP/REP/87/26, UNDP/FAO, Rome, 275 pp.
9. Steffens, W., 1989. Principles of Fish Nutrition. Ellis Horwood Ltd., West Sussex, 384 pp.
10. Tacon, A.G.J., 1990. Standard Methods for the Nutrition and Feeding of Farmed Fish and Shrimp. Argent Laboratories Press, Washington, 454 pp.
11. Tacon, A.G.J. and Basurco, B., 1997. Feeding Tomorrow's Fish. CIHEAM/FAO/IEO, Zaragoza (Espana), 307 pp.

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Course Profile :

Course Code: AQ 3104 **Course Title: Fish Nutrition**

Credit: 1 **Contact Hours: 16** **Level: 3** **Semester: 1**

Course offering department(s): Department of Aquaculture

Rationale:

In order to acquire practical knowledge and skills on various nutrients of fish and fish feed to apply those knowledge and skills for the production of safe and quality aquaculture products.

Course Learning Outcomes (CLO):

CLO 1: List down different laboratory equipments and safety procedures

CLO 2: Outline the procedures of proximate composition analysis of different fish, feed ingredients and compound feeds

CLO 3: Assess the digestibility of different fish feed

CLO 4: Examine growth performances under different feeding practices in field conditions

Mapping CLO with PLO

CLO/ PLO	PLO 1	PLO 2	PLO 3	PLO 4	PLO 5	PLO 6	PLO 7	PLO 8	PLO 9	PLO 10
CLO 1	✓	✓								
CLO 2	✓	✓	✓			✓		✓	✓	✓
CLO 3		✓	✓	✓		✓		✓		
CLO 4	✓	✓	✓		✓		✓			✓

Summary of Course Content

Content	Aligned CLO	No. of lectures
Introduction to laboratory equipment and safety procedures.	CLO 1	1
Proximate composition analysis, feed ingredients, compounded feed and naturally produced food and carcass samples: a) moisture/ dry matter, b) protein, c) lipid, d) ash, and e) crude fibre.	CLO 2	5
Techniques for faecal collection.	CLO 3	2
Determination of chromic oxide content in feed and fecal sample for the determination of digestibilty.	CLO 3	2
Analysis of growth responses, food conversion and protein utilization.	CLO 4	2
Study of growth performances under different feeding practices in field conditions	CLO 4	2
Aquaculture farm visit		1
Class Test		1
Total		16

Teaching Strategy:

Lecture, Multi-media, Video clipping, Demonstration.

Assessment Strategy:

Written exam, Quiz, Viva-voce, Field trip, Assignment.

Recommended books and other resources:

Text books:

1. De Silva, S.S. And Anderson, T.A. 1995. Fish nutrition in aquaculture. Chapman & Hall, London, 319 pp.
2. Halver, J.E. 1988. Fish Nutrition. Academic Press, New York, 798 pp.
3. Hepher, B. 1990. Nutrition of Pond Fishes. Cambridge University Press, Cambridge, 388 pp.
4. Lovell, T., 1998. Nutrition and Feeding of Fish. Kluwer Academic Publishers, 3300 AH Dordrecht, The Netherlands, 267 pp.
5. AOAC, 1990. Official Methods of Analysis-15th Edition, Association of Official Analytical Chemists, Washington DC.
6. Goddard, S., 1996. Feed Management in Intensive Aquaculture, Chapman & Hall, Dept. BC, 115 Fifth Avenue, New York, NY 10003, 194 pp.
7. Guillaume, J., Kaushik, S., Bergot, P. and Metailler, R., 2001. Nutrition and Feeding of Fish and Crustaceans. Praxis Publishing, Chichester, UK, 408 pp.

8. New, M.B., 1987. Feed and Feeding of Fish and Shrimp. ADCP/REP/87/26, UNDP/FAO, Rome, 275 pp.
9. Steffens, W., 1989. Principles of Fish Nutrition. Ellis Horwood Ltd., West Sussex, 384 pp.
10. Tacon, A.G.J., 1990. Standard Methods for the Nutrition and Feeding of Farmed Fish and Shrimp. Argent Laboratories Press, Washington, 454 pp.
11. Tacon, A.G.J. and Basurco, B., 1997. Feeding Tomorrow's Fish. CIHEAM/FAO/IEO, Zaragoza (Espana), 307 pp.

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B. Sc. Fisheries (Hons.)

Course Profile :

Course Code: FM 3101 **Course Title: Fish Population Dynamics**

Credit: 3 **Contact Hours: 48** **Level: 3** **Semester: 1**

Course Offering Department (s) : Department of Fisheries Management

Rationale:

This course is to expose students to basic concepts of fish population dynamics, to acquaint with models for estimation of population parameters, and to familiarize how these population parameters are used for sustainable exploitation and management of fisheries resources.

Course learning Outcomes (CLO):

CLO1. Discuss introductory aspect and importance of fish population dynamics study.
CLO2. Explain **distribution and abundance of individuals of fish population**.
CLO3. Explain **size relationships and length selectivity to fishing gears.**
CLO4. Discuss the estimation of population parameters and life history pattern of fish population.
CLO5. Describe the relationship population dynamics with stock assessment and yield estimation.

Mapping CLO with PLO:

	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8	PLO9	PLO10
CLO1	√	√	√							
CLO2	√	√				√		√		
CLO3	√	√				√		√		
CLO4	√	√					√	√		
CLO5	√	√				√	√	√		

Course contents:

Course contents	Aligned CLO	No. of Lectures
30. Introduction: Definitions, scope and importance.	**CLO 1**	**2**
31. Distribution and abundance: The concept of unit stock, identification and separation of unit stocks, spacing within a unit stock, relative abundance, marking and tagging, absolute abundance of fish populations and their estimations.	**CLO 2**	**8**
32. Size relationships and gear selectivity: Linear regression,	**CLO 3**	**6**

length-length and length-weight relationships, and condition of fish populations, gear selectivity, trawl and gill nets selectivity.		
33. Growth: Definition and types, acquaintance with different growth models, procedures for estimating the parameters of the von Bertalanffy and other growth curves using data from length-frequency analysis, hard part analysis, mark-recapture experiment, and graphical & computer-based analyses.	**CLO 4**	**7**
34. Reproduction: Definition, timing of reproduction, length & age at sexual maturity, frequency of spawning, semelparity & iteroparity, fecundity.	**CLO 4**	**5**
35. Recruitment: Definition, timing of recruitment, length and age at recruitment, factors affecting recruitment and stock-recruitment relationships.	**CLO 4**	**4**
36. Mortality: Factors causing mortality, concept of mortality equation; estimation of total mortality by age-based & length-based catch curves, natural and fishing mortalities and their estimations.	**CLO 4**	**7**
37. Life history patterns: Species life history strategy and its environment, effects related to stock density, concept of r- and k- selection of species, Bet-hedging.	**CLO 4**	**2**
9 Fish stock assessment: Prelude of fish stock assessment, yield estimation	**CLO 5**	**5**
10 Mid-term Examination and Class Test	**-**	**2**

Teaching strategy: Lectures, Problem based learning, Interactive learning, Q/A session, Group studies and Discussion.

Assessment Strategy: MCQ Test, Written test, Quiz, Oral test, Assignment and Presentation.

Learning Resources:

Text books:

1. King, M. 1995. Fisheries Biology, Assessment and Management. Fishing News Books. 342 pp.
2. Pauly, D. 1984. Fish population dynamics in tropical waters. A manual for use with programmable calculators. ICLARM, Manila. 325 pp.
3. Ricker, W. E. 1975. Computation and interpretation of biological statistics of fish populations. Bull. Fish. Res. Board Can. 191: 382 pp.
4. Sparre, P., E. Ursin, and S. C. Venema. 1989. Introduction to tropical fish stock assessment. Part 1. Manual. FAO Fisheries Technical Paper. No. 306.1. Rome, FAO. 337 pp.
5. Sparre, P., E. Ursin and S. C. Venema. 1989. Introduction to tropical fish stock assessment. Part 2. Exercises. FAO Fisheries Technical Paper. No. 306.2. Rome, FAO. 429 pp.

References:

1. Cushing, D. H. 1968. Fisheries Biology: A study in population dynamics. Univ. Wisconsin, Madison, USA. 200 pp.

2. Cushing, D. H. 1977. Science and the Fisheries. Edward Arnold Publishers Ltd. 25, Hill Street, London WIX 8LL. 60 pp.
3. Dwiponggo, A. 1986. Growth, mortality and recruitment of commercially important fishes and penaeid shrimps in Indonesian waters. Filipiniana Specialist, Manila. 91 pp. FAO. 2001. Yearbook of fishery. Statistics of catches and landings.
4. Gulland, J. A. 1983 (ed.) Fish Stock Assessment: A Manual of Basic Methods. Chichester, U.K., Wiley Interscience, FAO/Wiley series on food and agriculture, Vol. 1. 223 pp.
5. Gulland, J. A. 1988 (ed.) Fish Population Dynamics. Second edition. John Wiley & Sons, Inc., New York.
6. Nielsen, L. A. 1992. Method of Marking Fish and Shellfish. American Fish. Soc., Special Publication 23. 208 pp.
7. Nikolskii, G. V. 1982. Theory of fish population dynamics. Bishen Singh, Mahendra Pal Singh and Otto Koeltz, Sci. Publishers. 323 pp.
8. Parker, N. C., E. G. Albert, C. H. Roy, Jr. J. B. Douglas, D. P. Eric and A. W. Gary.1990. Fish Marking Techniques. Amer. Fish. Soc. Symp.-7, 876 pp.
9. Ricker, W. E. 1968. Methods of assessment offish production in freshwaters. Blackwell Scientific Publications, Oxford. 321 pp.
10. Rounsefell, G. A. and W. H. Everhart. 1953. Fishery Science: Its methods and application. John Wiley & Sons, Inc., New York. 444 pp.

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Course Profile :

Course Code: FM 3122 Course Title: Fish Population Dynamics

Credit: 1 Contact Hours: 16 Level: 3 Semester: 1

Course Offering Department (s) : Department of Fisheries Management

Rationale:

This course promotes students to estimate values of population parameters, and how these parameters are utilized to calculate maximum exploitation level of yield of fisheries resources.

Course learning Outcomes (CLO):

CLO1. Discuss sample collection, data recording andMicrosoft Excel software exercise.
CLO2. Calculation of fish population relative and absolute abundances.
CLO3. Estimation of size relationships of fish population.
CLO4. Determination of spawning seasons and fecundity of fish population.

Mapping CLO with PLO:

	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8	PLO9	PLO10
CLO1	√	√	√							
CLO2	√	√				√		√		
CLO3	√	√				√		√		
CLO4	√	√					√	√		
CLO5	√	√				√	√	√		

Course contents:

	Course contents	Aligned CLO	No. of Lectures
1	Sampling considerations for gathering information of fish populations, recording the length and weight of fish in a sample, exercise of Microsoft Excel software	**CLO 1**	**2**
2	Population relative and absolute abundances	**CLO 2**	**4**
3	Length-length and length-weight relationships, and condition factors of fish populations	**CLO 3**	**4**
4	Spawning seasons by gonadosomatic index and external feature of gonads, and fecundity	**CLO 4**	**2**
5	FAO-ICLARM Stock Assessment Tools II (FiSAT), its applications on computer for fish stock assessment	**CLO 1**	**2**
6	Visit to major inland habitats and the Bay of Bengal for	**CLO 1**	**1**

	collection of samples from fish populations.		
7	Class Test	**-**	**1**

Teaching strategy: Lectures, Problem based learning, Interactive learning, Q/A session, Group studies and Discussion.

Assessment Strategy: 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. test will form an essential part of Practical Examinations. Viva-voce, MCQ Test, Written test, Quiz, Oral test, Assignment and Presentation.

Learning Resources:

Text books:

1. King, M. 1995. Fisheries Biology, Assessment and Management. Fishing News Books. 342 pp.
2. Pauly, D. 1984. Fish population dynamics in tropical waters. A manual for use with programmable calculators. ICLARM, Manila. 325 pp.
3. Ricker, W. E. 1975. Computation and interpretation of biological statistics of fish populations. Bull. Fish. Res. Board Can. 191: 382 pp.
4. Sparre, P., E. Ursin, and S. C. Venema. 1989. Introduction to tropical fish stock assessment. Part 1. Manual. FAO Fisheries Technical Paper. No. 306.1. Rome, FAO. 337 pp.
5. Sparre, P., E. Ursin and S. C. Venema. 1989. Introduction to tropical fish stock assessment. Part 2. Exercises. FAO Fisheries Technical Paper. No. 306.2. Rome, FAO. 429 pp.

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Course profile

Course Code:		**FT 3221**	**Course Title: Fish Processing Technology**				
Credit:	**2**	**Contact Hours:**	**32**	**Level:**	**3**	**Semester:**	**1**
Course offering department(s): Department of Fisheries Technology							

Rationale:
Fish processing covers principles and applications of post-harvest handling and processing of fish in the form of all sorts of pre-treatment, reprocessing, packaging and quality control. Access to fish as food complies food security but the fish food safety…. through appropriate processing is the key to build up a healthy nation, while the students of this course will be dealt with.

Course Learning Outcomes (CLOs)

CLO 1: Landing, distribution and marketing of fish with associated good handling practice known.
CLO 2: Principles of post-harvest loss and practices of loss mitigation known.
CLO 3: Principles and chemistry of spoilage of fish and traditional products associated with good processing and preservation and packaging techniques understood.
CLO 4: Improved techniques of processing and storage apprehended.

Mapping CLO with PLO

CLO/PLO	PLO 1	PLO 2	PLO 3	PLO 4	PLO 5	PLO 6	PLO 7	PLO 8	PLO 9	PLO 10
CLO 1	✓			✓						
CLO 2		✓			✓					
CLO 3		✓			✓	✓				✓
CLO 4	✓									✓

Course Content	Aligned CLO(s)	No of Lectures
1. **Introduction to fish processing:** Scopes and limitations. Supply of inland, coastal and marine fish in Bangladesh. Capture and culture fishing, hilsa fishery, utilization of catch.	CLO 1 & CLO 2	2
2. **Fish landing and distribution:** Marketing of fish and fishery products in Bangladesh. Post-harvest loss of fish at different steps of harvest and distribution channel, mitigation measures and reduction of post-harvest fishery loss.		4
3. **Fish and shellfish muscles:** Structural characteristics, biochemical composition and role of biochemical compositions in fish quality and processability.	CLO 2 & 3	2
4. **Postmortem changes in fish:** Rigor mortis, impact of rigor mortis on processing and keeping quality of fish. Spoilage of fish and delaying spoilage.	CLO 1, 2 & 3	3

5. **Chilling and icing of fish:** Principles, types and nature; adequate ice box for transportation and marketing of fish; preparation of ice.	CLO 2 & 3	3
6. **Freezing:** Mechanism of freezing of fish muscle tissue, freezing methods and equipment; Freezing of shrimp/prawn in Bangladesh- exportable shrimp/prawn products, commercial freezing of prawn, semi IQF of whitefish, quality requirements of frozen shrimp; storage of frozen products.	CLO 1 & 2	4
7. **Curing:** Basic principles, methods and constraints of sun drying and dehydration, salting, smoking and fermentation of fish; storage and marketing of cured products.	CLO 1, 2 & 3	6
8. **Canning:** Principles, preparation of raw materials and steps, examination of processed fish can; appropriate species for fish canning in Bangladesh.	CLO 2 & 3	2
9. **Heat processing of fish meat:** Principles of protein gelation, methods of preparation of surumi and surumi based products.	CLO 2 3, & 4	2
10. **Packaging:** Functions of packaging, appropriate package selection, packaging regulations; modern approaches- irradiation in fish processing, modified atmospheric packaging and vacuum packaging.	CLO 2 3, & 4	3
Class test		1
Total		32

Teaching Strategy

Class Lectures, Problem based learning, Interactive learning, Group discussion, Web based learning

Assessment Strategy

Strategic Questioning, MCQ test, written test, Oral test, Assignment, Presentation

Recommended books and other resources:

1. Clucas, I. J. and A. R. Ward. 1996. Post-harvest Fisheries Development: A guide to handling, preservation, processing and quality. Natural Resource Institute, UK.
2. Hall, G. M. 1997. Fish Processing Technology. Blakie Academic & Professional, London, Weinheim, New York, Melbourne, Madras.
3. Nowsad, A. K. M. A. 2007. Participatory Training of Trainers: A New Approach Applied in Fish Processing. Bangladesh Fisheries Research Forum. Bangladesh.
4. Tanikawa, E., T. Motohiro and M. Akiba. 1985. Marine products in Japan. Koseisha Koseikaku Co., Ltd., Tokyo.
5. Balachandran, K. K. 2001. Post-harvest Technology of Fish and Fish Products. Daya Publishing House, Delhi – 110035. India.
6. Donald. 1968. (ed.). The Freezing Preservation of Foods. The Avi Publishing Company, INC.
7. Govindan, T. K. 1985. Fish Processing Technology. Oxford & IBH publishing Co., New Delhi.
8. Howgate, P., A. Johnston and Whittle, K. L. 1992. Multilingual Guide to EC freshness grades for fishery products (Torry Research Station, Food Safety Directorate, Ministry of Agriculture, Fisheries and Food; Aberden. Scotland, UK.
9. Martin, A. M. 1994. (ed.). Fisheries Processing: Biotechnological Applications. Chapman and Hall, London.
10. Motohiro, T., K. Hashimoto, H. Kadota and T.Tokunaga. 1992. Science of Processing Marine products, Vol. I & II. Kanagawa International Fisheries Training Center. Japan International Cooperation Agency.

11. Nowsad, A. K. M. A. 2005. Handling and Preparation of Wet Fish for Marketing (In Bengali). BGD/97/017 Field Doc. 2/2005 FAO, Bangladesh
12. Proceeding of conference on-Handling, Processing and Marketing of Tropical Fish. 1976. Tropical Product Institute, London.
13. Stansby, M. E. 1963. Industrial Fishery Technology. Reinhold Publ Corp. New York.Zaitsev, V. P. 1965. Preservation of Fish Products by Refrigeration. U.S. Department of Commerce.

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Course profile :

Course Code:		**FT 3122**		**Course Title: Fish processing Technology**			
Credit:	**1**	**Contact Hours:**	**16**	**Level:**	**3**	**Semester:**	**1**
Course offering department(s): Department of Fisheries Technology							

Rationale:

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 teachers (s) concerned. Viva voce test will form an essential part of the Practical Examinations.

Course Learning Outcomes (CLOs)

CLO 1: Describe fish processing laboratory and safety use of lab equipment, glassware and chemicals and also will know the procedure of standard chemical solutions and reagents.

CLO 2: Analyze the proximate composition (Protein, lipid, moisture and ash) of fish and fish products.

CLO 3: Develop of post-harvest quality loss of wet fish through sensory method

CLO 4: Students will be able to determine the rigor index of fish, non-protein nitrogen (NPN) of fish, and extraction procedure of actomyosin from fish muscle.

Mapping CLO with PLO

CLO/PLO	PLO 1	PLO 2	PLO 3	PLO 4	PLO 5	PLO 6	PLO 7	PLO 8	PLO 9	PLO 10
CLO 1	✓			✓						
CLO 2		✓			✓					
CLO 3		✓			✓	✓				✓

Course Content	**Aligned CLO(s)**	**No of Lectures**
1. Acquaintance with fish processing laboratory and safety use of lab equipment, glassware and chemicals.	CLO 1	1
2. Preparation of standard chemical solutions and reagents.	CLO 1	
3. Estimation of moisture content of fish by oven drying method	CLO 2	1
4. Estimation of ash content of fish by using Muffle Furnace.	CLO 2	1
5. Estimation of crude protein contents of fish by Kjeldhal method.	CLO 2	1
6. Estimation of crude lipid contents of fish by using Soxhlet Apparatus.	CLO 2	1
7. Assessment of post-harvest quality loss of wet fish through sensory method.	CLO 3	1

8. Determination of rigor index of fish.	CLO 4	1
9. Determination of non-protein nitrogen (NPN) of fish.	CLO 4	1
10. Extraction of actomyosin from fish muscle.	CLO 4	1
Class test		1
Total		**10**

Teaching Strategy

Class Lectures, Problem based learning, Interactive learning, Group discussion, Web based learning

Assessment Strategy

Strategic Questioning, MCQ test, written test, Oral test, Assignment, Presentation

Recommended books and other resources:

1. Hall, G. M. 1997. Fish processing technology. Blakie Academic & Professional, London, Weinheim, New York, Melbourne, Madras
2. Clucas, I. J. and A. R. Ward. 1996. Post-harvest Fisheries Development: A guide to handling, preservation, processing and quality. Natural Resource Institute, UK.
3. Govindan, T. K. 1985. Fish Processing Technology, Oxford & IBH publishing Co., New Delhi.
4. AOAC. 1980. Official methods of analysis. Association of Official Analytical Chemists. Washington, D. C.
5. Botta, J. R. 1995. Evaluation of Seafood Freshness Quality. VCH Publishers, Inc. New York.
6. Hasegawa, H. 1987. Laboratory Manual on Analytical Methods and procedures for Fish and Fishery Products. Marine Fisheries Research Department, Southeast Asian Fisheries Development Center, Singapore.
7. Howgate, P., A. Johnston and K. L. Whittle. 1992. Multilingual Guide to EC freshness grades for fishery products (Torry Research Station, Food Safety Directorate, Ministry of Agriculture, Fisheries and Food; Aberden. Scotland, UK.
8. Motohiro, T., K. Hashimoto, H. Kadota and T. Tokunaga. 1992. Science of Processing Marine products, Vol. I & II. Kanagawa International Fisheries Training Center. Japan International Cooperation Agency.
9. Nowsad, A. K. M. A. 2007. Participatory Training of Trainers: A New Approach Applied in Fish Processing. Bangladesh Fisheries Research Forum. Bangladesh.
10. Stansby, M. E. 1963. Industrial Fishery Technology. Reinhold Publ Corp. New York.

Bangladesh Agricultural University
Mymensingh-2202
B. Sc. Fisheries (Hons.)

Course Profile :

Course Code: FBG 3103 Course Title: Genetics and Reproduction of ornamental fish

Credit: 2 Contact Hours: 32 Level: 3 Semester: 1

Course Offering Department (s) :Department of Fisheries Biology and Genetics

Rationale:

In order to apply knowledge of genetics and reproduction for development of new traits and improvement, and production and promoting business of ornamental fish, students will need to acquire basic knowledge on genetics and inheritance pattern of the special traits, principles of heredity and gene interactions, mechanisms of sex determination and genetic manipulation, and induced breeding of fish.

Course learning Outcomes (CLO):

CLO1. Review economic importance of ornamental fish and their importance as model species for genetic research and business.

CLO2. Explain Mendelian genetics and inheritance of special traits, and gene interaction.

CLO3. Explain fishsex determination, sex related traits and genetic manipulation, selective breeding.

CLO4. Discuss mode of reproduction of ornamental fish, breeding behaviour in aquarium, breeding influencing factors and induced breeding techniques,

CLO5. Illustrate embryonic and larval development of fish, and larval rearing techniques.

Mapping CLO with PLO:

	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8	PLO9	PLO10
CLO1	√	√								
CLO2	√	√				√		√		√
CLO3	√	√			√	√		√		√
CLO4	√	√			√	√		√		√
CLO5	√	√				√				√

Course contents:

Course contents	Aligned CLO	No. of Lectures
1. Overview and importance: An overview of the ornamental fishes, economic importance, importance as model animals for basic, genetic and molecular biological research, prospects of ornamental fish business in Bangladesh.	**CLO 1**	**3**
2. The genetics and pattern of inheritance of the special features of ornamental fish: Color pattern, scale pattern, fin structure; Mendelian inheritance - simple gene effects, complex effect of alleles, interaction of genes; sexual dimorphism and sex-linked phenotypes; mechanism of sex-determination; selective breeding of ornamental fishes to produce desired phenotypic combinations, genetic manipulation.	**CLO 2, CLO 3**	**8**
3. Reproduction: Modes of reproduction in representative aquarium and farmed ornamental fishes; factors influencing reproduction of aquarium fishes.	**CLO 4**	**8**
4. Aquarium: 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.	**CLO 4**	**8**
5. Embryonic and larval development: Embryonic and larval development of representative ornamental fish, care for larvae and mass seed production techniques.	**CLO 5**	**4**
6. Mid-term Examination	**-**	**1**

Teaching strategy: Lectures, Problem based learning, Interactive learning, Q/A session, Group studies and Discussion.

Assessment Strategy: MCQ Test, Written test, Quiz, Oral test, Assignment and Presentation.

Learning Resources:

1. Herbert, R., D. Axelrod and H. Windelov. 1993. Complete Introduction to Breeding Aquarium Fishes. TFH Publisher.
2. McInerny, D. and G. Gerard. 1966. All about Tropical Fish (3rd ed). G. G. Harrap & Co. Ltd.
3. Purdom E. Colin. 1993. Genetics and Fish Breeding. Chapman & Hall, London.
4. Smart, J. and Bundell, J.H. 1996. Goldfish Breeding and Genetics. T.F.H. Publications Inc. USA.256p.
5. Andrews, C. 1986. A Fishkeeper's Guide to Fish Breeding. Tetra Press.
6. Gratzek, J.B. 1992. Aquariology: Fish Breeding and Genetics. Tetra Press.
7. Hampton, C.H. and C.D. Hampton. 1979. Care and Maintenance: A Freshwater Aquarium. TFH Publications.
8. Herbert, R., D. Axelrod and M.E. Sweeney. 1993. The Fascination of Breeding Aquarium
9. Fishes.
10. Herbert, R., D. Axelrod and H. Windelov. 1993. Complete Introduction to Breeding Aquarium Fishes. TFH Publisher, USA.
11. Jones, B. 1986. A Fishkeeper's Guide to Aquarium Plants. Tetra Press.
12. Kirpichnikov, V.S. 1981. Genetic Bases of Fish selection. Springer-Verlag, Berlin.
13. Leibel, W.S. 1993. A Fishkeeper's Guide to South American Cichlids. Tetra Press.
14. Loiselle, P.V. 1988. A Fishkeeper's Guide to African Cichlids. Tetra Press.
15. Mills, D. 1993. You and Your Aquarium. Alfred A. Knopf, Inc., New York.
16. Petrovicky, I. 1989. Aquarium Fish of the World. Natural Sciences of the World Series.
17. Smartt, J. and J.H. Bundell 1996. Goldfish Breeding and Genetics. TFH Publications, USA.
18. Schroder, J.H. 1976. Genetics for Aquarists. TFH Publications Inc, Neptune
19. Schliewen, U., 1992. Aquarium Fish. Baron's Educational Series Inc.

Bangladesh Agricultural University
Mymensingh-2202
B. Sc. Fisheries (Hons.)

Course Profile :

Course Code: **AQ 3105** **Course Title: Algal Product Technology**

Credit: **2** **Contact Hours:** **32** **Level:** **3** **Semester:** **1**

Course offering department(s): Department of Aquaculture

Rationale:

To establish smart production of bioenergy, biofuel and bioelectricity of different food products from microalgae.

Course Learning Outcomes (CLO):

CLO 1: Contrast scope and importance of algal technology.

CLO 2: Develop methods to produce biofuel, bioethanol and bio-glycerol from culture of micro-algal species.

CLO 3: Design the production technology of bio-oxygen, biodiesel, bio-petrol, bioelectricity from culture of microalgae in supernatant of digested agro-industrial wastes and rotten (spoiled) agro product.

CLO 4: Plan to prepare the medium from agro-industrial wastes and agro products.

CLO 5: Describe the production of feed additives, beverages, drinks, health foods like tablets, soup and bioactive compounds.

Mapping CLO with PLO

CLO/ PLO	PLO 1	PLO 2	PLO 3	PLO 4	PLO 5	PLO 6	PLO 7	PLO 8	PLO 9	PLO 10
CLO 1	✓									
CLO 2	✓	✓			✓		✓	✓	✓	✓
CLO 3	✓	✓	✓	✓			✓	✓		✓
CLO 4	✓			✓	✓		✓	✓	✓	✓

CLO 5	✓					✓				

Summary of Course Content

Content	Aligned CLO	No. of lectures
1. Introduction to algal technology, bionutrient production, bioactive compounds, scope and importance.	CLO1	2
2. Production of biofuel, bioethanol, bioglycerol and bioproduction technology from culture of microalgal species like Chlorella, Scenedesmus, Ankistrodesmus, Chaetoceros, Isochrysis, Skeletonema in supernatant of digested agro industrial wastes and spoiled agro products.	CLO2	10
3. Technology of production and measurement of bio-oxygen, biodiesel, biopetrol, bioelectricity from culture of microalgae in supernatant of digested agro-industrial wastes and rotten (spoiled) agro product.	CLO3	8
4. Procedure of preparation of medium from agro-industrial wastes and agro products, measurement of electron transport system (ETS), Electric conductivity (EC).	CLO4	6
5. Production of feed additives, beverages, drinks, health foods like tablets, soup and bioactive compounds.	CLO5	6
Class Test		1
Total		32

Teaching Strategy:

Lecture, Multi-media, video clipping, Demonstration.

Assessment Strategy:

Written exam, quiz, viva-voce, Field trip, assignment.

Recommended books and other resources:

1. Jesse Harris, Kelsey Viner, Pascale Champagne and Philip G. Jessop. 2018. Advances on microalgal lipid extraction for biofuel production: a review. Vol. 12. Pp. 1118-1135. Biofuels, Bioproduction and Biorefining. Society of chemical industry and John Wiley ans Sons Ltd. Canada.
2. Gulfem Soydemir, Ulker Diler Keris-Sen, Unal Sen and Mirat D. Gurol. 2016. Biodiesel Production potential of mixed microalgal culture grown in domestic wastewater. Bioprocess Biosystem Engineering 39: 45-51.
3. Noor Soyfuddin, Nurkholis, Rangga Handika and Roy Hendroko Setyobudis. 2018. Formulating Interest Subsidy Program to Support the Development of Electricity Generation from Palm Oil Mill Effluent (POME) Biomass: An Indoneshian Case Study. Published By EDP Sciences, MATEC. 164, 01033(2018).
4. Cheng-Han Thong, Siew-Moi Phang, Fonhg-Lee Ng, Vengadesh Peria, Tau-Chuan Ling, Kamran Yunus and Adrian C. Fisher. 2019. Effect of different irradiance levels on bioelectricity generation from algal biophotovoltaic (BPV) devices. Energy Sciences and Engineering. DOI: 10.1002/ese3.414.

5. Benjamas Cheirsilp and Yasmi Louhasakul. 2013. Industrial wastes as a promising renewable source for production of microbial lipid and direct transesterification of the lipid into biodiesel. Bioresource Technology. DOI: 10.1016/j.biortech.2013.05.012.

Bangladesh Agricultural University
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B. Sc. Fisheries (Hons.)

Course Code: FM 3123 Course Title: Haor Fisheries and Livelihood

Credit: 2 Contact Hours: 32 Level: 3 Semester: 1

Course Offering Department (s) : Department of Fisheries Management

Rationale:

This course is to expose students to haor resources and their sustainable management, and to provide skills in understanding livelihoods of fishers in haor areas of Bangladesh.

Course learning Outcomes (CLO):

CLO1. Discuss introductory aspect and importance of hoar fisheries and livelihood.

CLO2. Explain hoar fisheries resource management.

CLO3. Explain haor fisheries policies and regulations.

CLO4. Discuss Social structure,gender and sustainable livelihoods.

CLO5. Programs in sustainable haor fisheries and livelihood.

Mapping CLO with PLO:

	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8	PLO9	PLO10
CLO1	√	√	√							
CLO2	√	√				√		√		
CLO3	√	√				√		√		
CLO4	√	√					√	√		
CLO5	√	√				√	√	√		

Course contents:

Course contents	Aligned CLO	No. of Lectures
1. Introduction: Haors and their fisheries in Bangladesh	**CLO 1**	**2**
2. Haor fisheries resource management: Basic reasons of depletion of haor fisheries resources - overexploitation, water quality and environment pollution, definition and concept of haor fisheries management, data requirements, approaches to haor fisheries management and their strategies	**CLO 2**	**6**
3. Fishery policies and regulations: National and international fishery policies and regulations concerning sustainable hoar fisheries management	**CLO 3**	**6**
4. Social structure and sustainable livelihoods: Social structures in haor regions, social change, power structures and good governance, concept of livelihood and food security,	**CLO 4**	**6**

Sustainable Development Goals (SDGs)		
5. Gender and fisheries in Bangladesh: Gender related major concepts, gender role, gender division of labor, gender needs, gender position, equality, equity, awareness, empowerment and gender development, gender identities of women, issues and policies	**CLO 4**	**6**
6. Programs in sustainable haor fisheries and livelihood, approaches to study sustainable haor fisheries and rural livelihood issues	**CLO 5**	**6**

Teaching strategy: Lectures, Problem based learning, Interactive learning, Q/A session, Group studies and Discussion.

Assessment Strategy: MCQ Test, Written test, Quiz, Oral test, Assignment and Presentation.

Learning Resources:

1 Alam, Mohd Shamsul; Hossain, Md Sazzad (2012). "Haor". In Islam, Sirajul; Jamal, Ahmed A. (eds.). Banglapedia: National Encyclopedia of Bangladesh (Second ed.). Asiatic Society of Bangladesh.

2 Alam, Mohd Shamsul; Hossain, Md Sazzad (2012). "Wetland". In Islam, Sirajul; Jamal, Ahmed A. (eds.). Banglapedia: National Encyclopedia of Bangladesh (Second ed.). Asiatic Society of Bangladesh.

3 Haque, M. Inamul (2012). "Haors_and_Wetlands". In Islam, Sirajul; Jamal, Ahmed A. (eds.). Banglapedia: National Encyclopedia of Bangladesh (Second ed.). Asiatic Society of Bangladesh.

Bangladesh Agricultural University
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B. Sc. Fisheries (Hons.)

Course profile :

Course Code:		**FT 3103**	**Course Title:Fishery Waste Management (optional)**				
Credit:	**2.0**	**Contact Hours:**	**32**	**Level:**	**3**	**Semester:**	**1**
Course offering department(s):Department of Fisheries Technology							

Rationale:
In order to ensure food security and environmental safety, it is important to utilize the fishery industrial waste properly.

Course Learning Outcomes (CLO):

CLO 1: Identify fishery waste for their proper utilization and value addition.

CLO 2: Describe different methods of waste management and utilizations.

CLO 3: Plan proper waste management system considering environmental issues as well as buyers demand.

CLO 4: Plan appropriate protocol for waste keeping and utilizations.

Mapping CLO with PLO

CLO/PLO	**PLO 1**	**PLO 2**	**PLO 3**	**PLO 4**	**PLO 5**	**PLO 6**	**PLO 7**	**PLO 8**	**PLO 9**	**PLO 10**
CLO 1	✓			✓						✓
CLO 2	✓			✓						✓
CLO 3	✓	✓	✓	✓	✓		✓	✓		✓
CLO 4	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓

Course Content	**Aligned CLO(s)**	**No of Lectures**
11. **Introduction:** Significance of waste management and utilization, scopes of fishery waste management, fishery waste and environmental issues.	CLO 1 & CLO 2	3
12. **Types and nature of fishery waste:** Market wastes, industry wastes.	CLO 1 & CLO 2	3
13. **Solid waste utilization and management:** Sorting, preservation and storage of trimmed wastes, waste for mince, fish meal, fish oil, lather, glue, collagen, maws, isinglass, pearl essence, silage etc. preparation.	CLO 2, 3 & 4	9
14. **Liquid wastes recycling and utilization:** Recovery of mince, recovery of protein and fish oil, recovery of functional and nutraceutical components.	CLO 2, 3 & 4	8
15. **Waste management in the factory:** Waste management design and practice, affluent treatment and recycling.	CLO 2, 3 & 4	8
Class test		1
Total		**32**

Teaching Strategy

Class Lectures, Problem based learning, Interactive learning, Group discussion, Web based learning

Assessment Strategy

Strategic Questioning, MCQ test, written test, Oral test, Assignment, Presentation

Recommended books and other resources:

14. Clucas, I. J. and A. R. Ward. 1996. Post-harvest Fisheries Development: A guide to handling, preservation, processing and quality. Natural Resource Institute, UK.
15. Hall, G. M. 1997. Fish Processing Technology. Blakie Academic & Professional, London, Weinheim, New York, Melbourne, Madras.
16. Nowsad, A. K. M. A. 2007. Participatory Training of Trainers: A New Approach Applied in Fish Processing. Bangladesh Fisheries Research Forum. Bangladesh.
17. Tanikawa, E., T. Motohiro and M. Akiba. 1985. Marine products in Japan. Koseisha Koseikaku Co., Ltd., Tokyo.
18. Balachandran, K. K. 2001. Post-harvest Technology of Fish and Fish Products. Daya Publishing House, Delhi – 110035. India.
19. Donald. 1968. (ed.). The Freezing Preservation of Foods. The Avi Publishing Company, INC.
20. Govindan, T. K. 1985. Fish Processing Technology. Oxford & IBH publishing Co., New Delhi.
21. Howgate, P., A. Johnston and Whittle, K. L. 1992. Multilingual Guide to EC freshness grades for fishery products (Torry Research Station, Food Safety Directorate, Ministry of Agriculture, Fisheries and Food; Aberden. Scotland, UK.
22. Martin, A. M. 1994. (ed.). Fisheries Processing: Biotechnological Applications. Chapman and Hall, London.
23. Motohiro, T., K. Hashimoto, H. Kadota and T.Tokunaga. 1992. Science of Processing Marine products, Vol. I & II. Kanagawa International Fisheries Training Center. Japan International Cooperation Agency.
24. Nowsad, A. K. M. A. 2005. Handling and Preparation of Wet Fish for Marketing (In Bengali). BGD/97/017 Field Doc. 2/2005 FAO, Bangladesh
25. Proceeding of conference on-Handling, Processing and Marketing of Tropical Fish. 1976. Tropical Product Institute, London.
26. Stansby, M. E. 1963. Industrial Fishery Technology. Reinhold Publ Corp. New York.Zaitsev, V. P. 1965. Preservation of Fish Products by Refrigeration. U.S. Department of Commerce.

Bangladesh Agricultural University
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B. Sc. Fisheries (Hons.)

Course Profile :

Course Code: MFS 3101 Course Title: Sustainable Coastal Development

Credit: 2 Contact Hours: 32 Level: 3 Semester: 1

Course Offering Department (s) : Department of Marine Fisheries Science

Rationale:

This course aims to give necessary knowledge on coastal zone development especially on the important coastal resources and fisheries, the principles for coastal conservation and management.

Course learning Outcomes:

CLO1. Identify and prioritize threats to coastal resources associated with human activities.
CLO2. Understand planning and decision making with reference to water and coastal management.
CLO3. Communicate and facilitate the need to work in a co-ordinated and integrated manner to address coastal issues.

Mapping CLO with PLO:

	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8	PLO9	PLO10
CLO1	√		√					√		
CLO2	√			√		√	√			√
CLO3	√	√			√				√	

Course contents:

Sl. No.	**Course contents**	**Aligned CLO**	**No. of Lectures**
1.	Definition of Coastal Zone, Types of coastal landforms, Coastal ecosystems, Coastal forces and processes.	CLO1	3
2.	Land use pattern and human alterations of the coastal zone, Coastal development issues: Coastal development strategies, sustainable use of resources, biological diversity, pollution control, protection against natural hazards.	CLO1, CLO2	6
3.	Development impacts: Agriculture, aquaculture, forest industries, heavy industries, mining, Petroleum, Ports,	CLO1, CLO2	6

	tourism, settlements, waste disposal, shore protection works.		
4.	Stakeholders of coastal management, role of GO, coastal policy, CZM act, national marine sanctuary program.	CLO1, CLO2	5
5.	Management: aquaculture management, beach management, Coral reef management, Dredging management, Dune, mangrove forest, water quality management.	CLO1, CLO2, CLO3	6
6.	Monitoring Coastal Environments using Remote Sensing, GIS applications in Coastal management.	CLO3	5
7.	Class test		1

Teaching strategy: Lectures, Problem based learning, Power point slides, scientific papers, Professor and classmates will actively participate to the discussion by asking questions.

Assessment Strategy: MCQ Test, Written test, Assignment.

Learning Resources:

1. Timothy Beatley, David J. Brower, Anna K. Schwab. 2005. Introduction to Coastal Zone Management. 2nd Edition. Island Press. Washington D. C. 20009

2. John R Clark. 2005. Coastal zone management Hand book. CRC press

3. Darius Bartlett and Jennifer Smith, Eds. 2004. GIS for Coastal Zone Management: CRC press

4. Haq, B. U. et al. 1997. Coastal Zone Management: Imperative for Maritime Developing Nations. Kluwer Academic Publishers. 394 pp

Bangladesh Agricultural University
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B. Sc. Fisheries (Hons.)

Course Profile :

Course Code: FBG 3221 **Course Title: Fish Biodiversity & Conservation**

Credit: 2 **Contact Hours: 32** **Level: 3** **Semester: 2**

Course Offering Department (s) : Department of Fisheries Biology and Genetics

Rationale: Studentwishing to develop their career in fisheries will need to have a thorough understanding on fish biodiversity at global and national level, value of biodiversity, present status of biodiversity, different causes behind dwindling biodiversity and conservation measure.

Course learning Outcomes:

5. Thorough understanding of the students on aquatic biodiversity and its value at global and national level
6. Ability to explain Species, Ecosystem and Genetic biodiversityat national, regional and global context
7. Ability to explain the present status of freshwater and marine biodiversity of Bangladesh with pinpointing the major and minor causes responsible for biodiversity loss
8. Skilled and experienced in the measuring and mapping biodiversity using different indices and redlist criteria
9. Able to apply different measure to conserve aquatic biodiversity of Bangladesh

Mapping CLO with PLO:

	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8	PLO9	PLO10
CLO1	√									
CLO2	√				√					√
CLO3		√							√	
CLO4			√			√				√

Course Contents:

Course contents	Aligned CLO	No. of Lectures
1. Introduction: Course goals, objectives and outcomes.	**CLO 1**	**1**
2. Basic information on biodiversity: Definition of species. Ecosystem and genetic diversity. The nature and value of biodiversity-economic and ecological.	**CLO 2**	**7**
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	**CLO 3**	**7**
4. 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	**CLO 3**	**6**
5. Loss of the biodiversity: Causes; natural variation in time and space; Present situation, endangered aquatic species of Bangladesh.	**CLO 4**	**6**
6. In-situ and ex-situ conservation measures	**CLO 5**	**5**
7. Mid-term Examination	**-**	**1**

Teaching strategy: Lectures, Problem based learning, Interactive learning, Group studies and Discussion.
Assessment Strategy: MCQ Test, Written test, Oral test, Assignment and Presentation.

Learning Resources:

1. Helfman, G.S., Collette, B.B. and Facey, D.E., 1997. The Diversity of Fishes. Blackwell Science.
2. Gaston, K.J. and Spicer, J.I., 1998. Biodiversity - An Introduction. Blackwell Science.
3. Day, F., 1971. The Fishes of India. Today and Tomorrows Book Agency, New Delhi.
4. Misra, K.S., 1962. An aid to the identification of the common commercial fishes of India and Pakistan. In. Rec. Indian Mus.Vol. 57.
5. Rahman, A.K.A., 1989. Freshwater Fishes of Bangladesh. The Zoological Society of Bangladesh. Dhaka 1000.
6. Shafi, M. and Kuddus, M.M.A., 1982. BangladesherMatsyaSampad (Bangla) Bangla Academy, Dhaka.
7. Lagler, K.F. Bardach, J.E., Miller, R.R. and Passino, D.R.M., 1977. Ichthyology. John Wiley and Sons, New York.
8. McNeely, J.A. and Somchevita, S. (eds.), 1996. Biodiversity in Asia: Challenges and Opportunity for Scientific Community.Proceedings of a Conference on Prospects of Cooperation on Biodiversity Activities. OEPP, MSTE, Bangkok, Thailand.
9. IUCN, 1996. The Multiple Dimension of Biodiversity. The World Conservation Union, Gland, Switzerland.
10. Brown, K., Pearce, D., Perrings, C. and Swanson, T., 1993. Economics and the Conservation of Global Biological Diversity.Working Paper No. 2. UNDP, UNEP & World Bank.
11. Castilleja, G., Poole, P.J. and Geisler, C.C., (Shelton, H.D. ed.), 1993. The Social Challenge of Biodiversity Conservation. UNDP, UNEP & World Bank Working Paper No. 1.
12. Ponniah, A.G. and Sarker, U.K., 2001. Fish Biodiversity in North East India. National Bureau of Fish Genetic Resources,India.
13. Glowka, L., Pisupati, B., and de Silva, S., 2001. Access to Genetic Resources and Benefit Sharing. IUCN.
14. IUCN Bangladesh. 2015. Red List of Bangladesh Volume 5: Freshwater Fishes.IUCN, International Union for Conservation of Nature, Bangladesh Country Office,Dhaka, Bangladesh, pp xvi+360
15. IUCN Bangladesh. 2015. Red List of Bangladesh Volume 6: Crustaceans. IUCN,International Union for Conservation of Nature, Bangladesh Country Office, Dhaka,Bangladesh. pp. xvi+256

Bangladesh Agricultural University
Mymensingh-2202
B. Sc. Fisheries (Hons.)

Course Profile :

Course Code: AQ 3221 **Course Title: Fish Feed Technology**

Credit: 3 **Contact Hours: 48** **Level: 3** **Semester: 2**

Course offering department(s): Department of Aquaculture

Rationale:

In order to boost up aquaculture production, the fisheries graduates ought to have a clear concept about the role of fish feed in aquaculture as well as to understand quality feed production, storage and feeding strategy as well as identify feed related problems.

Course Learning Outcomes (CLO):

CLO 1: Justify the importance as well as scope of fish feed in aquaculture

CLO 2: Explain different aspects of feedstuffs used in fish feed

CLO 3: Interpret different aspects of feeding regime

CLO 4: Illustrate different activities of a commercial fish feed mill

CLO 5: Develop a legal framework for fish feed industries in Bangladesh

Mapping CLO with PLO

CLO/ PLO	PLO 1	PLO 2	PLO 3	PLO 4	PLO 5	PLO 6	PLO 7	PLO 8	PLO 9	PLO 10
CLO 1	✓	✓							✓	
CLO 2	✓	✓				✓				✓
CLO 3	✓	✓	✓	✓				✓		
CLO 4	✓	✓			✓	✓				✓
CLO 5	✓		✓	✓			✓		✓	

Summary of Course Content

Content	Aligned CLO	No. of lectures
Introduction: Scope, importance and brief review on nutritional requirements of cultivable fish and shellfish, current status of commercial aquafeeds, types of aquafeeds.	CLO 1	4
Feedstuffs: Significance of feedstuff of animal and plant origin, manufacture, processing, chemical properties, physiological properties, feeding value, recommended inclusion levels and legal aspects of conventional and unconventional feedstuffs applied in aquaculture.	CLO 2 CLO 5	12
Non-nutrient and antinutritonal / toxic components of feeds: Water, binders, fibre, antioxidants, feeding stimulants, pigments, antibiotics and growth promoters, 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.	CLO 2 CLO 5	10
Feed formulations and manufacture: Criteria for feedstuff selection, pearson's square hand formulation, spreadsheet formulation and least-cost feed formulations for fish and crustaceans, types of machineries and basic steps of commercial feed manufacturing.	CLO 4	6
Feed storage and quality control: Deteriorative changes in feedstuffs and feeds during storage and transportation with preventive measures.	CLO 4	5
Feeding regimes: Feeding levels and feeding frequency, compensatory feeding, methods of feed presentation in aquaculture.	CLO 3	5
Laws and regulations: National fish feed and animal feed law, definition, controlling authority, licensing authority, standard limit in feed ingredients uses, legal offense, process of legal practice and punishment, international code of conducts for inclusion of different feed ingredients in fish feed.	CLO 5	5
Class Test		1
Total		48

Teaching Strategy:

Lecture, Multi-media, Video clipping, Demonstration.

Assessment Strategy:

Written exam, Quiz, Viva-voce, Field trip, Assignment.

Recommended books and other resources:

Text books:

12. De Silva, S.S. And Anderson, T.A. 1995. Fish nutrition in aquaculture. Chapman & Hall, London, 319 pp.
13. Hertramptf, J.W. and F. Piedad-Pascual (2000). Hand book on ingredients for aquaculture feeds. Kluwer Academic Publishers, London, 573p.
14. New, M.B. (1987). Feeds and Feeding of fish and shrimp. ADCP/REP/87/26. UNDP/FAO, Rome, 275pp.
15. Steffens, W. (1989). Principles of Fish Nutrition. Ellis Horwood, 384pp.
16. Halver, J.E. (1989). Fish Nutrition (2nd Edition). Academic Press, 388 pp
17. Steffens, W., 1989. Principles of Fish Nutrition. Ellis Horwood Ltd., West Sussex, 384 pp.
18. Tacon, A.G.J., 1990. Standard Methods for the Nutrition and Feeding of Farmed Fish and Shrimp. Argent Laboratories Press, Washington, 454 pp.
19. Tacon, A.G.J. and Basurco, B., 1997. Feeding Tomorrow's Fish. CIHEAM/FAO/IEO, Zaragoza (Espana), 307 pp.
20. Goddard, S., 1996. Feed Management in Intensive Aquaculture, Chapman & Hall, Dept. BC, 115 Fifth Avenue, New York, NY 10003, 194 pp.
21. Guillaume, J., Kaushik, S., Bergot, P. and Metailler, R., 2001. Nutrition and Feeding of Fish and Crustaceans. Praxis Publishing, Chichester, UK, 408 pp.

Bangladesh Agricultural University
Mymensingh-2202
B. Sc. Fisheries (Hons.)

Course Profile :

Course Code: AQ 3222 **Course Title: Fish Feed Technology**

Credit: 1 **Contact Hours: 16** **Level: 3** **Semester: 2**

Course offering department(s): Department of Aquaculture

Rationale:

In order to develop practical knowledge and skills to evaluate the feed ingredients and preparation of artificial feeds and performances of the prepared feed to safe and quality fish production.

Course Learning Outcomes (CLO):

CLO 1: List down different laboratory equipments and safety procedures

CLO 2: Evaluate different fish feed ingredients used for compound fish feed preparation

CLO 3: Formulate compound fish feed

CLO 4: Outline the procedures of proximate composition analysis of the prepared fish feed

CLO 5: Determine the performances of prepared fish feed under different feeding practices in field conditions

Mapping CLO with PLO

CLO/ PLO	PLO 1	PLO 2	PLO 3	PLO 4	PLO 5	PLO 6	PLO 7	PLO 8	PLO 9	PLO 10
CLO 1	✓	✓	✓							
CLO 2	✓	✓			✓	✓				✓
CLO 3		✓	✓		✓	✓		✓		✓
CLO 4	✓	✓	✓	✓			✓		✓	
CLO 5	✓	✓			✓		✓	✓		

Summary of Course Content

Content	Aligned CLO	No. of lectures
Introduction to laboratory equipment and safety procedures.	CLO 1	1
Quick test for feedstuffs evaluation: a) Bulk density measurement b) Non-protein nitrogen in fish meal	CLO 2	2
Formulation of a supplemental and balanced feed using square technique for semi-intensive and intensive aquaculture respectively.	CLO 3	2
Analysis of prepared diets for their proximate composition.	CLO 4	6
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.	CLO 5	3
Visit to a commercial feed manufacturing plant.		1
Class Test		1
Total		16

Teaching Strategy:

Lecture, Multi-media, Video clipping, Demonstration.

Assessment Strategy:

Written exam, Quiz, Viva-voce, Field trip, Assignment.

Recommended books and other resources:

Text books:

1. De Silva, S.S. And Anderson, T.A. 1995. Fish nutrition in aquaculture. Chapman & Hall, London, 319 pp.
2. Hertramptf, J.W. and F. Piedad-Pascual (2000). Hand book on ingredients for aquaculture feeds. Kluwer Academic Publishers, London, 573p.
3. New, M.B. (1987). Feeds and Feeding of fish and shrimp. ADCP/REP/87/26. UNDP/FAO, Rome, 275pp.
4. Steffens, W. (1989). Principles of Fish Nutrition. Ellis Horwood, 384pp.
5. Halver, J.E. (1989). Fish Nutrition (2nd Edition). Academic Press, 388 pp

Bangladesh Agricultural University
Mymensingh-2202
B. Sc. Fisheries (Hons.)

Course Profile :

Course Code: AQ 3223 **Course Title: Integrated and Organic Aquafarming**

Credit: 2 **Contact Hours: 32** **Level: 3** **Semester: 2**

Course offering department(s): Department of Aquaculture

Rationale:

Having this course, students will be acquainted with the learning of fundamental aspects of integrated and organic aquaculture, development of integrated farming system and organic farming. They will gain knowledge on different model of integrated and organic aquaculture, farm planning, design, construction, and project implementation aspects.

Course learning Outcomes (CLO):

CLO1. Discuss and classify different complex and multicomponent integrated aquaculture systems
CLO2. Illustrate and explain nutrient dynamics in different integrated aquaculture systems
CLO3. Discuss and illustrate various integrated aquaculture systems
CLO4. Discuss organic aquaculture in different land and water based conditions
CLO5. Interpret and analyze different conventional and traditional organic aquaculture systems and their standard and certification

Mapping CLO with PLO:

	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8	PLO9	PLO10
CLO1	√	√								
CLO2	√	√		√				√		
CLO3	√	√				√			√	√
CLO4	√	√	√		√		√			
CLO5							√		√	√

Course contents:

Course contents	Aligned CLO	No. of Lectures
38. Integrated aquaculture systems: Introduction, its present status and prospects locally and globally; rationale of complex and multi-component integrated systems, categories of complex integrated systems - plant-fish; plant-animal-fish; animal-animal-fish; and waste-plant-fish.	**CLO1**	**5**
39. Integrated system environment: Nutrient dynamics in integrated aquaculture farming, action of wastes on ponds, autotrophic and heterotrophic pathways, role of fish in integrated systems, energy budgeting and nutrient transfer efficiency, and waste loading and environmental quality.	**CLO 2**	**5**
40. Integrated farming systems: Integrated rice-fish; integrated aquaculture-horticulture; integrated livestock-aquaculture; integrated; integrated multi-trophic aquaculture (IMTA) and integrated floating cage aquageoponics system (IFCAS).	**CLO 3**	**8**
41. Organic aquaculture systems: Development status of organic aquaculture, land use and fish husbandry, hatchery for fish seed production, certified organic fish feed, fish health, harvesting and transportation of fish, processing and marketing of organic products, organic aquatic plants production.	**CLO 4**	**8**
42. Conventional vs. organic aquaculture: Overview, production systems, environmental issues, and laws of regulations of conventional aquaculture; standard and certification of organic aquaculture; research and development in organic aquaculture.	**CLO 5**	**5**
43. Mid-term Examination		**1**
Total		**32**

Teaching strategy: Lectures, Problem based learning, Q/A session, Group studies and Discussion.

Assessment Strategy: MCQ Test, Written test, Quiz, Oral test, Assignment and Presentation.

Learning Resources:

Text Books

1. Ahilan B., K. Ravaneshwaran and P. Kumaravel, 2018. Integrated Aquaculture, Daya Publishing House, Delhi, pp.142.
2. Bergleiter, S. N. Berner, U. Censkowsky and G. Julià-Camprodon. 2009. Organic Aquaculture 2009: Production and Markets, Naturland E.V. & Organic Services GmbH.
3. Little, D. and J. Muir. 1987. A Guide to Integrated Warm Water Aquaculture, University of Stirling, Scotland, U. K. pp.238.

References

1. Little D.C., B. K. Barman, M. M. Haque, and M. A. Wahab. 2007. Decentralized Nile tilapia seed production. In: Van der Zijpp, A.J., J.A.J.Verreth, L. Q. Tri, M. E. F. van Mensvoort, R.

H. Bosma, and M. C. M. Beveridge, (Eds.), Fishponds in farming systems, Wageningen Academic Publishers, The Netherlands, pp. 49-58.

2. Little, D.C., M. Karim, D. Turongruang, E. J. Morales, F. J. Murray, B. K. Barman, M. M. Haque**, N.** Kundu, B. Belton, G. Faruque, M. E. Azim, F.U. Islam, L. Pollock, M.C.J. Verdegem, J. A. Young, W. Leschen, and M. A. Wahab. 2007. Livelihood impacts of ponds in Asia-opportunities and constraints. In: Van der Zijpp, A.J., J.A.J.Verreth, L. Q. Tri, M. E. F. van Mensvoort, R. H. Bosma, and M. C. M. Beveridge, (Eds.), Fishponds in farming systems, Wageningen Academic Publishers, The Netherlands, pp. 177-202.
3. Boehmer, S., G. Mary, S. Hauser, B. Thomas, and A. Young. 2005. Organic Aquaculture, Alternative Farming Systems Information Center, National Agricultural Library, U. S. Department of Agriculture, USA.
4. Little, D.C. and P. Edward. 2003. Integrated livestock-fish farming systems. Food and Agricultural Organization of the United Nations, Rome, Italy, pp.189.
5. FAO, 2001. Integrated Agriculture – Aquaculture: A Primer, FAO Fisheries Technical Paper, 407, Food and Agricultural Organizations of United Nations, Rome Italy.
6. Gooley, G.J. and F. M. Gavine. 2003. Integrated Agri-Aquaculture Systems: A Resource Handbook for Australian Industry Development. A report for the Rural Industries Research and Development Corporation, RIRDC Publication, Australia. pp.183.
7. Edmods, P., K. E. MeCoy and C. Chantachaeng. 1986. Pilot small-scale crop/livestock/fish farm. AIT, Bangkok, Thailand. pp.131.
8. Ruddle, K. and G. Zhong. 1988. Integrated Aquaculture in South China. Cambridge University Press, Cambridge, U. K.
9. WWF, 2010. Pangasius Aquaculture Dialogue Standards, World Wildlife Fund, Inc
10. Anonymous. 1997. Training on Integrated Fish Farming to Thana Fisheries Officer, Fisheries Research Institute, Mymensingh.
11. Edwards, P., R. S. V. Pullin and J. A. Granter. 1988. Research and education for development of integrated crop-livestock-fish farming in tropics. ICLARM Stud. Rev., Manilla, Philippines, ICLARM, No.16. pp.53.
12. Islam, M. A. 2001. Aquaculture. Bangla Academy. Dhaka. pp.352.
13. Pullin, R. S. V. and Z. H. Shehadeh (eds.). 1980. Integrated agriculture aquaculture farming systems. ICLARM conf. Proc., 4. Manilla, Philippines.

Bangladesh Agricultural University
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B. Sc. Fisheries (Hons.)

Course Profile :

Course Code: AQ 3224 **Course Title: Integrated and Organic Aquafarming**

Credit: 1 **Contact Hours: 16** **Level: 3** **Semester: 2**

Course offering department(s): Department of Aquaculture

Rationale:

In order to apply knowledge of integrate and organic aquafarming for enhancing diversified food production in a sustainable and environmentally friendly manner, students will need to acquire practical knowledge and skills on planning and operating integrated and organic farming using different farming components at the on-station and on-farm levels.

Course learning Outcomes (CLO):

CLO1. Illustrate the lay-out of different components of integrated & organic aquafarming
CLO2. Analyze nutrients available in waste and discuss their uses in integrated and organic aquaculture farming
CLO3. Demonstrate the reusing of nutrients in integrated and organic aquafarming farming
CLO4: Assess integrated and organic aquaculture farm through visit and direct observations

Course contents:

Course contents	Aligned CLO	No. of Lectures
1. General understanding on the lay-out of the operational systems of integrated and organic aquafarming	**CLO 1**	**1**
2. Analysis of decomposition patterns of aquaculture waste, animal waste and agro-residuals	**CLO 2**	**2**
3. Nutrient values of aquaculture wastes (pond sediments, pond water), common animal wastes and agro-residues and their potential productive uses.	**CLO 2**	**2**
4. Demonstration of reusing of aquaculture wastes for crop/horticulture uses to produce organic fish and other foods.	**CLO 3**	**2**
5. Microbiological examination in different wastes and fish in integrated aquafarming.	**- CLO 2**	**2**
6. Economic analysis of integrated and organic aquaculture practices visiting field.	**CLO 4**	**2**
7. Mid-term Examination		**1**
Total		**16**

Teaching strategy: Lectures, Problem based learning, Interactive learning, Q/A session, Group studies and Discussion.

Assessment Strategy: MCQ Test, Written test, Quiz, Oral test, Field visit, Assignment and Presentation.

Learning Resources:

6. Little, D.C. and P. Edward. 2003. Integrated livestock-fish farming systems. Food and Agricultural Organization of the United Nations, Rome, Italy, pp 189.

7. FAO, 2001. Integrated Agriculture – Aquaculture: A Primer, FAO Fisheries Technical Paper 407, Food and Agricultural Organization of United Nations, Rome, Italy.

8. Little, D. and J. Muir. 1987. A Guide to Integrated Warm Water Aquaculture, University of Stirling, Scotland, U. K. 238 pp.

Bangladesh Agricultural University
Mymensingh-2202
B. Sc. Fisheries (Hons.)

Course Profile :

Course Code: FM 3221 Course Title: Climate Change and Fisheries

Credit: 2 Contact hours: 32 Level: 3 Semester: 2

Course Offering Department (s) :Department of Fisheries Management

Rationale: To tackle the growing effects of climate change (CC) on Bangladesh fisheries, students should learn about the causes of climate change and resultant effects of CC like increased temperature, altered precipitation, sea level rise, ocean acidifications and at the same time, how these climatic events are hampering fisheries and aquaculture of Bangladesh.

Course Learning Outcomes (CLO)

4. Identify and describe cause of climate change
5. Explain how climate change alters aquatic ecosystems, causes sea level rise and results in ocean acidifications
6. Illustrates how climate change impacts inland, coastal & marine fisheries and aquaculture of Bangladesh
7. Demonstrates climate adaptation options in fisheries and aquaculture against climate vulnerabilities

Mapping CLO with PLO

	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8	PLO9	PLO10
CLO1	√									
CLO2	√	√								
CLO3	√	√				√	√			
CLO4		√				√				

Course Contents:

Course contents	Aligned CLO	No. of Lectures
27. Introduction to global climate change	**COL1**	**4**
28. Climate change and aquatic systems	**COL2**	**4**
29. Climate change and sea level rise	**COL2**	**3**
30. Biological and ecological impacts of higher CO2 concentrations	**COL2**	**3**
31. Impacts of climate change on Bangladesh inland fisheries	**COL3**	**5**
32. Impacts of climate change on Bangladesh coastal-marine fisheries including Sundarbans fisheries and biodiversity	**COL3**	**5**
33. Climate change and Bangladesh aquaculture	**COL3**	**4**
34. Vulnerabilities and adaptations to climate change	**COL4**	**4**

Teaching strategy: Lectures, Problem based learning, Interactive learning, Group studies and Discussion

Assessment Strategy: MCQ Test, Written test, Oral test, Assignment and Presentation

Text books:

11. Barange, M., Bahri, T., Beveridge, M.C.M., Cochrane, K.L., Funge-Smith, S. and F. Poulain (Eds.). 2018. Impacts of climate change on fisheries and aquaculture: synthesis of current knowledge, adaptation and mitigation options. FAO Fisheries and Aquaculture Technical Paper No. 627. Rome, FAO. 628 pp.
12. Bloom, A.J. 2010. Global Climate Change: Convergence of Disciplines. Oxford University Press.
13. Phillips, B.F. and M.P. Ramírez. 2017. Climate Change Impacts on Fisheries and Aquaculture: A Global Analysis. John Wiley & Sons Ltd.

References:

7. Alam, A.B.M.S., Chowdhury, M.S.M. and Sobhan, I. 2012. Biodiversity ofTanguar Haor: A Ramsar Site of Bangladesh Volume I: Wildlife, IUCN Bangladesh, Dhaka,Bangladesh, Pp. xi+234
8. Bindoff, N.L., Cheung, W.W.L., Kairo, J.G., Arístegui, J., Guinder, V.A., Hallberg, R., Hilmi, N., Jiao, N., Karim, M.S., Levin, L., O'Donoghue, S., Purca Cuicapusa, S.R., Rinkevich, B., Suga, T., Tagliabue, A. and P. Williamson. 2019. Changing Ocean, Marine Ecosystems, and Dependent Communities. In: IPCC Special Report on the Ocean and Cryosphere in a Changing Climate [H.-O. Pörtner, D.C. Roberts, V. Masson-Delmotte, P. Zhai, M. Tignor, E. Poloczanska, K. Mintenbeck, A. Alegría, M. Nicolai, A. Okem, J. Petzold, B. Rama, N.M. Weyer (eds.)]. In press.

9. Ghimire, M., Kanksha and Vikas, Mayank, Climate Change – Impact on the Sundarbans, a Case Study (2012). International Scientific Journal: Environmental Science, 2(1):7-15, 2012.
10. Giri, S.S. (Ed.). 2016. Climate Change Impact on Coastal Fisheries and Aquaculture in South Asia. SAARC Agriculture Centre, Dhaka, Bangladesh.
11. Glantz, M.H. 2009. Climate Variability, Climate Change and Fisheries. Cambridge University Press.
12. Harrould-Kolieb, E., Huelsenbeck, M. and V. Selz. 2010. Ocean acidification: the untold stories. Oceana, USA.

Bangladesh Agricultural University
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B. Sc. Fisheries (Hons.)

Course Profile :

Course Code: FM 3222 Course Title: Climate Change and Fisheries

Credit: 1 Contact hours: 16 Level: 3 Semester: 2

Course Offering Department (s) : Department of Fisheries Management

Rationale: For the successful fisheries production in lentic and lotic water bodies, students should identify the major inland waterbodies and the physical, chemical parameters of water that can affect the biological production of inland waters.

To critically understand climate change impacts on Bangladesh fisheries, students should investigate and setup experiment to understand causes of climate change and resultant effects of CC like increased temperature, altered precipitation, sea level rise, ocean acidifications, salinity intrusion and at the same time, how these climatic events are hampering fisheries and aquaculture of Bangladesh.

Course Learning Outcomes (CLO)

35. Demonstrate effects of high temperature on physiology and behavior of fish and other aquatic fauna
36. Analyze effects of salinity intrusion (or dilution of salinity) on physiology and life history traits of fish and other aquatic fauna
37. Analyze whether acidified waters stress aquatic fauna
38. Investigate measures towards adaptation of climate change in aquaculture and fishery

Mapping CLO with PLO:

	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8	PLO9	PLO10
CLO1	√	√						√		
CLO2	√	√						√		
CLO3	√	√						√		
CLO4	√	√	√			√	√			

Course Contents:

Course contents	**Aligned CLO**	**No. of Lectures**
39. Identifying climate vulnerable issues in fisheries and aquaculture of Bangladesh	**CLO 1 to 4**	**2**
40. Experimental setup demonstrating effects of high temperature on physiology and behavior of fish and other aquatic fauna	**CLO 1**	**3**
41. Experimental setup analyzing effects of salinity intrusion (or dilution of salinity) on physiology and life history traits of fish and other aquatic fauna	**CLO 2**	**3**

42. Experimental setup investigating on how acidified waters stress aquatic fauna	**CLO 3**	**3**
43. Review/ experimentation/ group exercise to find out measures towards adaptation of climate change in aquaculture and fishery	**CLO 4**	**3**
44. Field visit to study water quality parameters of a fish farm.	**CLO 1 to 4**	**2**

Teaching strategy: Lectures, Field visits, Demonstration, Practical note book, Problem based learning, Interactive learning, Group studies and Discussion.

Assessment Strategy: MCQ Test, Written test, Identification of samples, Oral test, Assignment and Presentation.

References:

14. Barange, M., Bahri, T., Beveridge, M.C.M., Cochrane, K.L., Funge-Smith, S. and F. Poulain (Eds.). 2018. Impacts of climate change on fisheries and aquaculture: synthesis of current knowledge, adaptation and mitigation options. FAO Fisheries and Aquaculture Technical Paper No. 627. Rome, FAO. 628 pp.
15. Bindoff, N.L., Cheung, W.W.L., Kairo, J.G., Arístegui, J., Guinder, V.A., Hallberg, R., Hilmi, N., Jiao, N., Karim, M.S., Levin, L., O'Donoghue, S., Purca Cuicapusa, S.R., Rinkevich, B., Suga, T., Tagliabue, A. and P. Williamson. 2019. Changing Ocean, Marine Ecosystems, and Dependent Communities. In: IPCC Special Report on the Ocean and Cryosphere in a Changing Climate [H.-O. Pörtner, D.C. Roberts, V. Masson-Delmotte, P. Zhai, M. Tignor, E. Poloczanska, K. Mintenbeck, A. Alegría, M. Nicolai, A. Okem, J. Petzold, B. Rama, N.M. Weyer (eds.)]. In press.
16. Eddy, F.B. and R.D. Handy. 2012. Ecological and Environmental Physiology of Fishes. Oxford University Press.
17. Giri, S.S. (Ed.). 2016. Climate Change Impact on Coastal Fisheries and Aquaculture in South Asia. SAARC Agriculture Centre, Dhaka, Bangladesh.
18. Harrould-Kolieb, E., Huelsenbeck, M. and V. Selz. 2010. Ocean acidification: the untold stories. Oceana, USA.
19. Schreck, C.B., Tort, L., Farrell, A. and C. Brauner. 2016. Biology of Stress in Fish, Volume 35, 1st Edition. Elsevier.

Bangladesh Agricultural University
Mymensingh-2202
B. Sc. Fisheries (Hons.)

Course Profile :

Course Code: FT 3221 **Course Title: Fishery Products Technology**

Credit: 2 **Contact Hours: 32** **Level: 3** **Semester: 2**

Course offering department(s): Department of Fisheries Technology

Rationale:

Fishery products technology plays important role in the post-harvest processing of fish, improved methods of preparation of fishery products. Knowledge of this course will help the students to gain scientific knowledge in different technologies and aspects of value addition for income generation, development and improvement of fishery products in relation to consumer behavior, and critically evaluate the functionality and safety of the products in the context of human health. Students will be trained to master the skills of problem solving capacity through analyzing the problems related to product quality and safety along the food chain.

Course Learning Outcomes (CLO):

CLO 1: Gain scientific knowledge and understanding of the biochemical processes in raw materials during post-harvest storage and their transformation into products.
CLO 2: Gain scientific knowledge and understanding of ecology, detection and combat microorganisms in food systems.
CLO 3: Apply scientific knowledge in different technologies and aspects of fishery product development in relation to consumer behavior.
CLO 4: Select appropriate method to improve the quality and extend shelf life of the products as well as add value for income generation.
CLO 5: Make plan to solve problems related to product quality and safety along the food chain.

Mapping CLO with PLO

CLO/PLO	PLO 1	PLO 2	PLO 3	PLO 4	PLO 5	PLO 6	PLO 7	PLO 8	PLO 9	PLO 10
CLO 1	✓			✓						
CLO 2	✓									
CLO 3		✓								
CLO 4										
CLO 5										

Summary of Course Content

Content	Aligned	No. of

	CLO	lectures
15. **Introduction to fishery products in Bangladesh:** Regional look at fishery product launches over time. Scientific and technological development in fishery products, Sustainability claims	CLO 1	3
16. **Wet fish products:** Various forms of wet fish, un-iced fish, iced and chilled fish, diversified/value added chilled fishery products, live fish and shellfish and its transport, packaging, transportation and marketing of wet fish.	CLO 1 & CLO 2	4
17. **Frozen products:** Various product forms, frozen fish , fish and shellfish packaging, storage, transportation, marketing and shipment of frozen products, Quality requirements and maintenance. Scientific and technological problems and resolutions.		4
18. **Dried and dehydrated fishery products:** Traditional sun dried freshwater and marine fishes, improved sun dried products. Packaging, storage and marketing. Good practices. Salted dehydrated products from different fishes. Scientific and technological problems and resolution.	CLO 1 & CLO 2	4
19. **Salted products:** Different types of salted fish, salting and salt-fermentation of hilsa, packaging, storage and marketing of salted fish products, Technological problems and resolutions.	CLO 3	2
20. **Smoked products:** Various types of smoked fish and shellfish, smoking of shrimp in Bangladesh, Packaging, transportation and marketing of smoked products. Technological problems and resolutions.	CLO 4 & CLO 5	3
21. **Canned products:** Canning of small freshwater and marine fish, catfish and carps. Tuna and sardine canning. Packaging, storage and marketing of canned products, quality requirements and maintenance of quality of fish can. Standards on traceability and sustainability of tuna cannery industry. Technological problems and resolutions.	CLO 4	3
22. **Fermented products:** Popular fermented fishery products in Southeast Asia, Fermented fishery products in Bangladesh: Chepa, shidhol shidil, nga-pi and other local products, Packaging, storage and marketing of fermented fishery products, Technological problems and resolutions.	CLO 4	3
23. **Surimi and diversified value-added fishery products:** Introduction to various fish mince- and surimi-based products such as- fish ball, fish finger, fish stick, fish sausages, fish burger, kamaboko, chikwa, fish pickles, fish soup powder, katsuabushi, etc.	CLO 1, CLO 4 & CLO 5	3
24. **Seaweed and seaweed based products:** Seaweed, health benefits, active ingredients and functional properties, Processing of different seaweeds like kolarpa, hypnea, nori, kombu, etc., Manufacture of different seaweed based products in Bangladesh- onigiri, seaweed cake, biscuits, etc. Manufacture of commercial ingredients from seaweed. Status and prospects of seaweed industry in Bangladesh	CLO 1, CLO 4 & CLO 5	2
25. Class test		1
Total		**32**

Teaching Strategy:

Classroom lectures using multimedia projector, white board, discussions, Group work, self-study, assignments, practical demonstrations, Field trips or visits

Assessment Strategy:

Written tests, written assignment, Oral tests, Practical tests, other assessments

Recommended books and other resources:

1. Hall, G. M. 1997. Fish processing technology. Blakie Academic & Professional, London, Weinheim, New York, Melbourne, Madras.
2. Gopakumar, K. 1997. Tropical fishery products, Science Publishers, Inc.
3. Nowsad, A. K. M. A. 2007. Participatory Training of Trainers: A New Approach Applied in Fish Processing. Bangladesh Fisheries Research Forum. Bangladesh.
4. Tanikawa, E., T. Motohiro and M. Akiba. 1985. Marine products in Japan, Published by Koseisha Koseikaku Co., Ltd., Tokyo.
5. Windsor, M. and S. Barlow. 1981. Introduction to Fishery by-products. Fishing News Books Ltd.
6. Balachandran, K. K. 2001. Post-harvest Technology of Fish and Fish Products. Daya Publishing House, Delhi – 110035. India.
7. Donald. 1968. (ed.). The Freezing Preservation of Foods. The Avi Publishing Company, INC.
8. Govindan, T. K. 1985. Fish Processing Technology, Oxford & IBH publishing Co., New Delhi.
9. Kuang, K. H., K. Miwa and M. B. Salim. 1991. (eds.). Proceedings of seminar on-Advances in Fishery Post-harvest Technology in Southeast Asia. SEAFDEC, Singapore.
10. Martin, A. M. 1994. (ed.). Fisheries Processing: Biotechnological Applications. Chapman and Hall, London.
11. Motohiro, T., K. Hashimoto, H. Kadota, and T. Tokunaga. 1992. Science of Processing Marine products, Vol. I & II. Kanagawa International Fisheries Training Center. Japan International Cooperation Agency.
12. Nowsad, A. K. M. A. 1995. Low-cost Fish Processing in Coastal Bangladesh. BGD/97/017/Field Doc. 5/2005, FAO, Bangladesh.
13. Proceeding of conference on-Handling, Processing and Marketing of Tropical Fish. 1976. Tropical Product Institute, London.
14. Ruiter, A. 1995. Fish and Fishery Products; composition, nutritive properties and stability. CAB International, UK.
15. Zaitsev, V. P. 1965. Preservation of Fish Products by Refrigeration. U.S. Department of Commerce.

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Course Profile :

Course Code: FT 3222			**Course Title: Fishery Products Technology**				
Credit:	**1**	**Contact Hours:**	**16**	**Level:**	**3**	**Semester:**	**2**
Course offering department(s): Department of Fisheries Technology							

Rationale:

Through this course, the students will be trained in different production technologies and aspects of fishery products for income generation, and improvement of product quality.

Course Learning Outcomes (CLO):

CLO 1:	Identify basic facilities and requirements of a fishery products laboratory.
CLO 2:	Evaluate the quality of different types of fishery products
CLO 3:	Develop new technology to produce fishery product in relation to consumer behavior.

Mapping CLO with PLO

CLO/PLO	**PLO 1**	**PLO 2**	**PLO 3**	**PLO 4**	**PLO 5**	**PLO 6**	**PLO 7**	**PLO 8**	**PLO 9**	**PLO 10**
CLO 1	✓			✓						
CLO 2	✓									
CLO 3		✓								

Summary of Course Content

Course Content	**Aligned CLO**	**No of Lectures**
1. Acquaintance with fishery products laboratory, its facilities and requirements	CLO 1 & 2	1
2. Preparation of wet fish, fish fillet, *shashimi* and fish loins and observation of their quality	CLO 3, 4 & 5	1

45. Study on the traditional and improved sun dried fishery products	CLO 3, 4 & 5	1
4. Study on traditional and improved salted products from hilsa and determination of salt content.	CLO 3, 4 & 5	1
5. Study on traditional and improved smoked fish and shrimp products and observation of their quality	CLO 3, 4 & 5	1
6. Study on traditional and improved fermented products and observation of their quality	CLO 3, 4 & 5	1
7. Study on mince and mince-based value added fish products, such as fish ball, fish finger, fish stick, fish burger etc	CLO 3, 4 & 5	1
8. Study on surimi and surimi-based products, such as kamaboko, chikuwa, hanpen, agemono, etc.	CLO 3, 4 & 5	1
9. Field visit to dried, fermented fishery product facility	CLO 3, 4 & 5	1
Class test		1
Total Lectures		**10**

Teaching Strategy:

Classroom lectures using multimedia projector, white board, discussions, group work, self-study, assignments, practical demonstrations, fish market visit, industry visit

Assessment Strategy:

Written tests, written assignment, oral tests, practical tests, other assessments

Recommended books and other resources:

1. Balachandran, K. K. 2001. Post-harvest Technology of Fish and Fish Products. Daya Publishing House, Delhi – 110035. India.
2. Donald. 1968. (ed.). The Freezing Preservation of Foods. The Avi Publishing Company, INC.
3. Gopakumar, K. 1997. Tropical fishery products, Science Publishers, Inc.
4. Kuang, K. H., K. Miwa and M. B. Salim. (eds.). 1991. Proceedings of seminar on-Advances in Fishery Post-harvest Technology in Southeast Asia. SEAFDEC, Singapore.
5. Martin, A. M. 1994. (ed.). Fisheries Processing: Biotechnological Applications. Chapman and Hall, London.
6. Nowsad, A.K.M.A. 2007. Participatory Training of Trainers: A New Approach Applied in Fish Processing. Bangladesh Fisheries Research Forum. Bangladesh.
7. Proceeding of conference on-Handling, Processing and Marketing of Tropical Fish. 1976. Tropical Product Institute, London.

8. Ruiter, A. 1995. Fish and Fishery Products; composition, nutritive properties and stability. CAB International, UK.
9. Tanikawa, E., T Motohiro and M. Akiba. 1985. Marine products in Japan, Published by KoseishaKoseikaku Co., Ltd., Tokyo.
10. Zaitsev, V. P. 1965. Preservation of Fish Products by Refrigeration. U.S. Department of Commerce.

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Course Profile :

Course Code: MFS 3201 **Course Title: Biological Oceanography**

Credit: 3 **Contact Hours: 48** **Level: 3** **Semester: 2**

Course Offering Department (s) : Department of Marine Fisheries Science

Rationale:

To know about the factors governing productivity, population dynamics and distribution of organisms in major ecosystems of the ocean.

Course Learning Outcomes:

CLO1. Understand the biomass and biodiversity of the ocean from microbes through mega plankton.
CLO2. Describe how biomass and biodiversity of microbes through megaplankton impacts the functioning and output of marine food webs and fisheries as well as global carbon cycles.
CLO3. Understand the processes which produce and maintain the abundances, composition, and temporal variations of organisms in the ocean, beginning with microbes and progressing through fisheries.
CLO4. Apply traditional biological oceanography methods in field and laboratory setting in observational and experimental studies.

Mapping CLO with PLO:

	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8	PLO9	PLO10
CLO1	√									√
CLO2	√		√			√				
CLO3	√	√		√	√				√	
CLO3							√	√		

Course contents:

Sl. No.	**Course contents**	**Aligned CLO**	**No. of Lectures**
1.	Fish and shellfish of BoB 1. Systematics of fish and shellfish: Classification of fishand shellfish of BoB 2. Life history, reproduction, food & feeding mechanisms, migration and distribution of commercial fisheries organisms of the Bay of Bengal	CLO1, CLO2	12
2.	Plankton 3. Definition, classification, morphology and importance of plankton 4. Phytoplankton and zooplankton classification,	CLO1, CLO2	16

	occurrence and distribution in the Bay of Bengal and major three oceans 5. Factors affecting the growth and abundance of Phytoplankton and zooplankton in the coastal and open water; Productivity measurement of phytoplankton: , Influence of the algal toxin in the marine ecosystem.		
3.	Benthos 6. Definition, classification of benthos in the ocean 7. Benthic communities and their distribution of seafloor 8. Benthic flora and fauna and their vertical stratification, aerobic and anaerobic organisms 9. Coral Reefs: Definition, classification of corals, mechanism of coral formation; Ecology, types and distribution of coral reef; degradation of corals	CLO1, CLO2, CLO3, CLO4	14
4.	Mangroves 10. Definition, classification, zonation, ecological role of mangroves	CLO1, CLO2	5
5	Class test		1

Teaching strategy: Lectures, Problem based learning, Power point slides, scientific papers, Professor and classmates will actively participate to the discussion by asking questions.

Assessment Strategy: MCQ Test, Written test, Assignment.

Learning Resources:

1. Ecology of Plankton, A. Kumar.
2. Biological Oceanographic Processes, T.R. Parsons, M. Takahashi and B. Hargrave.
3. *Marine Biology*, fourth edition (2003), by Castro and Huber. Publisher: McGraw Hill
4. Biological Oceanography, Miller, C.B. and Wheeler, P.A. 2012. 2nd Edition.Wiley Blackwell.

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Course Profile :

Course Code: MFS 3202 **Course Title: Biological Oceanography**

Credit: 1 **Contact Hours: 16** **Level: 3** **Semester: 2**

Course Offering Department (s) : Department of Marine Fisheries Science

Rationale:

To examine the processes governing the distribution, abundances, and production of plants, animals, and nutrients in the oceanic ecosystem.

Course Learning Outcomes:

CLO1. Describe how to collect and preserve marine organisms and estimate their productivity.
CLO2. Understandculture technique of phytoplankton and zooplankton and preparation of plankton and benthos slides.
CLO3. Analyze, present, and discuss different issues of marine biology.

Mapping CLO with PLO:

	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8	PLO9	PLO10
CLO1	√						√			
CLO2	√					√				
CLO3	√	√		√					√	

Course contents:

Sl. No.	**Course contents**	**Aligned CLO**	**No. of Lectures**
1.	Collection, preservation and identification of marine plankton, benthic organisms, crustaceans mollusc and fishes of the BoB	CLO1, CLO2	10
2.	Measurement of the biological productivity of marine waters	CLO1, CLO2	2
3.	Culture of marine phytoplankton and zooplankton	CLO1, CLO2	2
4.	Field trip for studying the coastal –marine flora and fauna in their ecosystem	CLO1, CLO3	1
5.	Class test		1

Teaching strategy: Lectures, lab work, Problem based learning, Power point slides, scientific papers
Assessment Strategy: MCQ Test, Written test, Assignment.

Learning Resources:

1. Ecology of Plankton, A. Kumar.
2. Biological Oceanographic Processes, T.R. Parsons, M. Takahashi and B. Hargrave.

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Course Profile :

Course Code : AM 3205 **Course Title: Agribusiness and Marketing**

Credit: 2 **Contact Hours: 32** **Level: 3** **Semester: 2**

Course Offering Department (s) : Department of Agribusiness and Marketing

Rationale:
Studying this course, the students will acquire knowledge on various aspects of agribusiness and marketing systems, especially about the business opportunities of food commodities for domestic as well as export markets.

Course Learning Outcomes (CLO):

CLO 1: Assess the size, composition, and complexity of agribusiness in Bangladesh

CLO 2: Evaluate the types and start-up factors of an agribusiness

CLO 3: Plan aqua entrepreneurship considering business framework

CLO 4: Explain the role of marketing in successful operation of an agribusiness firm

CLO 5: Examine factors of a consumer-driven market, and role of wholesalers and retailers in bringing consumers desired food products in domestic and international market

Mapping CLO with PLO:

CLO/PLO	PLO 1	PLO 2	PLO 3	PLO 4	PLO 5	PLO 6	PLO 7	PLO 8	PLO 9	PLO 10
CLO 1	✓								✓	
CLO 2		✓							✓	
CLO 3					✓				✓	
CLO 4					✓				✓	
CLO 5				✓					✓	✓

Summary of Course Content:

Course Content	Aligned CLO	No of Lectures
Agribusiness system: Meaning and scope of agribusiness, different types of agribusiness, present scenarios of agribusiness in Bangladesh	CLO 1	2
Planning and Organizing an Agribusiness: Importance of small business, general characteristics of entrepreneur, Challenges of entrepreneur, why agribusiness fail, agribusiness start-up factors to consider, applying business fundamentals, preparing a business plan	CLO 2	4
Types of agribusiness: Different types of agribusiness, characteristics, regulations, advantages, disadvantages of different types of agribusiness	CLO 2	4
Aqua-entrepreneurship: Concept of aqua-entrepreneurship, small and medium enterprise (SME), public-private partnership (PPP) in enterprise development, organizational structures, and economic impacts of aquaculture related SME in Bangladesh	CLO 3	4
Marketing: Basic concepts of marketing, marketing system vs.	CLO 4	8

marketing process, role of marketing in economic development, marketing functions and institutions, utilities of marketing, marketing channel, advantages of specialization and trade, conflicting needs of producers and consumers, development of marketing in Agribusiness.		
Fish from farms to markets: Fishers rights and share catches, farm gate prices, wholesale and retail markets, marketing channels for culture and capture fisheries, marine fish markets (artisan and commercial), problems of fish marketing in rural bazaar and urban markets	CLO 5	6
Regional and international fisheries and aquaculture trade: Value addition to fish and fishery products, consumer requirements, ethical issues, niche markets and future of sea food trade from Bangladesh	CLO 5	4

Teaching Strategy:
Lecture, Discussion, Demonstration by video, Question & answer (QA), Case studies

Assessment Strategy:
Question & Answer (QA), Assignment, Quiz, and Observation

Recommended books and other resources:

Beierlein, James G. and M. W. Woolverton (1991). Agribusiness Marketing – The Management Perspective, Prentice Hall, Englewood Cliffs, New Jursey.

Rickets, C. and O. Rawlins. 2001. Introduction to Agribusiness, Delmar, Thomson Learning.

Branson, R.E. and Norvell. 1983: Introduction to Agricultural Marketing. McGraw-Hill Book Company, New York.

Cramer, G. L., C.W. Jensen and D. D. Southgate Jr. 2001. Agricultural Economics and Agribusiness, 8th ed., John Wiley & Sons, Inc. Singapore.

Rama, R. 2004. Multinational Agribusiness (Crop Science). Food Product Press.

Engle, C. R. and K. Quagrainie. 2006. Aquaculture Marketing Handbook, Blackwell Publishing.

Palfreman, A. 1999. Fish Business Management: Strategy, Marketing and Development. Blackwell Publishing.

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Course Profile :

Course Code: FBG 3202 Course Title: Fish Cryobiology

Credit: 2 Contact Hours: 32 Level: 3 Semester: 2

Course Offering Department (s) : Department of Fisheries Biology and Genetics

Rationale:

In order to apply knowledge of cryobiology for conservation and improvement of fish strain, students will need to acquire knowledge on principles of cryopreservation, cryoinjuries, cryostorage of cells, use of cryostored sperm in artificial insemination, fertility of cryopreserved sperm and seed production.

Course learning Outcomes (CLO):

CLO1. Explain basic concepts of cell cryopreservation, applications of cryopreservation in aquaculture and fisheries

CLO2. Describegenetic diversity and conservation of fish having economic importance.

CLO3 Classify factors causing cryoinjuries and their effects, and remedy.

CLO4. Discuss essential components of cryopreservation, cryogenic storage of fish gametes and embryos.

CLO5. Review applications of cryopreservation in other branches of science.

Mapping CLO with PLO:

	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8	PLO9	PLO10
CLO1	√	√	√							
CLO2	√	√				√		√		√
CLO3	√	√				√		√		
CLO4	√	√			√	√	√	√		√
CLO5	√	√					√	√	√	√

Course contents:

Course contents	Aligned CLO	No. of Lectures
1. Introduction: Overview of cryobiology, scope and significance of cryobiology in aquaculture and fisheries.	**CLO 1, CLO 2**	**3**
2. Cryopreservation of cells: History of cryopreservation, definition and principles of cryopreservation, scope and	**CLO 1, CLO2**	**10**

application of cryopreservation, basic concepts of cell cooling, osmosis, supercooling, cryopreservation and long-term conservation.		
3. Biodiversity conservation: Species diversity, ecosystem diversity, genetic diversity, *ex-situ* and *in-situ* conservation, and cryogenic gene/sperm banking.	**CLO2**	**4**
4. Cryoinjuries: Factors and causes of cryoinjuries, effects of cryoinjuries and its remedial measures.	**CLO3**	**6**
5. Basic elements: Extenders, cryoprotectants, equilibration time, activation of sperm motility, toxicity of cryoprotectants, cryogenic storage of fish gametes and embryos.	**CLO4**	**6**
6. Advanced applications of cryobiology in medical and other sciences.	**CLO5**	**2**
7. Mid-term Examination	**-**	**1**

Teaching strategy: Lectures, Problem based learning, Interactive learning, Q/A session, Group studies and Discussion.

Assessment Strategy: MCQ Test, Written test, Quiz, Oral test, Assignment and Presentation.

Learning Resources:

1. Tiersch TR and Mazik PM (editors). 2000. *Cryopreservation in Aquatic Species*. World Aquaculture Society, Advances in World Aquaculture, Volume 7, Baton Rouge, Louisiana, 439 p.
2. Tiersch TR and Green CC (editors). 2011. *Cryopreservation in Aquatic Species*, 2nd edition. World Aquaculture Society, Advances in World Aquaculture, Baton Rouge, Louisiana, 1003 p.
3. Manju Yadav(Author). 2010. Textbook of Cryobiology. Discovery Publishing Pvt. Ltd.
4. **Audrey U. Smith. 1970 Current Trends in Cryobiology. Springer, Boston, MA.,Springer-Verlag US, 252p.**
5. **Marianne Wilde (Editor). 2015. Cryopreservation: Modern Insights, Published by: M L Books International Pvt. Ltd., 240 p.**
6. Harold Thayer Meryman (Editor). 1996. Cryobiology. Academic Press, 775 p.
7. Alexander I. Zhmakin. 2010. Fundamentals of Cryobiology: Physical Phenomena and Mathematical Models, *Biological and Medical Physics, Biomedical Engineering*. Springer Berlin Heidelberg (Publisher), 278 p.

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Course Profile :

Course Code:AQ 3205 Course Title: Geographical Information Systems in Fisheries

Credit: 2 Contact Hours: 32 Level: 3 Semester: 2

Course offering department(s): Department of Aquaculture

Rationale:

To take necessary spatial decision, fisheries professionals ought to have knowledge on Geographical Information Systems (GIS) and be acquainted with GIS tools ensuring sustainable aquatic production.

Course Learning Outcomes (CLO):

CLO 1: Explain GIS along with its components

CLO 2: Differentiate and manage spatial data

CLO 3: Analyze and store spatial data

CLO 4: Evaluate multi criteria for suitability modeling

CLO 5: Plan for sustainable aquaculture and development

Mapping CLO with PLO

CLO/ PLO	PLO 1	PLO 2	PLO 3	PLO 4	PLO 5	PLO 6	PLO 7	PLO 8	PLO 9	PLO 10
CLO 1	✓	✓								
CLO 2	✓	✓				✓				✓
CLO 3	✓	✓		✓				✓		✓
CLO 4		✓	✓	✓	✓	✓		✓		✓
CLO 5		✓	✓	✓	✓		✓	✓	✓	✓

Summary of Course Content

Content	Aligned CLO	No. of lectures
Introduction to geographical information systems (GIS): Definition, history and components of GIS.	CLO 1	3
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 of vector and raster data. Other sources of spatial data: Census and survey data, arial photographs, satellite images; field data sources: Surveying and GPS.	CLO 2	5
Data input, verification, storage, and output: Methods of data input; editing, presentation, updating and storage of data.	CLO 3	4
Data analysis: Measurement in GIS: Lengths, perimeters and areas. Reclassification, buffering, distance; vector to raster and raster to vector transformation; integrating data into GIS – map overlay, spatial interpolation and their use in fisheries sectors.	CLO 3	8
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 location-using satellite images.	CLO 4 & CLO 5	6
Use of GIS for aquaculture planning and development.	CLO 4 & CLO 5	3
Case Study: Fish habitat suitability modelling in different environmental conditions.	CLO 4 & CLO 5	2
Class Test		1
Total		32

Teaching Strategy:
Lecture, chalk and talk, multi-media, video clipping, demonstration.
Assessment Strategy:
Tutorials (written examination), quiz, assignment, class response.

Recommended books and other resources:

1. Star, J. and J. Estes (1990). Geographical Information Systems: An Introduction. Prentice Hall, Englewood Cliffs.
2. Hugh Mathews and Ian Foster (1995). Geographical Data, sources, presentation and analysis. Oxford University Press.
3. Ian Heywood, Sarah Cornelius and Steve Carver (1998). An introduction to Geographical Information Systems. Longman, London.
4. Aguilar, M.J. and Nath, S.S. (1998). A strategic reassessment of fish farming potential in Africa. Food and Agriculture Organisation, Rome, Italy.

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Course Profile :

Course Code: FM 3203 **Course Title: Fish Stock Assessment**

Credit: 2 **Contact Hours: 32** **Level: 3** **Semester: 2**

Course Offering Department (s) : Department of Fisheries Management

Rationale:

This course is to expose students to basic concepts of fish stock assessment, to acquaint with models for estimation of maximum sustainable yield, and to familiarize how these population parameters are used for sustainable exploitation and management of fisheries resources.

Course learning Outcomes (CLO):

CLO1. Discuss introductory aspect and importance of fish stock assessment.
CLO2. Explain surplus production models.
CLO3. Estimate yield per recruit models.
CLO4. Discuss biomass models
CLO5. Explain computer based analysis of fish stock parameters.

Mapping CLO with PLO:

	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8	PLO9	PLO10
CLO1	√	√	√							
CLO2	√	√				√		√		
CLO3	√	√				√		√		
CLO4	√	√					√	√		
CLO5	√	√				√	√	√		

Course contents:

Course contents	Aligned CLO	No. of Lectures
44. Introduction: Definitions, scope and importance.	**CLO 1**	**2**
45. Surplus production models: Equilibrium models, Non-equilibrium models	**CLO 2**	**6**
46. Yield per recruit models: The classical yield per recruit models	**CLO 3**	**6**
47. Biomass models: The effects of fishing mortality on a single cohort, Including different age classes	**CLO 4**	**6**
48. Computer based yield estimation: Familiar with FiSAT and R softwares and their operation	**CLO 5**	**6**
49. Mid-term Examination and Class Test	**-**	**6**

Teaching strategy: Lectures, Problem based learning, Interactive learning, Q/A session, Group studies and Discussion.

Assessment Strategy: MCQ Test, Written test, Quiz, Oral test, Assignment and Presentation.

Learning Resources:

Text books:

6. King, M. 1995. Fisheries Biology, Assessment and Management. Fishing News Books. 342 pp.
7. Pauly, D. 1984. Fish population dynamics in tropical waters. A manual for use with programmable calculators. ICLARM, Manila. 325 pp.
8. Ricker, W. E. 1975. Computation and interpretation of biological statistics of fish populations. Bull. Fish. Res. Board Can. 191: 382 pp.
9. Sparre, P., E. Ursin, and S. C. Venema. 1989. Introduction to tropical fish stock assessment. Part 1. Manual. FAO Fisheries Technical Paper. No. 306.1. Rome, FAO. 337 pp.
10. Sparre, P., E. Ursin and S. C. Venema. 1989. Introduction to tropical fish stock assessment. Part 2. Exercises. FAO Fisheries Technical Paper. No. 306.2. Rome, FAO. 429 pp.

References:

11. Cushing, D. H. 1968. Fisheries Biology: A study in population dynamics. Univ. Wisconsin, Madison, USA. 200 pp.
12. Cushing, D. H. 1977. Science and the Fisheries. Edward Arnold Publishers Ltd. 25, Hill Street, London WIX 8LL. 60 pp.
13. Gulland, J. A. 1983 (ed.) Fish Stock Assessment: A Manual of Basic Methods. Chichester, U.K., Wiley Interscience, FAO/Wiley series on food and agriculture, Vol. 1. 223 pp.
14. Gulland, J. A. 1988 (ed.) Fish Population Dynamics. Second edition. John Wiley & Sons, Inc., New York.

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Course Profile :

Course Code: FT 3223 **Course Title: Safety and Microbiology of Fishery Products**

Credit: 2 **Contact Hours: 32** **Level: 3** **Semester: 2**

Course offering department(s): Department of Fisheries Technology

Rationale:

The main objectives of this course is to know the composition and characteristics of naturally occurring microorganisms in fish and shellfish; microbial problems in the safety and quality of different types of fishery products and the role of microorganisms in the fishery products development.

Course Learning Outcomes (CLO):

CLO 1:		Describe the qualitative and quantitative properties of microorganisms related to different fish and fish products.
CLO 2:		Adopt good handling practices and good manufacturing practices in harvesting, marketing, processing and storage of fish and fish products.
CLO 3:		Participate in policy making of different fields for safe and quality products development of the country.

Mapping CLO with PLO

CLO/PLO	PLO 1	PLO 2	PLO 3	PLO 4	PLO 5	PLO 6	PLO 7	PLO 8	PLO 9	PLO 10
CLO 1	✓	✓		✓		✓		✓		
CLO 2	✓		✓	✓	✓	✓	✓	✓	✓	✓
CLO 3		✓	✓	✓	✓	✓	✓	✓	✓	✓

Summary of Course Content

Content	Aligned CLO	No. of lectures
46. Microbiology of finfish processing: Harvesting and onboard handling, fishing vessel sanitation, processing and preservation. Effects of low temperature, high temperature, curing process and other processing methods on microorganisms.	CLO 1, CLO 2 & CLO 3	7
47. **Microbiology of molluscan shellfishes:** Microflora of molluscan shellfish at harvest; effect of processing; indicators of spoilage and public health concern at handling and retail procedures.	CLO 1, CLO 2 & CLO 3	5
48. **Microbiology of crustacean shellfishes:** Naturally occurring microflora, microbiological changes through distribution system, microorganism associated with spoilage and public health concern; effect of processing, handling and retail procedures.	CLO 1, CLO 2 & CLO 3	5
49. **Microbiology and spoilage of fishery products:** Frozen fish, dried fish, salted fish, smoked fish, canned fish, marinades, fish sausages and fermented fish.	CLO 1, CLO 2 &CLO 3	9

50. Microbiology of mince, surimi, value added products and by products.	CLO 1, CLO 2& CLO 3	3
51. **Microbiological quality and standards of fishery products:** Microbiological standard and sanitation in fish processing industry; indicator microorganisms and pathogens in fish and fishery products.	CLO 1, CLO 2& CLO 3	2
Class test		1
Total		**32**

Teaching Strategy:

Methods of teaching:

- Classroom lectures using multimedia projector, white board, discussions
- Group work, self-study, assignments, practical demonstrations
- Field trips or visits

Assessment Strategy:

52. Continuous assessments: (will contribute 20% of final examination mark)
    53. Written tests, Written assignment, Oral tests and, Practical tests
54. Final examination:
    - Written tests, Oral tests and, Other assessments

Recommended books and other resources:

10. Burrows, W. 1985. Textbook of Microbiology. 22nd Edition. W. B. Saunders Co., Philadelphia and London. 1038 pp.
11. Chichester, C. O. and H. D. Graham. 1973. Microbial Safety of Fishery Products. Academic Press, New York and London. 308 pp.
12. Frazier, W. C. and D. C. Westhoff. 1990. Food Microbiology. 3rd Edition. McGrow Hill Book Co., New York. London. 502 pp.
13. Ward, D. R. and C. R. Hackney. 1991. Microbiology of Marine Food Products. An AVI Book, Van Nostrand Reinhold, New York. 438 pp.
14. Adam, M. R. and N. O. Moss. 2008. Food Microbiology. 3rd Edition. RSC Publishing Co., Cambridge, U.K.
15. Alcamo, I. E. 1984. Fundamentals of Microbiology. Addison-Wesley Publishing Company.
16. Barbara M. L., T. C. B. Parker and G. W. Gould. 2000. The Microbiological Safety and Quality of Food. Volume I. Aspen Publishers, Inc., 200 Orchard Ridge Drive, Suite 200, Gaithersburg, Maryland, 20878.
17. Mansur, M.A. 2010. Microbiology In "Fisheries Studies": Part-I. Botomul (Publisher), Dhaka. 234-312 pp.
18. Michael, P. D. and R. B. Larry. 2007. Food Microbiology: fundamentals and frontiers. ASM Press, Washington, D.C.
19. Nickerson, J. T. and A. J. Sinskey. 1993. Microbiology of Food and Food Processing. Elsevier, New York, Oxford, Amsterdam.
20. Ravindran, K. N., I. A. Nair, P. A. Perigreen, Paniker and M. Thomas. 1985. Harvest and Post-harvest Technology of Fish. Society of Fisheries Technologists, India.
21. Reinheimer, G. 1985. Aquatic Microbiology. John Wiley & Sons. New York, Brisbane, Toronto.
22. Thomas, J. M. and R. M. Karl. 2008. Food Microbiology: an introduction. ASM Press, Washington, D.C.
23. Wood, B. J. B. 1985. Microbiology of Fermented Foods. Volume I, Blackie Academic and Professional, 2-6 Boundary Row, London, SE1, 8HN, UK.

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Course Profile :

Course Code: **MFS 3203** Course Title: **Marine Hazards and Contaminants**

Credit: 2 **Contact Hours: 32** **Level: 3** **Semester: 2**

Course Offering Department (s) : Department of Marine Fisheries Science

Rationale:

This course will provide the knowledge on types, sources and impact of hazards and contaminants on marine resources and to learn the pollution monitoring methods, ocean management and marine pollution abatement programs**.**

Course Learning Outcomes:

CLO1. Define and distinguish different sources of marine hazards and contaminants.
CLO2. Describe the methods for marine pollution monitoring.
CLO3. Identify global and regional agreements and initiatives addressing marine pollution.

Mapping CLO with PLO:

	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8	PLO9	PLO10
CLO1	√						√			
CLO2	√		√			√		√		
CLO3	√	√		√					√	√

Course contents:

Sl. No.	**Course contents**	**Aligned CLO**	**No. of Lectures**
1.	Introduction -Definition of contamination, types of common hazards and contaminants in the ocean	CLO1, CLO2	2
2.	Major marine pollutants: Types, sources and ecological effects on marine environment – Sewage, heavy metal, pesticide, oil, nuclear, thermal, plastic and micro-plastic pollution.	CLO1, CLO2	8
3.	Marine pollution monitoring – Physical, chemical and biological methods. Biological indicators and accumulators. Conservation and management of the living resources in the high sea.	CLO1, CLO2	8
4.	Current issues on marine pollution: Microplastics – Micro plastics in marine environment – Sources – Bioaccumulation - Impacts on marine organisms – Marine food web –Microplastic toxicity and its effects on organisms and ecosystems, pollution and water fouling in harbour and sea port.	CLO1, CLO3	7
5.	Pollution abatement programs- Pollution abatement	CLO1, CLO3	6

	programs in developed countries – case studies. Assessing pollution damage. Law pertaining to marine pollution.		
6.	Class test		1

Teaching strategy: Lectures, lab work, Problem based learning, Power point slides, scientific papers

Assessment Strategy: MCQ Test, Written test, Assignment.

Learning Resources:

1. Carl J. Sindermann, 2005. Coastal pollution: Effects on living resources and humans (Marine Science Series). 271 pp.
2. Churchill, R. R and A.V. Lowe, 1983. The Law of the Sea, 3d ed. (Manchester: Manchester University Press) 494 pp
3. Clark, R. B. 2001. Marine pollution, Fifth edition. Oxford University press, New York Inc., 231pp.
4. Water Pollution, by AK Tripallhi, Astish Pub. New Delhi. 1990.
5. Assessment of Water Pollution, by SR Mishra. APH Pub. New Delhi. 1996.

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Course Profile :

Course Code: FBG 4101 **Course Title: Genetics and Fish Breeding**

Credit: 3 **Contact Hours: 48** **Level: 4** **Semester: 1**

Course Offering Department (s) : Department of Fisheries Biology and Genetics

Rationale: The students will learn the basic genetic and breeding principles and techniques and their applications for improvement and conservation of fish stocks. This course is aimed at attracting students who are interested in aquaculture species, but students interested in natural populations and genetics in general can benefit from taking the course too.

Course Learning Outcomes

1. Discuss the objectives of fish breeding and the problems faced by breeders.
2. Apply genetic principles and techniques to manage and conserve wild and captive populations.
3. Understand complex inheritance. Explain genetic and environmental sources of variation, to explain the role of environment on phenotype.
4. Apply genetic principles and techniques to improve the economic value and performance of farm fish. To understand and be able to consider the tools available to maximize response to genetic selection.
5. Set up and develop a breeding program at the farm and participate in planning and implementation of breeding programs at the population level. Propose problem solutions that can occur in breeding of different fish species.

Mapping CLO with PLO

	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8	PLO9	PLO10
CLO1	√	√				√				
CLO2	√	√	√			√		√	√	√
CLO3	√	√	√			√		√	√	√
CLO4	√	√	√			√	√	√	√	√
CLO5	√	√	√		√	√		√	√	√

Course contents:

	Course Content	Aligned CLO	No. of Lectures
1.	Introduction: Overview of fish genetic resources of Bangladesh, scope and potential of genetics in aquaculture and fisheries.	CLO1	2
2.	Genetics of populations: Genetic variability in a population, gene pool and gene frequency, Hardy-Weinberg Equilibrium, factors influencing gene and genotype frequency.	CLO2	5
3.	Genetics of quantitative phenotypes: Quantitative phenotypic variation and its components; characteristics of quantitative inheritance, gene-environment interaction, environmental factors affecting productivity.	CLO3	7
4.	Selection: Heritability and selection response, basic types of selection programs- individual selection, family selection and mass selection, tandem selection, independent culling, selection index.	CLO4	8
5.	Hybridization: Types of cross breeding programme, uses of hybridization, heterosis, recurrent selection, impact of hybridization, planning of cross breeding programmes	CLO5	4
6.	Inbreeding: Genetic effects and practical applications; inbreeding co-efficient and its calculation; inbreeding depression, control of inbreeding accumulation; effective breeding number and genetic drift	CLO5	6
7.	Seed storage and genetic conservation: Cryopreservation of gametes; live and cryogenic gene banking.	CLO5	4
8.	Chromosome manipulation: Gynogenesis, androgenesis, polyploidy, sex-reversal and production of monosex populations	CLO4	6
9.	Recent developments in genetics: Genetic engineering-applications and biosafety of GMOs	CLO4	6

Teaching strategy: Lectures, problem based learning, interactive learning, group studies and discussion.

Assessment strategy: MCQ Test, Written Test, Oral Test, Assignment and presentation.

Learning Resources

Text and Reference Books:

1. Tave, D. 1993. Genetics for Fish Hatchery Managers (2nd Edition) Van Nostrand Reinhold, New York. 415pp.
2. Falconer, D. S. 1996. Introduction to Quantitative Genetics (4th Edition), Longman.
3. Gjedrem, T. 2005. Selection and breeding programs in Aquaculture, Springer, 364 pp.
4. Shah, M. S. 2010. Genetics of Aquaculture and Fisheries Management. 269 pp.
5. Hartland, D. L. and A. G. Clark. 2007. Principles of Population Genetics. 4th Edition. Sinaur and Associates, Sunderland, M.A. 652 pp.
6. Mostafa, S. 1999. (ed.) Genetics in Sustainable Fisheries Management. Fishing News Books.
7. Reddy, P. V. G. K. 1999. Genetic Resources of the Indian Major Carps FAO Fisheries Technical Paper No. 387.
8. Ryman, N. and F. Utter. 1987. (eds.) Population Genetics and Fishery Management. University of Washington Press Seattle and London.
9. Tave, D. 1999. Inbreeding and Broodstock. Management. FAO Technical Paper No.392.
10. Tave, D. 1995. Selective Breeding Programs for Medium-sized Fish Farms. FAO Fisheries Technical Paper No. 352, Rome. 122 pp.

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Course Profile :

Course Code: FBG 4122 **Course Title: Genetics and Fish Breeding**

Credit: 1 **Contact Hours: 16** **Level: 4** **Semester: 1**

Course Offering Department (s) : Department of Fisheries Biology and Genetics

Rationale: The students will have opportunity to analyze practical problems using the latest techniques in population and quantitative genetics and breeding. Students will develop skills needed to operate a fish breeding center as well as in public services and genetics laboratories. Working with small groups of students enables individual approach and student-centered learning.

Mapping CLO with PLO

	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8	PLO9	PLO10
CLO1	√	√	√			√		√	√	√
CLO2	√	√	√			√		√	√	√
CLO3	√	√	√		√	√		√	√	√
CLO4	√	√	√			√	√	√	√	√
CLO5	√	√	√			√	√	√	√	√

Course Learning Outcomes:

1. Demonstrate skill to identify problems and state a hypotheses. Learn how to carry out genetic studies in the laboratory and skill to analyze and interpret experimental data using population genetics tools.
2. The student gains experience in analyzing simple but realistic problems in the inheritance of quantitative characters and selection of quantitative characters using tools from quantitative genetics.
3. Learn how to produce monosex fish and identify male and female juveniles by microscopic studies.
4. Skill for chromosome manipulation and cryopreservation.
5. The skills to write a laboratory report.

Course contents:

Course contents	Aligned CLO	No. of Lectures
1. Collection, length-weight measurement and frequency distribution to study quantitative phenotypes of fishes.	CLO1	1
2. Lab test for population genetics to see how the genetics of populations can be modeled using Hardy-Weinberg population genetics and to see the effects of various deviations from the Hardy-Weinberg assumptions on the allele frequencies of a population (micro-evolution).	CLO1	1
3. Techniques of starch gel electrophoresis and calculation of gene and genotype frequencies from allozyme data/ blood group data.	CLO1	1
4. Calculation of heritability and expected response from selection differential and heritability. Estimation of inbreeding coefficient. Estimation of effective population size.	CLO2	1
5. Study of hormonal sex-reversal using androgen and/or estrogen hormones. Feeding the fry every day and observation	CLO3	1
6. Identification of sexes of juvenile fish by acetocarmine squash method to evaluate the results of sex-reversal experiments.	CLO3	1
7. Study of chromosome manipulation techniques to produce polyploidy and gynogenetic fish and familiarization with cryopreservation techniques.	CLO4	1
8. 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	CLO5	1

Teaching strategy: Lectures, problem based learning, interactive learning, group studies and discussion. Field visits.

Assessment strategy: MCQ Test, Written Test, Oral Test, Assignment and presentation.

References:

1. Tave, D. 1993. Genetics for Fish Hatchery Managers (2nd Edition) Van Nostrand Reinhold, New York. 415pp.
2. Gjdrem, T. and M. Baranski. 2009. Selective Breeding in Aquaculture. Springer. 221 pp.
3. Tave, D. 1999. Inbreeding and Broodstock. Management. FAO Technical Paper No.392.
4. Tave, D. 1995. Selective Breeding Programs for Medium-sized Fish Farms. FAO Fisheries Technical Paper No. 352, Rome. 122 pp.
5. Krauter, K. and M. Winey. 2012. Practical Genetics for the 21st Century. Flatworld Knowledge.
6. Lutz, C. G. 2001. Practical genetics for Aquaculture. Fishing News Books. Blackwell Science. 235 pp.
7. Ryman, N. and F. Utter. 1987. (eds.) Population Genetics and Fishery Management. University of Washington Press Seattle and London.

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Course Profile :

Course Code: AQ 4121 **Course Title: Aquatic Animal Health and Immunology**

Credit: 2 **Contact Hours: 32** **Level: 4** **Semester: 1**

Course offering department(s): Department of Aquaculture

Rationale:

In order toprevent and control diseases in the aquaculture systems, students will need to be provided with holistic knowledge on health management and immune defense of aquatic animals.

CLO 1: To describe the overview and impacts of aquatic animal diseases and classify health management strategies in aquaculture
CLO 2: To categorize trans-boundary aquatic animal diseases and their impacts
CLO 3: To explain the overall immune responses of aquatic animals
CLO 4: To summarize and illustrate the antibody probes, immunodiagnostics and vaccination strategies in aquaculture

Mapping CLO with PLO:

	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8	PLO9	PLO10
CLO 1	√	√		√						√
CLO 2		√		√		√		√		
CLO 3	√	√		√				√		
CLO 4	√	√		√	√			√		

Course contents:

Course contents	Aligned CLO	No. of Lectures
1. **Introduction and aquatic animal health management strategies:** Concept of health and disease; causes of disease outbreak in aquatic animals, host, pathogen and environmental interaction, overview and impact of aquatic animal diseases. Terminologies related to immunology. Disease surveillance, monitoring, quarantine, health certification, biosecurity and emergency disease response capacity. Prophylaxis, prevention and control of major diseases of aquatic animal. Use of immunostimulants, prebiotics, probiotics and synbiotics.	**CLO 1**	**8**

2. **Transboundary aquatic animal diseases:** International trade and movement of live aquatic species, movement of pathogens, transboundary aquatic diseases and its impact.	**CLO 2**	**6**
3. **Immune response of aquatic animal:** Components, characteristics and immune functions of fish blood; types and characteristics of immune responses; organs and cells associated non-specific immunity and specific immunity; physical, humoral and cellular factors. Antigen and antibody; immunoglobulin, mechanisms of immunoglobulin formation, structure, class and functions of Ig, primary and secondary antibody response.	**CLO 3**	**8**
4. **Antibody probes and immunodiagnostics**: Polyclonal and monoclonal antibodies- characteristics, preparation and use, antigen-antibody reaction, antibody titre, serology, principles of major immunodiagnostic techniques in aquaculture.	**CLO 4**	**6**
5. Fish vaccines and vaccination: Definition, types, purpose, commercially available fish vaccines, vaccine development, methods of vaccine delivery, vaccination vs chemotherapy.	**CLO 4**	**3**
6. Class-test Examination	**-**	**1**

Teaching strategy: Lectures, Discussion, Problem based learning, Interactive learning, Q/A session, e-learning, Vide- footage and Group studies.

Assessment Strategy: MCQ Test, Written test, Quiz, Oral test, Assignment and Presentation.

Recommended books and other resources:

Text books :

1. Austin, B. and D. A. Austin. 1999. Bacterial Fish Pathogens: Diseases in Farmed and Wild Fish. 3rd ed. Ellis Horwood, England. 552 pp.
2. Iwame, G. and T. Nakanishi. 1996. (eds.) The Fish Immune System. Academic press. 378 pp.
3. Woo, P. T. K. and D. W. Bruno. 1999. Fish Diseases and Disorders Vol. 3. CABI Publishing. 874 pp.

References :

1. Anderson, D. P. 2010. Text Book of Fish Immunology. Narendra Publishing House.
2. Gilda D. Lio-Po Celia R. Lavilla Erlinda R. Cruz-Lacierda. 2012. Health Management in Aquaculture. Southeast Asian Fisheries Development Cener, Tigbauan, Iloilo, Philippines.
3. Brown, L. 1994. Aquaculture for Veterinarians: Fish Husbandry and Medicine Pergamon Press Oxford. 545 pp
4. Charnatchkool. P., J. F Turnbul and C. Limsuween 1996. Health Management in Shrimp Ponds AAHRI, Kasetsurt University Campus, Bangkok. 3rd Edition.

5. Gudding, R., A. Lillenaug, P. J. Midtlyng and F. Brown 1997. Fish Vaccinology. Development of Biological Standardization, Karger.
6. Inglis, V., R. J. Roberts and N. R. Bromage. 1993. Bacterial Diseases of Fish. Blackwell Science.
7. Kapoor, B. G., G. Zaccone, J. Meseguer, M. J. Manning and Y. Suzuki 2009. Fish Defenses: Immunology v 1. Science Publishers, U.S.
8. Plumb. J. A. 1994. Health Maintenance of Cultured Fishes: Principal Microbial Diseases. Argent: B- HEAL-MCF.
9. Roberts, R. J. 1989. Fish Pathology. Baillere Tindall, London, 2nd Edition.
10. Thrusfield, M. 1995. Veterinary Epidemiology. 2nd Edition. The University Press, Cambridge
11. Treves-Brown, K. 1989. Applied Fish Pharmacology. Aquaculture Series. Chapman & Hall.

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Course Profile :

Course Code: AQ 4122 **Course Title: Aquatic Animal Health and Immunology**

Credit: 1 Contact Hours: 16 Level: 4 Semester: 1

Course offering department(s): Department of Aquaculture

Rationale:

In order toprevent and control diseases in the aquaculture systems successfully, students will need to become knowledgeable regarding the practical aspects of health management and immune defense of aquatic animals.

CLO 1: To demonstrate clinical diagnosis of aquatic animal diseases by level investigation and to implement questionnaire survey for epidemiological studies
CLO 2: To arrange disease monitoring and surveillance facilities in fish farms
CLO 3: To isolate and identify of aquatic pathogens followed by examine pathogenicity by experimental infection
CLO 4: To prepare rabbit anti-serum, demonstrate immunodiagnostic techniques and classify various health management techniques in aquaculture
CLO 5: To organize field trips to public and private fish farms for practical exposure.

Mapping CLO with PLO:

	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8	PLO9	PLO10
CLO 1	√	√		√						√
CLO 2		√		√		√		√		
CLO 3	√	√		√				√		
CLO 4	√	√		√	√		√	√		√
CLO 5	√	√	√			√		√		

Course contents:

Course contents	Aligned CLO	No. of Lectures
9. Clinical diagnosis of aquatic animal diseases by field level investigation	**CLO 1**	**2**
10. Development of questionnaire for collection of data for epidemiologic studies	**CLO 1**	**2**

11. Disease monitoring and surveillance in fish farms.	**CLO 2**	**2**
12. Isolation and identification of aquatic pathogens.	**CLO 3**	**2**
13. Health management of aquatic animals by husbandry method.	**CLO 4**	**2**
14. Preparation of rabbit anti-serum and study of immunodiagnostic techniques	**CLO 4**	**2**
15. Experimental infection of fish	**CLO 3**	**2**
16. Field trips to public and private fish farms for practical exposure.	**CLO 5**	**1**
17. Class-test Examination	**-**	**1**

Teaching strategy: Lectures, Problem based learning, Interactive learning, Q/A session, Group studies, Discussion, Practical demonstration, Laboratory sessions and Field visit.

Assessment Strategy: Practical work,MCQ Test, Written test, Quiz, Oral test, Assignment, Practical Notebook and Presentation.

Recommended books and other resources:

References :

1. Bonded-Reantaso, M. G., S. E. McGladdery, I. East, and R. E. Subsinghe. 2001 (eds.). Asia Diagnostic Guide to Aquatic Animal Diseases. FAO Fisheries Technical Paper No 402, Supplement 2. Rome, FAO. 240 pp.
2. Frerichs, N. G and S. D. Millar 1993. Manual for the Isolation and Identification of Fish Bacterial Pathogens, Pisces Press, Stirling.
3. Plumb. J. A. 1994. Health Maintenance of Cultured Fishes: Principal Microbial Diseases. Argent: B- HEAL-MCF.
4. Stolen, J. S., T. C. Fletcher, D. P. Anderson, B. S. Robertson and W. B. Uan Muiswinkel. 1993 (eds.) Techniques in Fish Immunology, FITC-1.
5. Thoesen, J. C. 1994 (ed.). Bluebook: Suggested Procedures for the Detection and Identification of Certain Finfish and Shellfish Pathogens, AFS, Fish Health Section. 4th ed. Argent. B- BLUE-SPD.
6. Tonguthai, K., S. Chainabut, T. Somsiri, Chanratchkakool and S. Kanchanakhan. 1999. Diagnostic Procedure for Finfish Diseases. Aquatic Animal Health Research Institute, Department of Fisheries, Bangkok, Thailand.

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Course Profile :

Course Code: FM 4121 **Course Title: Inland Fisheries Management**

Credit: 2 **Contact Hours: 32** **Level: 4** **Semester: 1**

Course Offering Department (s) :Department of Fisheries Management

Rationale:

To produce quality fisheries graduate with updated knowledge on principles and practices of inland fisheries resource management for conservation and sustainable exploitation.

Course learning Outcomes:

CLO1: Explain various concepts of inland open and close waters in Bangladesh

CLO2: Describe different types of devices to improve lentic and lotic water environment

CLO3: Relate various fisheries management policies and regulations for sustainable management of inland fisheries sector

CLO4: Suggest solution for management problems of inland water bodies in Bangladesh

CL05: Explain various aspects of recreational fisheries for sustainable fisheries and tourism.

Mapping CLO with PLO:

	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8	PLO9	PLO10
CLO1	√	√	√			√		√		√
CLO2	√							√		
CLO3	√	√	√					√		
CLO4	√	√			√			√		
CLO5	√	√						√		

Course Contents:

Course contents	**Aligned CLO**	**No. of Lectures**
1. Introduction: Definition of fisheries management and its branches, concept of inland fisheries management, history of fisheries management, importance of life history data in fisheries management, types of inland water bodies with multipurpose uses.	**CLO 1**	**4**
2. Fisheries Regulations: Purpose, theories, classification and application, fish and wildlife ordinance of Bangladesh.	**CLO 3**	**4**
3. Habitat Restoration: Fish pass, screens and racks, operation and maintenance, habitat improvement devices for lentic and lotic water environment, management of 'flood control, drainage and irrigation'	**CLO 2**	**6**

(FCDI), necessities and development of new fishing water.		
4. Fisheries Management Policy of Bangladesh: History, principals and objectives of New Fisheries Management Policy (NFMP), management problems of inland water bodies in Bangladesh (rivers, *haors*, *baors*, *beels*, floodplains), mitigation measures.	**CLO 3**	**6**
5. Fisheries Cooperative: Roles, objectives, general principles, activities and problems of fisheries cooperative, mitigation measures.	**CLO 4**	**3**
6. Recreational Fisheries: History, objectives, major recreational fisheries resources, recreational fisheries and tourisms, management of recreational fisheries, future development of recreational fisheries with tourism activities.	**CLO 5**	**3**
7. Community Based Fisheries Management: Concept, scope and importance, overview, models of community based fisheries management, community based organizations (CBOs), constraints and mitigation measures for community based fisheries management.	**CLO 4**	**3**
8. Sustainable Fisheries Management: Concept, framework, sustainable management factors (social, economic, environmental and technological aspects), ecosystem approach to fishing.	**CLO 4**	**3**

Teaching strategy: Lectures, Problem based learning, Interactive learning, Group studies and Discussion.

Assessment Strategy: MCQ Test, Written test, Oral test, Assignment and Presentation.

Learning Resources:

1. Cowx, I. G. 2000. Management and Ecology of River Fisheries. Fishing News Books, Blackwell Science Limited, Oxford OX2 0EL, UK.
2. Templeton, R. G. 1995. Freshwater Fisheries Management. Fishing News Books, Farnham, Surey, UK.
3. Tsai, C. and M. Y. Ali. 1997. Openwater Fisheries of Bangladesh. The University Press Limited, Dhaka 1000, Bangladesh.
4. Welcomme, R. L. 2001. Inland Fisheries: Ecology and Management. Fishing News Books, Farnham, Surrey, UK.
5. Ali, M. 1997. Fish, Water and People: Reflection on Inland Openwater Fisheries Resources of Bangladesh. The University Press Limited, Dhaka 1000, Bangladesh.
6. Anderson, L. G. and J. C. Seijo. 2010. Bioeconomics of Fisheries Management. Blackwell Publishing Ltd, Oxford OX4 2DQ, UK.
7. Berkes, F., R. Mahon, P. McConney, R. Pollance and R. Pomeroy. 2001. Managing Small-Scale Fisheries: Alternative Directions and Methods. International Development Research Center, Canada.
8. Cunningham, S. and T. Bostock. 2005. Successful Fisheries Management: Issues, Case Studies, Perspectives. Eburon Publishers, Delft, USA.

9. FAO. 2003. The Ecosystem Approach to Fisheries. Technical Guidelines for Responsible Fisheries No. 4, Food and Agriculture Organization (FAO) of the United Nations, Rome, Italy.
10. Graff, G. D., B. Born, A. M. U. Kamal and F. Marttin. 2001. Floods, Fish and Fishermen. The University Press Limited, Dhaka 1000, Bangladesh.

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Course Profile :

Course Code: FM 4122 **Course Title: Inland Fisheries Management**

Credit: 1 **Contact Hours: 16** **Level: 4** **Semester: 1**

Course Offering Department (s) : Department of Fisheries Management

Rationale:

In order to produce graduates with practical knowledge in fisheries 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.

Course learning Outcomes:

CLO1: Explain various tools and techniques for field visits and data collection in fisheries

CLO2: Observe different fishing practices and livelihood analysis of open water fishers

CLO3: Visit to fish market, fisheries cooperative society and community based fisheries management implemented areas in Bangladesh

CLO4: Field trip to understand sustainable fisheries management practices in open waters

Mapping CLO with PLO:

	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8	PLO9	PLO10
CLO1	√	√	√			√		√		√
CLO2	√							√		
CLO3	√	√	√					√		
CLO4	√	√			√			√		

Course Contents:

Course contents	**Aligned CLO**	**No. of Lectures**
1. Participatory Rural/ Rapid Appraisal (PRA) tools and techniques for field visits and data collection on fisheries.	**CLO 1**	**3**
2. Field trip to observe fishing practices on the Old Brahmaputra River to identify management constraints and mitigation measures.	**CLO 2**	**2**
3. Field trip to fishing villages on the bank of the Old Brahmaputra River for livelihood analysis of fishers.	**CLO 2**	**2**
4. Visit to fish markets for observation of marketing systems with its constraints and mitigation measures.	**CLO 3**	**2**
5. Visit to a fisheries cooperative society to understand how fisheries regulations are being implemented.	**CLO 3**	**2**

6. Visit to a place where community based fisheries management are being implemented.	**CLO 3**	**2**
7. Visit to *haor, baor, beel* and floodplain to understand sustainable fisheries management practices.	**CLO 4**	**3**

Teaching strategy: Lectures, Problem based learning, Interactive learning, Group studies and Discussion, Field visit.

Assessment Strategy: MCQ Test, Written test, Oral test, Assignment and Presentation.

Learning Resources:

1. Conroy, C. 2002. PRA Tools used for Research into Common Pool Resources. Socio-economic Methodologies for Natural Resources Research. Best Practice Guidelines. Chatham, UK: Natural Resources Institute.
2. DFID (Department for International Development). 1999. Sustainable Livelihoods Guidance Sheets. Department for International Development, London, UK.
3. Engle, C. R. and K. Quagrainie. 2006. Aquaculture Marketing Handbook. Blackwell Publishing Ltd, Oxford OX4 2DQ, UK.
4. Hoggarth, D. D., V. J. Cowan, A. S. Halls, M. Aeron-Thomas, A.J. McGregor, C. A. Garaway, A. I. Payne and R. L Welcomme. 1999. Management Guidelines for Asian Floodplain River Fisheries. FAO Fisheries Technical Paper 384 (1&2), FAO, Rome, Italy.
5. Murphy, B. R. and D. W. Willis. 1996. Fisheries Techniques. American Fisheries Society, USA.
6. Narayanasamy, N. 2009. Participatory Rural Appraisal: Principles, Methods and Applications. SAGE Publications Pvt. Ltd, India.
7. Pound, B., A. Braun, C. McDougall and S. Snapp. 2003. Managing Natural Resources for Sustainable Livelihoods – Uniting Science and Participation. Natural Resource Institute, University of Greenwich, Chatham, UK.
8. Sultana, P. and P. Thompson. 2003. Methods of Consensus Building for Community Based Fisheries Management in Bangladesh and Mekong Delta. CAPRi Working Paper No. 30, International Food Policy Research Institute, Washington DC, USA.
9. Villareal, L. V. 2004. Guidelines on the Collection of Demographic and Socio-economic information on Fishing Communities for use in Coastal and Aquatic Resources Management. Food and Agriculture Organisation (FAO) of the United Nations, Rome, Italy.
10. Sultana, P. and P. Thompson. 2003. Methods of Consensus Building for Community Based Fisheries Management in Bangladesh and Mekong Delta. CAPRi Working Paper No. 30, International Food Policy Research Institute, Washington DC, USA.

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Course Profile :

Course Code:		**FT 4121**	**Course Title:Quality Control of Fish and Fishery Products**				
Credit:	**3**	**Contact Hours:**	**48**	**Level:**	**4**	**Semester:**	**1**
Course offering department(s):			**Department of Fisheries Technology**				

Rationale:
This course will enable the students with basic and applied knowledge on quality of fish and fishery products, techniques of fish quality assessment, sanitation, HACCP and Traceability.

Course Learning Outcome (CLOs):
CLO 1: Describe quality, aspects of fish quality, quality attributes, quality programmes, quality control and quality assurance.
CLO 2: Analyze e quality requirements of fishery raw materials and finished products, quality deterioration and defect in fishery products, fish flavour and quality, fish texture and quality.
CLO4: Apply modern approach to quality such as HACCP, traceability, sanitation in fish industries in relation to quality, techniques of quality assessment of fish and fishery products
CLO 5: Plan Organizational of quality control and QMIS.

Mapping CLO with PLO

CLO/PLO	**PLO 1**	**PLO 2**	**PLO 3**	**PLO 4**	**PLO 5**	**PLO 6**	**PLO 7**	**PLO 8**	**PLO 9**	**PLO 10**
CLO 1	✓			✓						
CLO 2	✓			✓						
CLO 3	✓	✓		✓		✓				✓
CLO 4	✓	✓		✓		✓				✓
CLO 5	✓	✓	✓	✓	✓	✓				✓

Summary of Course Content

Content	**Aligned CLO**	**No. of lectures**
1. **Introduction:** Concept of quality; various aspects of fish quality – Intrinsic quality, Quality deterioration, Extrinsic quality defect; Factors affecting fish quality, quality attributes	CLO 1	6
2. Quality programme: Definition and types, quality control and quality assurance, purpose and functional responsibilities of quality programme.	CLO 1 & CLO 2	3
3. Quality requirement of Fishery Raw material and finished product.		3
4. **Modern approach to Quality:** HACCP, Traceability.	CLO 1 & CLO 2	6
5. **Quality deterioration and defect in fishery products:** Chilled processed fish, frozen fish, smoked fish, dried fish, salted fish, canned fish, marinades. Fish flavor and quality, Fish Texture and quality.	CLO 3	5

6. **Organization of quality control:** objectives and importance, industrial quality control, Official quality control, organogram. Quality Management Information System (QMIS).	CLO 4 & CLO 5	5
7. **Sanitation in processing industries:** Hygienic practice, clean-up procedure, water supply, various aspects of sanitation in fish processing.	CLO 4	5
8. Analytical Methods of assessing quality of fish: sensory methods, mechanical or instrumental methods and laboratory methods – chemical and biochemical analysis and microbiological analysis. Sophisticated apparatus: GC-MS, LC-MS, HPLC, Spectrophotometer	CLO 4	5
Field Trip		1
Class test		1
Total		**32**

Teaching Strategy

Lecture, Discussion, Demonstration by audio-Visual Aids, Questions and Answers, Self Study, Group Discussion, Practice and Presentation of Assignments, Visits to Laboratories and related Office and Industries.

Assessment Strategy

Examinations: Class Test, Final Examination.

Books Recommended:

1. Connell, J. J. (1980). Control of Fish Quality. Fishing News Books Ltd. (2nd Edition), England 222pp.
2. Bonnell, A. D. (1994). Quality Assurance in Seafood Processing: A Practical Guide. Chapman & Hall, London, 208 pp.
3. Mansur, M. A. (2012). Fisheries Studies Part-II. Botomul, Dhaka. 352 pp. ISBN: 978-984-8796-14-6.
4. Seafood HACCP Alliance. (2001). Hazard Analysis Critical Control Point. Training Curriculum. Fourth Edition.
5. Bremer, H. A. 2002. Safety and Quality Issues in Fish Processing. CRC Press, 2002 - Technology & Engineering. 507 pp.
6. Fish Inspection, Quality Control, and HACCP: A Global Focus. Proceedings of the Conference. Held May 19-24, 1996, Arlington, Virginia, USA.
7. Food and Drug Administration. 1996. Fish and Fisheries Products Hazard and Control Guide; 1st Edition.
8. Huss, H. H., L. Ababouch and L. Gram. 2003. Assessment and Management of Seafood Safety and Quality. Food and Agriculture Organization of the United Nations, Nature. 230 pp.
9. Huss, H. S. 1995. Assurance of Seafood Quality, FAO Fisheries Technical Paper 334. Technology laboratory, Technical University, Lyngby, Denmark. Royal Veterinary and Agricultural University, Copenhagen, Denmark.
10. Pau, L. F. and R. Olafsson. 1991. Fish Quality Control by Computer Vision. Food Science and Technology. Marcel Dekker, Inc., 270 Madison Avenue, New York, New York 10070.
11. Seafood Quality Determination. Proceedings of the International Symposium on Seafood Quality Determination, coordinated by the University of Alaska Sea Grant College Program, Anchorage, Alaska.
12. Shahidi, F. and B. K. Simpson. 2004. Seafood Quality & Safety: Advances in the New Millennium. Science Tech Publishing Company, St. John's NL, Canada.

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Course Profile :

Course Code:		**FT 4102**	**Course Title: Quality Control of Fish and Fishery Products**				
Credit:	**1.0**	**Contact Hours:**	**16**	**Level:**	**4**	**Semester:**	**1**
Course offering department(s):			**Department of Fisheries Technology**				

Rationale:
This course will enable the students with practical knowledge on quality of fish and fishery products, techniques of fish quality assessment, sanitation, HACCP.

Course Learning Outcome (CLOs):
CLO 1: Describe quality, aspects of fish quality, quality attributes, quality programmes, quality control and quality assurance.
CLO 2: Analyze e quality requirements of fishery raw materials and finished products, quality deterioration and defect in fishery products, fish flavour and quality, fish texture and quality.
CLO4: Apply modern approach to quality such as HACCP, traceability, sanitation in fish industries in relation to quality, techniques of quality assessment of fish and fishery products
CLO 5: Plan Organizational of quality control and QMIS.

Mapping CLO with PLO

CLO/PLO	**PLO 1**	**PLO 2**	**PLO 3**	**PLO 4**	**PLO 5**	**PLO 6**	**PLO 7**	**PLO 8**	**PLO 9**	**PLO 10**
CLO 1	✓			✓						
CLO 2	✓			✓						
CLO 3	✓	✓		✓		✓				✓
CLO 4	✓	✓		✓		✓				✓
CLO 5	✓	✓	✓	✓	✓	✓				✓

Summary of Course Content

Content	**Aligned CLO**	**No. of lectures**
1. Introduction: Terminologies used in the Quality Control and Quality Assurance of Fish and Fishery Products.	CLO 1	1
2. Methods of Assessing quality of Fish and Fishery Products.	CLO 1 & CLO 2	1
3. Statistical methods for sensory analysis experiments for Quality Assessment of Fish and Fishery Products.		1
4. Quality Assessment of Fish and Processed Fish by sensory method.	CLO 1 & CLO 2	1
5. Study of Triangle Test and Duo-Trio Test to determine whether or not there is a detectable difference between two formulations of New Fish Product to assess consumers' acceptability.	CLO 3	1
6. Determination of TVB-N and TMA-N of fish and fishery products as	CLO 4 & CLO 5	1

quality test.		
7. Study of Practical aspects of HACCP. HACCP Worksheet analysis. Study of Internal Quality Audit of Sea Fish Processing Industry. Study of Model Purchase Specification.	CLO 4	2
8. Principle and method of GC-MS analysis for identification of flavor components of fish and fishery products as quality test. HPLC method for determination of Antioxidant Activity of Fish Antioxidants.	CLO 4	2
Field Trip		1
Class test		1
Total		**32**

Teaching Strategy

Laboratory Class/Lecture, Discussion, Demonstration by audio-Visual Aids, Questions and Answers, Self Study, Group Discussion, Practice and Presentation of Assignments, Visits to Laboratories and related Office and Industries.

Assessment Strategy

Examinations: Class Test, Final Examination.

Books Recommended:

13. Connell, J. J. (1980). Control of Fish Quality. Fishing News Books Ltd. (2nd Edition), England 222pp.
14. Bonnell, A. D. (1994). Quality Assurance in Seafood Processing: A Practical Guide. Chapman & Hall, London, 208 pp.
15. Mansur, M. A. (2012). Fisheries Studies Part-II. Botomul, Dhaka. 352 pp. ISBN: 978-984-8796-14-6.
16. Seafood HACCP Alliance. (2001). Hazard Analysis Critical Control Point. Training Curriculum. Fourth Edition.
17. Bremer, H. A. 2002. Safety and Quality Issues in Fish Processing. CRC Press, 2002 - Technology & Engineering. 507 pp.
18. Fish Inspection, Quality Control, and HACCP: A Global Focus. Proceedings of the Conference. Held May 19-24, 1996, Arlington, Virginia, USA.
19. Food and Drug Administration. 1996. Fish and Fisheries Products Hazard and Control Guide; 1st Edition.
20. Huss, H. H., L. Ababouch and L. Gram. 2003. Assessment and Management of Seafood Safety and Quality. Food and Agriculture Organization of the United Nations, Nature. 230 pp.
21. Huss, H. S. 1995. Assurance of Seafood Quality, FAO Fisheries Technical Paper 334. Technology laboratory, Technical University, Lyngby, Denmark. Royal Veterinary and Agricultural University, Copenhagen, Denmark.
22. Pau, L. F. and R. Olafsson. 1991. Fish Quality Control by Computer Vision. Food Science and Technology. Marcel Dekker, Inc., 270 Madison Avenue, New York, New York 10070.
23. Seafood Quality Determination. Proceedings of the International Symposium on Seafood Quality Determination, coordinated by the University of Alaska Sea Grant College Program, Anchorage, Alaska.
24. Shahidi, F. and B. K. Simpson. 2004. Seafood Quality & Safety: Advances in the New Millennium. Science Tech Publishing Company, St. John's NL, Canada.

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Course Profile :

Course Code: MFS 4101 **Course Title: Marine Policy and Legislation**

Credit: 3 **Contact Hours: 48** **Level: 4** **Semester: 1**

Course Offering Department (s) : Department of Marine Fisheries Science

Rationale: To broaden the traditional approach to the law of the sea from jurisdictional issues to include substantial law such as conservation and sustainable use of biological resources and protection of biodiversity and the environment.

Course learning Outcomes:

CLO1. Comprehensive understanding of the contemporary law of the sea regimes.
CLO2. Analyze both factual and legal issues related to the law of the sea cases.

CLO3. Examine the past decisions, and predict future decisions by inventing new legal policies.

Mapping CLO with PLO:

	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8	PLO9	PLO10
CLO1	√						√			
CLO2	√		√		√					√
CLO3	√	√		√		√			√	

Course Contents:

	Course contents	**Aligned CLO**	**No. of Lectures**
1.	Introduction to the Law of the Sea: Concept, Evolution, U.N. Conferences and Conventions 1.1 History of the law of the sea 1.2 Concept and evolution of the law of the sea 1.3 The United Nations Conferences and Conventions 1.4 UNCLOS 1.5 The U.N. Law of the Sea Convention 1982	CLO1, CLO2	6
2.	Law of the Maritime Territory&Territorial Sea: case study- Bangladesh's Maritime boundary negotiation with Myanmar	CLO1, CLO2	6
3.	Functional Marine Zones: 1. The contiguous zone 2. Fishery zones	CLO1, CLO2	6
4.	Implications of the EEZ 1. The EEZ and its legal implications 2. Right of the Coastal states	CLO1, CLO2	6

	3. Rights that all states have in the EEZ		
5.	The Legal regime of the continental shelf, Deep sea bed, high seas Legal Fisheries Regime: 1. Background to the International Law of Fisheries 2. International Law of Fisheries	CLO1, CLO2	9
6.	Marine Pollution Legal Regulation	CLO1, CLO2	5
7.	Geopolitics of Bay of Bengal:Geo-political importance of Bay of Bengal, Case study: Bangladesh Myanmar maritime boundary conflict and verdict.	CLO1, CLO2	4
8.	Marine Scientific Research: Legal problems and Solution 1. The Geneva Rules 2. The Law of the Sea convention 3. Research installation.	CLO1, CLO2, CLO3	5
8.	Class test		1

Teaching strategy: Lectures, Problem based learning, Power point slides, scientific papers, Professor and classmates will actively participate to the discussion by asking questions.

Assessment Strategy: MCQ Test, Written test, Assignment.

Learning Resources:

1. Hand book on Marine Pollution, Edgargold.

2. The Law of the sea, R. R. Churchill and A. V. Lowe.

3. Law of the sea, United Nations.

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Course Profile :

Course Code: AGEXT 4127 **Course Title: Fisheries Extension**

Credit: 2 **Contact Hours: 32** **Level: 4** **Semester: 1**

Course Offering Department (s) : Department of Agricultural Extension Education

Rationale

In order to deliver responsibilities in the field of fisheries extension, the students will need to have a thorough understanding of the fundamental issues of technology transfer in fisheries sector.

Course Learning Outcomes (CLO)

CLO 1. Describe the basic concepts of agricultural extension, perceive the significance of extension work in the context of fisheries extension services, and apply the knowledge while working in development organizations

CLO 2. Conceptualize fundamental issues of education, learning, organization, motivation and leadership; assess various extension teaching methods and their use in different learning situations

CLO 3. Apply critical issues of communication in extension work and conduct communication effectively with farmers and other stakeholders

CLO 4. Undertake appropriate initiatives while involve in process of diffusion of technologies as well as to overcome associated barriers

CLO 5. Develop and implement need-based extension programmes as well as monitor and evaluate extension programmes

CLO 6. Describe the gender roles in fisheries development sector and execute appropriate extension strategies for fisheries entrepreneurship development

Mapping CLO with PLO

CLO/PLO	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8	PLO9	PLO10
CLO1										
CLO2										
CLO3		X							X	
CLO4						X				
CLO5	X									
CLO6										

Course Content

Course Content	Aligned CLO	No. of Lecture
Agricultural Extension: Concept and meanings of agricultural extension; principles of agricultural extension; scopes of agricultural extension; importance of extension education for fisheries services development in Bangladesh	CLO 1	5
Extension Organization and Leadership: Meaning of organization and extension organization; features of an extension organization; an overview of organizations related to agricultural and rural development in Bangladesh; categories of (technical) personnel involved in an extension organizations - qualifications and responsibilities; meaning and types of leadership, importance of leadership in extension work; qualifications of a good leader; role of professional and local leaders in extension work; training and recognition of local leaders in extension work	CLO 2	5
Education, Learning and Motivation: Education: concept, purpose and types; meaning and concept of learning; elements of learning process; laws of learning with their implications in fisheries extension work; concept of motivation; motivation process (motivation cycle); Maslow's Need Theory of motivation and its implication in extension work	CLO 2	5
Communication in Extension: Meaning and importance of communication; basic communication process; models of communication: Shannon-Weaver and Berlo; key elements of extension communication process (as per Leagans); factors affecting effective communication in extension work	CLO 3	5
Extension Teaching Methods: Meaning of teaching, extension teaching and extension teaching methods; steps of extension teaching; classification of extension teaching methods; meaning, advantages and limitations of farm and home visits, farm clinic, method demonstration, result demonstration, radio, and television	CLO 2	5
Diffusion and Adoption of Innovations: Concept of innovation and its types; attributes of an innovation; innovation-decision process; elements of diffusion process; innovativeness and adopter categories	CLO 4	4
Programme Planning & Evaluation in Extension: Concept of extension programme planning and its importance; principles of extension programme planning; steps of programme planning for livestock development; meaning and purposes of monitoring and evaluation; differences between monitoring and evaluation; types of programme evaluation; principles of evaluation of livestock development programmes; steps of evaluation of fisheries extension programmes	CLO 5	4
Gender Issues and Veterinary/Livestock Extension: Concept of gender; gender needs, gender roles, gender mainstreaming, women empowerment; extension strategies for fisheries entrepreneurship development for rural women	CLO 6	2
Review class and Class test		2
Total		32

Teaching strategy

- Lecture and discussion
- Self-study
- Assignment

Assessment strategy

- Written test
- MCQ
- Assignment

Text and Reference Books

1. Bhuiya, M.H., Miah, M.A.M., Akanda, M.G.R., and Bashar, M.A. 2014. *Agricultural Extension Education.* Dhaka: g-Science Implementation & Publication.
2. Kashem, M.A. 2004. *Fundamentals of Extension Education*. Mymensingh: Lima Printing Press.
3. Mannan, Z. 2016. *Business Communication: Strategies for Success in Business and Profession*. Dhaka: University Grants Commission of Bangladesh.
4. Ray, G.L. 2006. *Extension Communication and Management*. 6th ed. Kolkata: Naya Prokash.
5. Rogers, E.M. 2003. *Diffusion of Innovations*. 5thed. New York: The Free Press.
6. Van den Ban, A.W. and H.S. Hawkins. 1996. *Agricultural Extension*. 2nd ed. London: Blackwell Science Ltd.

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Course Profile :

Course Code: AGEXT 4128 **Course Title: Fisheries Extension**

Credit: 1 **Contact Hours: 16** **Level: 4** **Semester: 1**

Course Offering Department (s) : Department of Agricultural Extension Education

Rationale

The course is designed to develop the capacity of students to use different extension teaching methods and aids effectively; to investigate rural communities through questionnaire survey; capacity of students to plan and present PowerPoint slides

Rationale

In order to deliver services in the field of fisheries extension considering the practical issues, students will need to develop their capacity to use different extension teaching methods and aids effectively; to investigate rural communities through appropriate data collecting tools, develop training programmes, prepare and present presentations, and prepare a report.

Course Learning Outcomes (CLOs)

CLO 1. Prepare and use basic extension teaching aids in effective ways
CLO 2. Moderate clients groups and deliver lectures in a group setting
CLO 3. Prepare instruments (questionnaire) for data collection and apply fundamental issues of data collection in practice
CLO 4. Plan and prepare a good PowerPoint presentation while making presentation
CLO 5. Demonstrate leadership skills by developing training progemmes (schedules) for clients
CLO 6. Prepare a report on Upazila Parishad as a tier of local government, functions of nation building organizations working at upazila level as well as grassroots level practices of veterinary extension activities based on week-long field attachment.

Mapping CLO with PLO

CLO/PLO	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8	PLO9	PLO10
CLO1										
CLO2			X						X	
CLO3										
CLO4			X							
CLO5	X									

CLO6										

Course Content

Course Content	Aligned CLO	No. of Lecture
Extension Teaching Aids: Preparation and use of poster and leaflets	CLO 1	2
Preparation and Presentation of Extension Lecture: Practice of delivering a talk on an assigned topic	CLO 2	3
Methods of Data Collection: Concept and types of data; meaning, advantages and limitations of methods of data collection;	CLO 3	1
Preparation of Questionnaire: Concept of structured, semi-structured and non-structured questionnaire; characteristics of a good questionnaire; preparation of a questionnaire; steps in interviewing	CLO 3	3
Preparation and Presentation of Power Point Slides: Preparation of ideal slides and practice session	CLO 4	3
Preparation of Training Program: Concept of education and training; preparation of a training programme on a specific topic	CLO 5	2
Comprehensive Field Attachment: Implementation of field attachment at Upazila level and submission of report	CLO 6	**6 Days**
Review class and Class test		2
Total		16

Teaching Strategy

- Lecture and discussion
- Individual and group presentation
- Group discussion/ group work
- Field attachment report preparation

Assessment Strategy

- Written test and MCQ
- Skill practice on teaching aids preparation
- Assignment record and reports
- Viva voce

Reference Books

1. DAE. 2018. *Agricultural Extension Manual*, 4th edition. Department of Agricultural Extension, Ministry of Agriculture, Government of the People's Republic of Bangladesh, Dhaka.
2. DAEE. 2019. *Practical Manual for Agricultural Extension Education*. Department of Agricultural Extension Education, Bangladesh Agricultural University, Mymensingh.

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Course Profile :

Course Code: FBG 4103 **Course Title: Molecular Biology and Biotechnology**

Credit: 2 **Contact Hours: 32** **Level: 4** **Semester: 1**

Course Offering Department (s) : Department of Fisheries Biology and Genetics

Rationale:

Studentwishing to develop their career in Fish Molecular Biology and Biotechnology will need to introduce with the scope and applications of molecular biology and biotechnology; methods of gene cloning and gene transfer;as well as acquainted with different DNA markers and their applications in fisheries and aquaculture.

Course learning Outcomes (CLO):

CLO1.Delineate the overview, scope and application of molecular biotechnology in fisheries and aquaculture.

CLO2. Illustrate the restriction enzyme, creation of recombinant DNA molecule, cDNA synthesis, isolation of gene andcreation of gene library.

CLO3.Explain different molecular markers and techniques for identification and genetic improvement of fishes.

CLO4.Discuss method of gene transfer and expression of transgene in fish, biosafety of genetically engineered fish,environmental and food safety.

Mapping CLO with PLO:

	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8	PLO9	PLO10
CLO1		√								
CLO2	√		√		√	√		√	√	√
CLO3	√	√	√					√		
CLO4	√		√				√	√		√

Course contents:

Course contents	Aligned CLO	No. of Lectures
1. Introduction: Overview of molecular biology and biotechnology, scope of molecular biology and biotechnology, applications of biotechnology in fisheries and aquaculture.	**CLO 1**	**2**
2. Recombinant DNA technology: Restriction endonucleases, creation of recombinant DNA molecules, cloning vectors, creation of gene library, isolation of a specific gene.	**CLO 2**	**6**
3. Molecular techniques: Electrophoresis, southern blotting, northern blotting, western blotting, Polymerase Chain Reaction (PCR).	**CLO 3**	**7**
4. DNA markers: Applications, RFLP, RAPD, AFLP and microsatellite DNA markers.	**CLO 3**	**8**
5. Transgenic technology: Methods of gene transfer in fish, genomic integration and expression of transgenes, applications.	**CLO 4**	**5**
6. Biosafety of genetically engineered fish, environmental safety and food safety.	**CLO 4**	**3**
7. Class Test Examination	**-**	**1**

Teaching strategy: Lectures, Problem based learning, Interactive learning, Q/A session, Group studies and Discussion.

Assessment Strategy: MCQ Test, Written test, Quiz, Oral test, Assignment and Presentation.

Learning resources:

1. Kingsman, S. M. and A. J. Kingsman. 1989. Genetic Engineering. Blackwell Scientific Publications. 522 pp.
2. Primrose, S. B., R. M. Twyman and R. W. Old. 2002. Principles of Gene Manipulation. 6th Edition. Blackwell Publishers, London. 480 pp.
3. Walker, J. M. and R. Rapley. 2008. Molecular Biomethods. 2nd Edition. Humana Press. 1124 pp.
4. Watson, J. D., M. Gilman, J. Witkowski and M. Zoller. 1992. Recombinant DNA (2nd Edition). Scientific American Books. W. H. Freeman and Company, New York.
5. Alberts, B., A. Johnson, J. Lewis, M. Raff, K. Roberts and P. Walter. 2008. Molecular Biology of the Cell. 5th Edition. Garland Science (Taylor and Francis Group).
6. Avise, J. C. 1994. Molecular Markers, Natural History and Evolution. Chapman and Hall. 511 pp.
7. Hew, C. L. and G.L. Fletcher. 1992. Transgenic Fish. World Scientific.
8. Kreuzer, H. and A. Massey. 2001. Recombinant DNA and Biotechnology: A Guide for Students. 2nd Edition. American Society of Microbiology, Washington D.C.
9. Ranga, M. M. 2000. Animal Biotechnology. Agrobios (India).
10. Wong, D. W. S. 2006. The ABCs of Gene Cloning. (2nd Edition) Springer. 242 pp.
11. Recombinant DNA…….

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Course Profile :

Course Code: **AQ 4103** **Course Title:** **Shellfish Diseases**

Credit: **2** **Contact Hours:** **32** **Level:** **4** **Semester:** **1**

Course offering department(s): **Department of Aquaculture**

Rationale:

In order to reduce the impacts of shellfish diseases in the aquaculture systems, students will need to become familiar with different diseases of shellfish of commercial importance.

CLO 1: To describe the shellfish disease producing factors and to categorize various microbial diseases of shrimp and prawn in details
CLO 2: To compare protozoan and metazoan parasitic diseases of shrimp and prawn with causative agents, clinical signs, pathology and control measures
CLO 3: To explain Non-infectious diseases and their effects on shrimp and prawn health
CLO 4: To summarize common diseases of non-shrimp crustaceans and molluscs with causative agents, clinical signs and control measures

Mapping CLO with PLO:

	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8	PLO9	PLO10
CLO 1	√	√		√						√
CLO 2		√		√				√		
CLO 3	√	√		√				√		
CLO 4	√	√		√	√			√		

Course contents:

Course contents	Aligned CLO	No. of Lectures
9. **Introduction and Microbial diseases of shrimp and prawn:** Importance of shellfish diseases with special reference to shrimp, disease producing factors and general indications of shellfish health. Viral, bacterial and fungal diseases of shrimp and prawn with their etiology, epizootiology, clinical signs, pathology, diagnosis, distribution, prevention and control measures.	**CLO 1**	**13**
10. **Common protozoan and metazoan parasitic diseases in shrimp and prawn:** Causative agents, clinical signs, pathology and control measures.	**CLO 2**	**6**
3. **Non-infectious diseases of shellfish:** Environmental diseases of shrimp and prawn and their management, dietary diseases and their effects on shrimp and prawn health, care and management.	**CLO 3**	**6**
4. **Diseases of non-shrimp crustaceans and molluscs:** Causative agents, clinical signs and control measures for common diseases in lobsters, crabs, crayfishes, oyster, clam and abalone.	**CLO 4**	**6**
5. Class-test Examination	**-**	**1**

Teaching strategy: Lectures, Discussion, Problem based learning, Interactive learning, Q/A session, e-learning, Vide- footage and Group studies.

Assessment Strategy: MCQ Test, Written test, Quiz, Oral test, Assignment and Presentation.

Recommended books and other resources:

Text books :

4. Austin, B. and D. A. Austin. 1999. Bacterial Fish Pathogens: Diseases in Farmed and Wild Fish. 3rd ed. Ellis Horwood, England. 552 pp.
5. Iwame, G. and T. Nakanishi. 1996. (eds.) The Fish Immune System. Academic press. 378 pp.
6. Woo, P. T. K. and D. W. Bruno. 1999. Fish Diseases and Disorders Vol. 3. CABI Publishing. 874 pp.

References :

1. Anderson, D. P. 2010. Text Book of Fish Immunology. Narendra Publishing House.
2. Gilda D. Lio-Po Celia R. Lavilla Erlinda R. Cruz-Lacierda. 2012. Health Management in Aquaculture. Southeast Asian Fisheries Development Cener, Tigbauan, Iloilo, Philippines.

3. Brown, L. 1994. Aquaculture for Veterinarians: Fish Husbandry and Medicine Pergamon Press Oxford. 545 pp
4. Charnatchkool. P., J. F Turnbul and C. Limsuween 1996. Health Management in Shrimp Ponds AAHRI, Kasetsurt University Campus, Bangkok. 3rd Edition.
5. Gudding, R., A. Lillenaug, P. J. Midtlyng and F. Brown 1997. Fish Vaccinology. Development of Biological Standardization, Karger.
6. Inglis, V., R. J. Roberts and N. R. Bromage. 1993. Bacterial Diseases of Fish. Blackwell Science.
7. Kapoor, B. G., G. Zaccone, J. Meseguer, M. J. Manning and Y. Suzuki 2009. Fish Defenses: Immunology v 1. Science Publishers, U.S.
8. Plumb. J. A. 1994. Health Maintenance of Cultured Fishes: Principal Microbial Diseases. Argent: B- HEAL-MCF.
9. Roberts, R. J. 1989. Fish Pathology. Baillere Tindall, London, 2nd Edition.
10. Thrusfield, M. 1995. Veterinary Epidemiology. 2nd Edition. The University Press, Cambridge
11. Treves-Brown, K. 1989. Applied Fish Pharmacology. Aquaculture Series. Chapman & Hall.

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Course Profile :

Course Code: FM 4123 Course Title: Shellfish Exploitation and Management

Credit: 2 Contact hours: 32 Level: 4 Semester: 1

Course Offering Department (s) : Department of Fisheries Management

Rationale: To become successful fisheries managers, the students should be familiar with the available molluskan and crustacean shellfish resources and the strategies for sustainable exploitation and management of shellfish from freshwater, coastal and marine water habitats.

Course Learning Outcomes (CLO)

1. List different types of shellfish resources, discuss their importance and relate their global distribution
2. Justify environmental requirements for optimal growth and reproduction of shellfish
3. Illustrate basic life cycle of major shellfish groups
4. Analyze basic larval ecology of major shellfish groups
5. Plan shellfish resources exploitation and management strategies

Mapping CLO with PLO:

	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8	PLO9	PLO10
CLO1	√	√				√	√	√		√
CLO2	√	√	√		√	√	√	√	√	√
CLO3	√	√				√	√	√		√
CLO4	√	√				√	√	√		√
CLO5	√	√	√		√	√	√	√	√	√

Course Contents:

Course contents	**Aligned CLO**	**No. of Lectures**
1. Introduction: Types of shellfish; mollusks- different groups, commercial importance of different groups, global distribution; crustaceans- different groups, commercial importance of different groups, global distribution.	**CLO 1**	**4**
2. Environmental requirements for shellfish: Water temperature, DO, pH, salinity, turbidity, food availability, water current, substrate, tides, waves etc.	**CLO 2**	**4**
3. Basic life cycle of major shellfish groups: Uniodoids, oyster, clam, cockle, mussel, scallop, abalone, shrimp, prawn, crabs etc	**CLO 3**	**6**
4. Shellfish larval ecology: Larval development strategies, distribution, dispersion and settlement, substrate selection	**CLO 4**	**5**

5. Shellfish resources management: Site selection, spat collection, clutching system, clutching materials, nursing of spats, culture systems, cleaning, thinning, pest removal, predators, fouling control, health management, food and feeding habits, harvesting and handling, potential health benefits and risks, shellfishing regulations.	**CLO 5**	**8**
6. Conservation of shellfish resources: Mortality, habitat loss, pollution and recruitment limitations; coping with harvesting and predation; strategies to address habitat loss and pollution; measuring recruitment to the shellfish population	**CLO 2**	**5**

Teaching strategy: Lectures, Problem based learning, Interactive learning, Group studies and Discussion.

Assessment Strategy: MCQ Test, Written test, Oral test, Assignment and Presentation.

Learning Resources:

1. Elizabeth Gosling. 2003. Bivalve Molluscs: Biology, Ecology and Culture,1st Edition. Wiley-Blackwell. Pp. 456.
2. Sandra E. Shumway. 2011. Shellfish Aquaculture and the Environment. John Wiley & Sons. Pp. 528.
3. Brian Bayne. 2017. Biology of Oysters, Volume 41, 1st Edition. Academic Press. Pp. 860.
4. Brian Spencer. 2002. Molluscan Shellfish Farming, 1st Edition. Wiley-Blackwell. Pp. 296.
5. M. Jasim Uddin, Zulfigar Yasin and Aileen Tan Shau-Hwai. 2013. Diseases and Parasites in Commercial Tropical Mollusks. LAP LAMBERT Academic Publishing, Germany. Pp. 70.
6. The Coastal Resources Center. 2014. The Rhode Island Shellfish Management Plan, Version II.

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B. Sc. Fisheries (Hons.)

Course Profile :

Course Code:		**FT4103**	**Course Title:**		**Aquatic Product Biotechnology**		
Credit:	**2**	**Contact Hours:**	**32**	**Level:**	**4**	**Semester:**	**1**

Course offering department(s): **Department of Fisheries Technology**

Rationale:

Aquatic product biotechnology is an applied science that utilizes biotechnological applications for the preservation, processing, value-addition and fortification of aquatic food products obtained from finfish, shellfish and aquatic plants. Knowledge of this course will help the students to gain scientific knowledge in different technologies for consumer benefit by preparing chemical products, enzymes, bioactive compounds and other products and processes.

Course Learning Outcomes (CLO):

CLO 1:	Gain scientific knowledge and understanding on biotechnological applications to harness the potential of the marine environment for human benefit.
CLO 2:	Apply scientific knowledge in different biotechnological approaches to develop safe fishery products.
CLO 3:	Choose appropriate biotechnological approach for detection of hazards in seafood.
CLO 4:	Make plan to utilize aquatic resources through recycling and recovery of bioactive compounds from seafood industry wastes.

Mapping CLO with PLO

CLO/PLO	PLO 1	PLO 2	PLO 3	PLO 4	PLO 5	PLO 6	PLO 7	PLO 8	PLO 9	PLO 10
CLO 1	✓			✓						
CLO 2	✓									
CLO 3		✓								
CLO 4										

Summary of Course Content

Content	Aligned CLO	No. of lectures
26. **Introduction:** Scientific and technological developments and biotechnological applications in food industry.	CLO 1	2
27. **Proteases from aquatic organisms:** General properties and	CLO 1 & CLO 2	5

application of proteases; criteria for selection a protease in industry; classification of fish proteases and traditional applications of proteases in the seafood industry.		
28. **Production of fish protein hydrolyzates by microorganisms:** Solubilization of fish mince; microbial proteases; biotechnological approaches to fish meat solubilization; solubilization of fish meat by immobilized microbial cells; future prospects.		5
29. **Fish sauce production:** Types of traditional fermented fish products; fish sauce production; processing of fish sauce; changes during fermentation; microbiology of fish sauce and chemistry of fish sauce.	CLO 1 & CLO 2	4
30. Applications of crustacean wastes in biotechnology; quality and composition of crustacean waste; recovery of crustacean waste components and application of crustacean waste components.	CLO 3	4
31. **New packaging technology for seafood preservation:** Food preservation methods; packaging for seafood; modern food packaging; shelf-life extension and pathogen control.	CLO 4 & CLO 5	3
32. **Rapid method and automation for seafood microbiology:** Improvements in sampling and sample preparation; alternative method for the viable cell count procedure; new microbiological techniques; new and novel techniques.	CLO 4	4
33. **Seafood waste recycling:** Recovery of protein, colour and flavour compounds from seafood waste. Treatment of waste water from fish processing industry. Application of membrane filtration technology.	CLO 4	4
Class test		1
Total		**32**

Teaching Strategy:

Classroom lectures using multimedia projector, white board, discussions, Group work, self-study, assignments, practical demonstrations, Field trips or visits

Assessment Strategy:

Written tests, written assignment, Oral tests, Practical tests, other assessments

Recommended books and other resources:

16. Adams, M.R. and C.F.A Hope. 1989. Rapid methods in food microbiology. Elsevier, Amsterdam.
17. Fujita, T. 1990. Seafood products, in Food Packaging (ed. T. Kadoya) Academic press, New York.
18. Martin, A. M. 1994. Fisheries processing; Biotechnological applications. Chapman & Hall.

19. Adams, M.R., R.D Cook and P. Rattagol. 1985. Fermented fish products of Southeast Asia. Trop. Sc., 25, 61-73.
20. Adler-Nissen, J. 1977. Enzymatic hydrolysis of fish proteins. Process Biochem., 12,18-23.
21. Arason, S., G. Thorodasson, and G. Valdimarsson. 1990. The production of silage from waste and industrial fish; the Icelandic experience. Marketing profit out of seafood wastes. Proceedings of the International Conference of Fish By-products, (ed. S. Keller) University of Alaska Fairbanks, Alaska, pp. 79-85.
22. Sandford, P.A. 1989 Shitosan: commercial uses and potential applications in chitin and chitosan, sources, Chemistry, Biochemistry Physical Properties and Applications, Elsevier Applied Science, New York.

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Course Profile :

Course Code: **MFS 4101** Course Title: **Ocean Mapping and Modeling**

Credit: 2 **Contact Hours: 32** **Level: 4** **Semester: 1**

Course Offering Department (s) :Department of Marine Fisheries Science

Rationale:

This course will introduce students to basic methods and skills of mapping and modeling of ocean for using geographic information systems, satellite location technology (eg. GPS) and remote sensing technology in marine and coastal applications.

Course Learning Outcomes:

CLO1. Operate specialized mapping equipment to acquire bathymetric data and detect anomalies on the seafloor.

CLO2. Install sensors on a survey vessel, configure devices and interface hardware with acquisition and navigation software.

CLO3. Process, analyze and interpret data captured in the marine and coastal environments.

Mapping CLO with PLO:

	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8	PLO9	PLO10
CLO1	√						√			
CLO2	√		√		√					√
CLO3	√	√		√		√			√	

Course contents:

	Course contents	**Aligned CLO**	**No. of Lectures**
1.	Mapping and scales: Types of Maps, Map scale, Coordinates and projection systems	CLO1, CLO2	5
2.	General concept of modeling - Biological model, Ecological model, Mathematical models, Open ocean models	CLO1, CLO2	5
3.	Modeling techniques - Ordinary differential equations, Numerical modelling	CLO1, CLO2	5
4.	Modeling case studies - Mathematical basis of population models, Ocean models, Statistical analysis and numerical modeling for oceanography data	CLO1, CLO3	8
5.	Introduction to marine GIS: General introduction and definitions; GIS requirements (hardware, software,	CLO1, CLO3	8

	manpower); GIS and related technologies (Remote Sensing, GPS, Computerized Cartography, photogrammetry); Applications of GIS; Future directions of GIS (WebGIS, OpenGIS)		
6.	Class test		1

Teaching strategy: Lectures, lab work, Problem based learning, Power point slides, scientific papers

Assessment Strategy: MCQ Test, Written test, Assignment.

Learning Resources:

1. Modeling Methods for Marine Science, Glover, Jenkins and Deney.
2. Applied Factor Analysis in the Natural Sciences, Reyment and Joreskog.
3. Regional Ocean Modeling System(ROMS) NPZD, Gruber et al,2006.
4. An Introduction to geographical Information Systems, by I Heywood, S Cornelius and S Carver. Longman.279pp. 1998.

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B. Sc. Fisheries (Hons.)

Course Profile :

Course Code: FBG 4221 **Course Title: Broodstock and Hatchery Management**

Credit: 2 **Contact Hours: 32** **Level: 4** **Semester: 2**

Course Offering Department (s) :Department of Fisheries Biology and Genetics

Course rationale

In order to apply knowledge of broodstock and hatchery management for improvement of brood and seed quality and fish production, students need to acquire knowledge on basic requirements of a hatchery, its construction and operation, broodstock production, maintenance and their transportation, water quality management, induced breeding and fry rearing of economically important fish species.

Course learning Outcomes (CLO):

CLO1. Illustrate present status and scope of fish hatcheries in Bangladesh, criteria for establishment of fish hatcheries and their essential components.

CLO2. Classify fish hatcheries and types of incubators.

CLO3. Explain broodstock development and management, impact of brood management on fish production; operational management of hatcheries, water quality management of fish hatcheries.

CLO4. Discuss spawning, control of spawning, handling of eggs and incubation, rearing of larvae and fry.

CLO5. Describe conditioning, anesthetization and transportation of live fish using traditional and modern transportation techniques.

Mapping CLO with PLO:

	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8	PLO9	PLO10
CLO1	√	√	√			√				
CLO2	√	√			√	√		√		√
CLO3	√	√	√	√	√	√		√		√
CLO4	√	√	√		√			√		√
CLO5	√	√			√	√	√	√		√

Course contents:

Course contents	Aligned CLO	No. of Lectures
1. Importance of fish hatchery: Present status and role of hatchery to meet the fish seed requirements in Bangladesh.	**CLO 1, CLO 2 CLO 3**	**3**

2. Fish Hatchery: Site selection, essential components - types of incubators, hatching trays, catfish troughs, hatching jars, circular incubator, bottle hatchery, hapa and vertical tray incubators, their advantages and disadvantages prawn and shrimp hatchery components	**CLO2**	**6**
3. Broodstock management: Overview of present brood management practices, domestication of broodstock, impact of brood management on fish production; brood rearing strategies.	**CLO 3**	**6**
4. Operational management of hatchery: Species selection, manpower, economic considerations, budgeting, cost-benefit analysis and economic viability.	**CLO 3**	**2**
5. Water management in hatchery: Water supply and treatment, treatment of water for reuse, water pollutants from hatchery.	**CLO 3**	**2**
6. Spawning and egg handling: Inducing agents, artificial spawning methods, control of spawning, egg incubation and hatching.	**CLO 4**	**5**
7. Larvae and fry rearing: First feeding, feed particle size, live food, nursery pond preparation, one stage and two stage fry rearing.	**CLO 4**	**4**
8. Live fish transportation: Importance, conditioning, equipment, traditional versus modern transportation systems.	**CLO 5**	**3**
9. Mid-term Examination		**1**

Teaching strategy: Lectures, Problem based learning, Interactive learning, Q/A session, Group studies and Discussion.

Assessment Strategy: MCQ Test, Written test, Quiz, Oral test, Assignment and Presentation.

Learning Resources:

1. Haylor, G. 1998. A Fish Hatchery Manual for Africa Pisces Press Ltd, Stirling, Scotland.
2. Jhingran, V. G and R. S. V. Pullin. 1985. A Hatchery Manual for Common, Chinese and Indian Major Carps. Asian Development Bank and International Centre for Living Aquatic Resources Management, Manila, Philippines. 191p.
3. Wedemeyer, G. A. 2002. Fish Hatchery Management. American Fisheries Society Publication.
4. Al-hajj, A B. and A. S. D. Farmaer. 1984. Shrimp Hatchery Manual. Safut. Kuwit for Institute for Scientific Research.

5. BAFRU (Bangladesh Agricultural and Fisheries Resources Unit). 1990. A guide to Shrimp and Prawn Hatchery Techniques in Bangladesh. Stirling, Scotland, HAFRU/ Institute of Aquaculture.
6. Billard, R. 1995. Culture. Praxis Publishing, Chichester, UK.
7. Black, K. D and A. D. Pickerin. 1998. Biology and Cultivation of Fish. Fishing News Books Ltd. Faroham, Surey, England.
8. Chondar, S. L. 1994. Induced Carp Breeding. 3rd Edition. CBS Publishers and Distributers. 142 p.
9. Lee C. S., M. S. Su and I. C. Liao. 1991. Finfish Hatchery in Asia (Proceedings of Finfish Hatchery in Asia'91). Tungakang Marine Laboratory, Taiwan.
10. Piper, R. G., I. B. McElwan, L. E. Orme, J. P. McCraren, L. G. Fowler and J. R. Leanard. 1998. Fish Hatchery Management. US Department of Interior Fish and Wildlife Service, Washington D.C.
11. Woynarovich, E. and L. Horvath, L. 1984 The Artificial Propagation of Warm-water Finfishes, a manual for extension. FAO Fisheries Technical Paper 201.

Bangladesh Agricultural University
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B. Sc. Fisheries (Hons.)

Course Profile :

Course Code: FBG 4222 **Course Title: Broodstock and Hatchery Management**

Credit: 1 **Contact Hours: 16** **Level: 4** **Semester: 2**

Course Offering Department (s) : Department of Fisheries Biology and Genetics

In order to apply practical knowledge of broodstock and hatchery management for improvement of brood and seed quality and fish production, students need to acquire practical knowledge on construction and operation of hatchery, broodstock production and maintenance, water quality management, hands-on training on induced breeding and fry rearing of economically important fish species.

Course learning Outcomes (CLO):

CLO1. Illustrate the layout of fish and shrimp hatchery.

CLO2. Identify ready to spawn brood fish and examine their sex.

CLO3. Collect fish PG and prepare its extract, calculate dose of inducing agents and their administration to broods, stripping of eggs and sperm, calculate fertilization, hatching and survival rates.

CLO4. Visit to Government and private hatcheries.

Mapping CLO with PLO:

	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8	PLO9	PLO10
CLO1	√	√	√		√					√
CLO2	√	√	√		√	√		√		√
CLO3	√	√	√		√	√		√		√
CLO4	√	√	√		√			√		√

Course contents:

Course contents	Aligned CLO	No. of Lectures
1. Drawing the layout of typical fish and shrimp hatchery.	**CLO 1**	**2**
2. Selection of breeders, handling and management. (a) Sex identification and selection of the ready-to-spawn breeders. (b) Collection of PG, preparation of PG and HCG extracts. (c) Dose calculation of inducing agents, injection, stripping and fertilization.	**CLO 2, CLO3**	**6**
3. Use of incubators for hatching of eggs: (a) Incubation of fertilized eggs in different types of incubators.	**CLO 3**	**5**

(b) Study of fertilization, hatching and survival rates		
4. Field visit to commercial fish and shrimp hatcheries	**CLO2, CLO 3**	**2**
5. Mid-term Examination	**-**	**1**

Teaching strategy: Lectures, Problem based learning, Interactive learning, Q/A session, Group studies and Discussion, Practical Note Book.

Assessment Strategy: MCQ Test, Written test, Quiz, Oral test, Assignment and Presentation.

Learning Resources:

1. Al-hajj, A. B. and A. S. D. Farmaer. 1984. Shrimp Hatchery Manual. Safut. Kuwit for Institute for Scientific Research.
2. BAFRU (Bangladesh Agricultural and Fisheries Resources Unit). 1990. A guide to Shrimp and Prawn Hatchery Techniques in Bangladesh. Stirling, Scotland, HAFRU/ Institute of Aquaculture.
3. Billard, R. 1995. Culture. Praxis Publishing, Chichester, UK.
4. Black, K. D and A. D. Pickerin. 1998. Biology and Cultivation of Fish. Fishing News Books Ltd. Faroham, Surrey, England.
5. Chondar, S. L. 1994. Induced Carp Breeding. 3rd Edition. CBS Publishers and Distributers. 142 p.
6. Lee C. S., M. S. Su and I. C. Liao. 1991. Finfish Hatchery in Asia (Proceedings of Finfish Hatchery in Asia'91). Tungakang Marine Laboratory, Taiwan.
7. Piper, R. G., I. B. McElwan, L. E. Orme, J. P. McCraren, L. G. Fowler and J. R. Leanard. 1998. Fish Hatchery Management. US Department of Interior Fish and Wildlife Service, Washington D.C.
8. Woynarovich, E. and L. Horvath, L. 1984 The Artificial Propagation of Warm-water Finfishes, a manual for extension. FAO Fisheries Technical Paper 201.

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Course Profile :

Course Code: **AQ 4221** **Course Title: Fish Pharmacology and Medicine**

Credit: **2** **Contact Hours:** **32** **Level:** **4** **Semester:** **2**

Course offering department(s): **Department of Aquaculture**

Rationale:

In order to treat fish using any therapeutic drugs or chemicals, students will need to become knowledgeable about aspects fish pharmacology and medicine.

Course learning Outcomes (CLO):

CLO1. Explain properties, types and sources of drugs with their nomenclature, classification, parmacodynamics and pharmachokinetics.
CLO2. Classify therapy of fish disease and mthods of drug administration in fish.
CLO3. Discuss chemotherapeutic drugs including antiparasitic and antimicrobial agents with their source, classification and rational use.
CLO4. Describe use, abuse and controling of commercial aquamedicines in Bangladesh aquaculture.
CLO5. Illustrate prescription writing.

Mapping CLO with PLO:

	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8	PLO9	PLO10
CLO1	√	√	√	√						√
CLO2	√	√				√		√		
CLO3	√				√			√		
CLO4	√	√			√			√	√	
CLO5	√	√	√			√	√			

Course contents:

Course contents	Aligned CLO	No. of Lectures
11. Principles of pharmacology and medicine: Terminologies, branches; pharmacopoeia; drugs and medicines; properties, types and source of drugs; drug nomenclature and classification. Pharmacodynamics and pharmachokinetics of drugs	**CLO 1**	**8**
2. Therapy and drug administration in fish: Principles and types of therapy, selection of drug; drug administration - in-feed medication, topical, immersion, injection and water medication; chemoprophylaxis.	**CLO 2**	**4**
6. Chemotherapeutic drugs: Antiparasitic, antiviral, antibacterial, antifungal drugs and pharmacodynamic agents.	**CLO 3**	**8**
7. Commercial aquamedicines: Categories, trade and generic name, their doses and dosages; pharmacheutical companies; abuse and off-label use.	**CLO 4**	**4**
8. Guideline for controling aquamedicine: Drug laws and legislations. Safety issues of fish medicines- safety to the target species, operator, consumer and environment .	**CLO 4**	**4**
9. Prescription writing: Types and parts of prescription, rational use of drugs and rational prescribing, irrational prescribing; drug incompatibilities & adverse effects; withdrawalperiod.	**CLO 5**	**3**
10. Class-test Examination	**-**	**1**

Teaching strategy: Lectures, Discussion, Problem based learning, Interactive learning, Q/A session, e-learning, Vide- footage and Group studies.

Assessment Strategy: MCQ Test, Written test, Quiz, Oral test, Assignment and Presentation.

Learning Resources:

1. Richard D. Howland, Mary Julia Mycek, Richard A. Harvey, Pamela C. Champe 2005. Pharmacology 6thedition (Lippincott Illustrated Reviews Series).
2. K.M. Treves Brown. 2000. Applied Fish Pharmacology. Aquaculture Series 3, Kluwer AcademicPublishers. Dordrecht, The Netherlands. 309 p.
3. Stoskoipf M K. 1993. Fish medicine. W B Saunders company philadelphia. 882 p.
4. Noga E J. 1996. Fish disease. Diagnosis and treatment. Mosby-Year book Inc., St. Louis,Missouri.367p.

Bangladesh Agricultural University
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B. Sc. Fisheries (Hons.)

Course Profile :

Course Code: **AQ 4222** **Course Title: Fish Pharmacology and Medicine**

Credit: **1** **Contact Hours:** **16** **Level:** **4** **Semester:** **2**

Course offering department(s): **Department of Aquaculture**

Rationale:

In order for fish disease treatment and control to be successful, students will need to become knowledgeable about practical aspects of fish pharmacology and medicine.

Course learning Outcomes (CLO):

CLO1. Demonstrate drug therapy and methods of drug administration in fish through oral, injection, immersion and pond treatment.

CLO2. Analyze antibiotic sensitivity of drugs.

CLO3. Classify common indigenous medicinal plant.

CLO 4: Implement survey of commercial aquamedicines and health beneficiary products.

CLO5: Organize field trips to fish farms and pharmaceutical companies for practical exposure.

Course contents:

Course contents	Aligned CLO	No. of Lectures
1. Drug therapy and methods of drug administration in fish: oral, injection, immersion and pond treatment.	**CLO 1**	**6**
2. Determination of antibiotic sensitivity.	**CLO 2**	**2**
3. Collection, identification and use of common indigenous medicinal plant.	**CLO 3**	**2**
4. Survey of commercial aquamedicines and health beneficiary products	**CLO 4**	**3**
5. Field trips to fish farms and pharmaceutical companies for practical exposure.	**CLO 5**	**2**
6. Mid-term Examination	**-**	**1**

Teaching strategy: Lectures, Problem based learning, Interactive learning, Q/A session, Group studies, Discussion, Practical demonstration, Laboratory sessions and Field visit.

Assessment Strategy: Practical work,MCQ Test, Written test, Quiz, Oral test, Assignment, Practical Notebook and Presentation.

Learning Resources:

1. K.M. Treves Brown. 2000. Applied Fish Pharmacology. Aquaculture Series 3, Kluwer AcademicPublishers. Dordrecht, The Netherlands. 309 p.
2. Stoskoipf M K. 1993. Fish medicine. W B Saunders company philadelphia. 882 p.
3. Noga E J. 1996. Fish disease. Diagnosis and treatment. Mosby-Year book Inc., St. Louis,Missouri.367p.

Bangladesh Agricultural University
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B. Sc. Fisheries (Hons.)

Course Profile :

Course Code: FM 4221 Course Title: Marine Fisheries Management

Credit: 2 Contact Hours: 32 Level: 4 Semester: 2

Course Offering Department (s) : Department of Fisheries Management

Rationale:

To extend the knowledge base on marine fishery resources and to introduce the methods and approaches in coastal and marine resources management and conservation; to develop students as fishery managers to implement fishery management plans in the maritime environment of Bangladesh.

Course learning Outcomes (CLO):

CLO1. Discuss introductory aspect and importance of marine fisheries management.
CLO2. Explain various types of marine fisheries.
CLO3. Develop marine fisheries management plan.
CLO4. Discuss the national and global rules to protect marine fisheries.
CLO5. Describe the fishers' livelihood and economic conditions.

Mapping CLO with PLO:

	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8	PLO9	PLO10
CLO1	√	√	√							
CLO2	√	√				√		√		
CLO3	√	√				√		√		
CLO4	√	√					√	√		
CLO5	√	√				√	√	√		

Course contents:

Course contents	Aligned CLO	No. of Lectures
1. Introduction:Definition, purpose and scope, need for fisheries management, characteristics of major fisheries resources and major fishing nations of the world, present trend of marine fisheries	**CLO 1**	**4**
2. Types of fisheries: Subsistence, artisanal, industrial, recreational fisheries	**CLO 2**	**4**
3. Management plan: Purpose, goals, objectives, management standards (indicators and reference points), management measures (input and output controls, control to protect	**CLO 3**	**8**

ecosystems), decision control rules, compliance and enforcement, monitoring, control and surveillance, illegal, unreported and unregulated fishing		
4. Rules and regulations: Marine fish protection and conservation laws for the Bay of Bengal in Bangladesh, FAO code of conduct for responsible fisheries	**CLO 4**	**6**
5. Conservation aspects: Biodiversity principles, categorization of species into endangered, indeterminate and extinct varieties, managing the highly exploited fishery resources. fishers' welfare and livelihood support; fish marketing and trade	**CLO 4**	**4**
6. Fishers' livelihood: Fishers' income, economic efficiency, welfare and livelihood support; fish marketing and trade.	**CLO 5**	**4**

Teaching strategy: Lectures, Problem based learning, Interactive learning, Q/A session, Group studies and Discussion.

Assessment Strategy: MCQ Test, Written test, Quiz, Oral test, Assignment and Presentation.

Learning Resources:

Text books:

1. Grafton, R. Q., R. Hilborn, D. Squires, M. Tait and M. Williams. 2009 (eds.). Handbook of Marine Fisheries Conservation and Management. Oxford University Press, 784 pp.

2. Helfman, G. S. 2007. Fish conservation: a guide to understanding and restoring global aquatic biodiversity and fishery resources. Island Press, Washington, USA. 688 pp.
3. King, M. 1995. Fisheries biology, assessment and management. Fishing News Books. 342 pp.
4. Tsai, C. and M. Y. Ali. 1997. Open water Fisheries of Bangladesh. Bangladesh Centre for Advanced studies. The University Press Limited, Dhaka. 212 pp.

References :

1. Akerman, S. E. 1986. The Coastal Set Bagnet Fishery of Bangladesh: Fishing Trials and Investigations. BOBP/REP/34.
2. BOBP. 1985. Marine Small-Scale Fisheries of Bangladesh: A General Description. BOBP/INF/8.
3. Chowdhury, Z. A., M. Q. M. Huq, M. S. Islam, M. G. Khan, M. G. Mustafa, S. C. Paul, S. A. Quayum and M. N. Sada. 1993. Studies of Interactive Marine Fisheries of Bangladesh Bay of Bengal Programme (BOBP) for Fisheries Development - BOBP/WP/89. 125 pp.
4. DOF. 2008. Hilsa fisheries conservation, development and management techniques. 2nd Edition. Department of Fisheries, Dhaka, Bangladesh.
5. DOF. 2010. Fish Acts and Regulations. Department of Fisheries, Dhaka, Bangladesh.
6. FAO. 1995. Code of Conduct for Responsible Fisheries. Rome, FAO. 41 pp
7. FAO. 2007. The State of World Fisheries and Aquaculture. FAO Fisheries Department, Rome, Italy.
8. Hoq, M. E. 2008. Sundarbans Mangrove: Fish & Fisheries – Ecology, Resources, Productivity and Management Perspectives. Graphic Media, Dhaka, Bangladesh. 271 pp.

9. Rahman, A. K. A., S. M. H. Kabir, M. Ahmad, A. T. A. Ahmed, Z. U. Ahmed, Z. N. T. Begum, M. A. Hassan and M. Khondker. 2009 (eds.). *Encyclopedia of Flora and Fauna of Bangladesh*, Vol. 24. *Marine Fishes*. Asiatic Society of Bangladesh. 485 pp.
10. Silvestre, G and D. Pauly. 1997 (eds.). Status and Management of tropical coastal fisheries in Asia. ICLARM Conference. Proceedings 53. 208 pp.

Bangladesh Agricultural University
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B. Sc. Fisheries (Hons.)

Course Profile :

Course Code: FM 4202 **Course Title: Marine Fisheries Management**

Credit: 1 **Contact Hours: 16** **Level: 4** **Semester: 2**

Course Offering Department (s) : Department of Fisheries Management

Rationale:

To extend the knowledge base on marine fishery resources and to introduce the methods and approaches in coastal and marine resources management and conservation; to develop students as fishery managers to implement fishery management plans in the maritime environment of Bangladesh.

Course learning Outcomes (CLO):

CLO1. Discuss subsistence, artisanal and industrial fisheries in the Bay of Bengal.
CLO2. Describe composition and activities of a fisheries cooperative and fish marketing.
CLO3. Develop marine fisheries management plan.
CLO4. Discuss how fishery regulations are being implemented currently.

Mapping CLO with PLO:

	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8	PLO9	PLO10
CLO1	√	√	√							
CLO2	√	√				√		√		
CLO3	√	√				√		√		
CLO4	√	√					√	√		
CLO5	√	√				√	√	√		

Course contents:

	Course contents	Aligned CLO	No. of Lectures
1	Field trips to study subsistence, artisanal and industrial fisheries in the Bay of Bengal.	**CLO 1**	**4**
2	Study the composition and activities of a fisheries cooperative and fish marketing at field level.	**CLO 2**	**4**
3	Development of a sustainable fisheries management plan of a fish stock in the Bay of Bengal.	**CLO 3**	**4**
4	Visit to marine fisheries surveillance check post, Marine	**CLO 4**	**3**

	Fisheries Office of DoF to know how fishery regulations are being implemented currently.		
5	Class Test	**-**	**1**

Teaching strategy: Lectures, Problem based learning, Interactive learning, Q/A session, Group studies and Discussion.

Assessment Strategy: 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, MCQ Test, Written test, Quiz, Oral test, Assignment and Presentation.

Learning Resources:

Learning Resources:

Text books:

5. Grafton, R. Q., R. Hilborn, D. Squires, M. Tait and M. Williams. 2009 (eds.). Handbook of Marine Fisheries Conservation and Management. Oxford University Press, 784 pp.

6. Helfman, G. S. 2007. Fish conservation: a guide to understanding and restoring global aquatic biodiversity and fishery resources. Island Press, Washington, USA. 688 pp.
7. King, M. 1995. Fisheries biology, assessment and management. Fishing News Books. 342 pp.
8. Tsai, C. and M. Y. Ali. 1997. Open water Fisheries of Bangladesh. Bangladesh Centre for Advanced studies. The University Press Limited, Dhaka. 212 pp.

References :

11. Akerman, S. E. 1986. The Coastal Set Bagnet Fishery of Bangladesh: Fishing Trials and Investigations. BOBP/REP/34.
12. BOBP. 1985. Marine Small-Scale Fisheries of Bangladesh: A General Description. BOBP/INF/8.
13. Chowdhury, Z. A., M. Q. M. Huq, M. S. Islam, M. G. Khan, M. G. Mustafa, S. C. Paul, S. A. Quayum and M. N. Sada. 1993. Studies of Interactive Marine Fisheries of Bangladesh Bay of Bengal Programme (BOBP) for Fisheries Development - BOBP/WP/89. 125 pp.
14. DOF. 2008. Hilsa fisheries conservation, development and management techniques. 2nd Edition. Department of Fisheries, Dhaka, Bangladesh.
15. DOF. 2010. Fish Acts and Regulations. Department of Fisheries, Dhaka, Bangladesh.

Bangladesh Agricultural University
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B. Sc. Fisheries (Hons.)

Course profile :

Course Code: FT4221 Course Title: Fish Inspection and Legislation

Credit: 2 Contact Hours: 32 Level: 4 Semester: 2

Course offering department(s): Department of Fisheries Technology

Rationale:
Familiarize students with inspection and legislations of fish and fishery products, fish processing industry and official inspection practices in EU, US, India and Japan. The students will also be taught the inspection of fish and fishery products in Bangladesh and legislation related to fish inspection and quality.

Course Learning Outcomes (CLOs)

CLO 1: Discuss organization of fish inspection and quality control, programmes of fish inspection and quality control (FIQC), organizational structure, duties and responsibilities and inspection services of FIQC in Bangladesh.

CLO 2: The students will know the Inspection and quality control regulations for fish and fishery products, with updated version of EU, USFDA rules and regulations of Inspection and quality control for fish and fishery products.

CLO 3: Discuss the traceability, steps of implementing traceability in fish and shrimp value chain, National Residue Control Plan (NRCP), policy guideline for NRCP planning, implementation and monitoring

CLO 4: To help establishing regulations to control the quality aspects of the fish and fishery products produced in Bangladesh.

Mapping CLO with PLO

CLO/PLO	PLO 1	PLO 2	PLO 3	PLO 4	PLO 5	PLO 6	PLO 7	PLO 8	PLO 9	PLO 10
CLO 1	✓			✓						
CLO 2		✓			✓					
CLO 3		✓			✓	✓				✓

Course Content	Aligned CLO(s)	No of Lectures
1. **Introduction:** Organization of fish inspection and quality control, the Importance of inspection in the utilization of fishery resources; programmes of fish inspection and quality control (FIQC), organizational structure, duties and responsibilities and inspection services of FIQC.	CLO 1& 2	6
2. **Inspection of fishery products:** Fresh, precooked and frozen fish; hygiene and safety aspect of fishery products.	CLO 2 & 3	4
3. **Food Laws and regulations:** Inspection and quality control	CLO 1, 2 &3	7

regulations for fish and fishery products; fish feed and animal feed act, fish hatchery act, updated version as well as previous acts with amendments, EU and USFDA regulations and guidelines.		
4. **Traceability:** Legal background, benefits and steps of implementing traceability in fish and shrimp value chain.	CLO 2 & 3	4
5. **National Residue Control Plan-NRCP:** Policy guideline for NRCP planning, implementation and monitoring; role of department of fisheries, Bangladesh.	CLO 1 & 2	4
6. Checklist of inspections of farms, depots and processing industries.	CLO 1, 2 & 3	3
7. **Standards of different fishery products and processing plants**: CODEX standards and Bangladesh Standard specification for different fishery products.		3
Class test		1
Total		**32**

Teaching Strategy

Class Lectures, Problem based learning, Interactive learning, Group discussion, Web based learning

Assessment Strategy

Strategic Questioning, MCQ test, Written test, Oral test, Assignment, Presentation

Books Recommended:

1. Bonnell, A. D. 1994. Quality Assurance in Seafood Processing: A Practical Guide. Chapman & Hall, London. 208 pp.
2. Connell, J. J. 1980. Control of Fish Quality. Fishing News Books Ltd. (2nd Edition). England. 222 pp.
3. Kramer, A. and B. A. Twigg. 1966. Fundamentals of Quality Control for the Food Industry. The Avi. Publishing Co. Inc., Westport.
4. Kreuzer, R. 1971. (ed.). Fish Inspection and quality control. Fishing News Books. Ltd. London.
5. Botta, J. R. 1995. Evaluation of Seafood Freshness Quality. VCH Publishers, Inc. New York.
6. Bremer, H. A. 2002. Safety and Quality Issues in Fish Processing. CRC Press, 2002 -Technology & Engineering. 507 pp.
7. Clucas, I. J. and A. R. Ward, 1996. Post-harvest Fisheries Development: A guide to handling, preservation, processing and quality. Natural Resource Institute, UK.
8. Fish inspection, quality control, and HACCP: a global focus : proceedings of the conference held May 19-24, 1996, Arlington, Virginia, USA.
9. Hasegawa, H. 1987. Laboratory Manual on Analytical Methods and procedures for Fish and Fishery Products. Marine Fisheries Research Department, SEAFDEC, Singapore.
10. Huss, H. H., L. Ababouch and L. Gram 2003. Assessment and management of seafood safety and quality. Food and Agriculture Organization of the United Nations, Nature. 230 pp.
11. Proceeding of conference on-Handling, Processing and Marketing of Tropical Fish. 1976. Tropical Product Institute, London.
12. Seafood HACCP Aliance. 2001. HACCP: Hazard Analysis and Critical Control Point. Training Curriculum. 4th Edition.
13. Shahidi, F. and B. K. Simpson 2004. Seafood Quality & Safety: Advances in the New Millennium. Science Tech Publishing Company, St. John's NL, Canada.

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Course profile :

Course Code:		**FT4222**	**Course Title:Fish Inspection and Legislation**				
Credit:	**1**	**Contact Hours:**	**16**	**Level:**	**4**	**Semester:**	**2**
Course offering department(s):			**Department of Fisheries Technology**				

Rationale:
Establishments producing, handling, processing or storing Fish and Fishery Products must be listed and maintained for official control of Fish and Fishery Products. The students will be familiarized with the complete production and supply chain allowing the traceability of the products. The students will learn practically the following aspects for official control of the different establishments dealing with fish and fishery products in Bangladesh.

Course Learning Outcomes (CLOs)

CLO 1: Develop inspection/audit and recording system of different establishments in fish/shrimp supply chain.
CLO 2: Understand farm registration, farm information, depot/arat/landing centre, feed mills, ice factories, hatchery, vessels, transport and processing establishments.
CLO 3: Identify food safety hazards in fish and fishery products using risk based system.
CLO 4: Develop traceability and trace back systems for identification of hazards in fish/shrimp supply chain.
CLO 5: Finally the student will be able to audit of different establishments in fish/shrimp supply chain;

Mapping CLO with PLO

CLO/PLO	**PLO 1**	**PLO 2**	**PLO 3**	**PLO 4**	**PLO 5**	**PLO 6**	**PLO 7**	**PLO 8**	**PLO 9**	**PLO 10**
CLO 1	✓			✓						
CLO 2		✓			✓					
CLO 3		✓			✓	✓				✓

Course Content	**Aligned CLO(s)**	**No of Lectures**
1. Exercise on inspection/audit and recording system of different establishments in fish/shrimp supply: Farm registration, farm information, depot/arat/landing centre, feed mills, ice factories, hatchery, vessels, transport and processing establishments.	CLO 1& 2	4
2. Exercise on traceability and trace back systems for identification of hazards in fish/shrimp supply chain	CLO 2 & 3	1

3. Exercise on identification of food safety hazards in fish and fishery products using risk based system	CLO 1, 2 & 3	1
4. Development of risk based checklist for inspection/verification and audit of different establishments in fish/shrimp supply chain;	CLO 2 & 3	1
5. Exercise on NRCP and other sample collection procedure from different establishments and testing of residues (heavy metals/antibiotics/chemicals (formalin and other harmful chemicals) in the laboratory.	CLO 1 & 2	1
6. Field visit of different establishments using risk based checklist (farms, fish working premises (depots/markets/landing centres/arat), ice factories, feed mills, hatchery, transport, vessels and processing establishment) for audit/verification.	CLO 1, 2 & 3	1
Class test		1
Total		**10**

Teaching Strategy

Class Lectures, Problem based learning, Interactive learning, Group discussion, Web based learning

Assessment Strategy

Strategic Questioning, MCQ test, Written test, Oral test, Assignment, Presentation

Recommended books and other resources:

14. Bonnell, A. D. 1994. Quality Assurance in Seafood Processing: A Practical Guide. Chapman & Hall, London. 208 pp.
15. Connell, J. J. 1980. Control of Fish Quality. Fishing News Books Ltd. (2nd Edition). England. 222 pp.
16. Kramer, A. and B. A. Twigg. 1966. Fundamentals of Quality Control for the Food Industry. The Avi. Publishing Co. Inc., Westport.
17. Kreuzer, R. 1971. (ed.). Fish Inspection and quality control. Fishing News Books. Ltd. London.

References:

1. Botta, J. R. 1995. Evaluation of Seafood Freshness Quality. VCH Publishers, Inc. New York.
2. Bremer, H. A. 2002. Safety and Quality Issues in Fish Processing. CRC Press, 2002 -Technology & Engineering. 507 pp.
3. Clucas, I. J. and A. R. Ward, 1996. Post-harvest Fisheries Development: A guide to handling, preservation, processing and quality. Natural Resource Institute, UK.
4. Fish inspection, quality control, and HACCP: a global focus : proceedings of the conference held May 19-24, 1996, Arlington, Virginia, USA.
5. Hasegawa, H. 1987. Laboratory Manual on Analytical Methods and procedures for Fish and Fishery Products. Marine Fisheries Research Department, SEAFDEC, Singapore.
6. Huss, H. H., L. Ababouch and L. Gram 2003. Assessment and management of seafood safety and quality. Food and Agriculture Organization of the United Nations, Nature. 230 pp.

7. Proceeding of conference on-Handling, Processing and Marketing of Tropical Fish. 1976. Tropical Product Institute, London.
8. Seafood HACCP Aliance. 2001. HACCP: Hazard Analysis and Critical Control Point. Training Curriculum. 4th Edition.
9. Shahidi, F. and B. K. Simpson 2004. Seafood Quality & Safety: Advances in the New Millennium. Science Tech Publishing Company, St. John's NL, Canada.

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B. Sc. Fisheries (Hons.)

Course Profile :

Course Code: FBG 4223 **Course Title: Fish Genomics**

Credit: 2 **Contact Hours: 32** **Level: 4** **Semester: 2**

Course Offering Department (s) : Department of Fisheries Biology and Genetics

Rationale: Studentwishing to develop their career in fisheries will need to know some of the cutting edge genomic tools and technologies for fisheries and aquaculture applications and to use web-based bioinformatics tools for exploring the databases of genomic data.

Course learning Outcomes:

10. Describe genome, genomics, transcriptomics, proteomics, metagenomics and metabolomics.
11. ExplainNext-Generation Sequencing Technologies and the methods for the assembly of sequences generated using various sequencing platforms.
12. Determinesequence identities using BLAST, phylogeneticand syntenic analyses.
13. Illustrate genome annotation and genome-wide association studies of performance traits.
14. Discuss the Role of genomics in fisheries management and aquaculture.

Mapping CLO with PLO:

	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8	PLO9	PLO10
CLO1	√	√								√
CLO2	√	√		√	√	√		√	√	√
CLO3	√	√		√				√	√	√
CLO4	√	√		√	√	√		√		√
CLO5	√	√	√				√		√	

Course Contents:

Course contents	Aligned CLO	No. of Lectures
10. **Introduction to the course:** Organization of the genome;overview of genomics, transcriptomics, proteomics and metabolomics; genetics vs genomics; scope of genomics.	**CLO 1**	**3**
11. **Next-Generation Sequencing Technologies and the Assembly of Short Reads into Reference Genome Sequences:** DNA sequencing technologies- Illumina, SOLiD, Ion Torrent, PacBio, and Oxford Nanopore; methods for the assembly of sequences generated using various sequencing platforms.	**CLO 2**	**8**
12. **Determining Sequence Identities: BLAST, Phylogenetic and Syntenic Analyses:** Phylogenetic analysis, and syntenic analysis using nucleotide or protein sequences using BLAST and phylogeny reconstructing software.	**CLO 3**	**6**
13. **Genome Annotation:** Overview for genome annotation; strategies- evidence-based gene prediction and *ab initio* gene prediction. Principles, algorithm, advantages, and disadvantages.	**CLO 4**	**6**
14. **Genome-wide Association Studies of Performance Traits:** Concepts, study designs, and statistical methods for genome-wide association study (GWAS) for aquaculture species.Recent developments in GWAS methodologies.	**CLO 4**	**5**
15. Role for genomics in fisheries management and aquaculture: Genomic approaches to discrimination of populations; applications in management and conservation of natural populations; genomics in aquaculture breeding; marker assisted selection; linkage maps and QTL mapping in aquatic species.	**CLO5**	**3**
16. Mid-term Examination	**-**	**1**

Teaching strategy: Lectures, Problem based learning, Interactive learning, Group studies and Discussion.

Assessment Strategy: MCQ Test, Written test, Oral test, Assignment and Presentation.

Learning Resources:

12. Arthur Lesk, (2017) Introduction to Genomics. 3rd Edition. Oxford University Press; 3 edition. 613p.
13. N.J. Chikhale and VirendraGomase (2007) Bioinformatics- Theory and Practice.Himalaya Publication House, India; 592p.
14. Jonathan Pevsner (2015) Bioinformatics and Functional Genomics, 3rd edition. Wiley-Blackwell. 1160p.
15. Christina Marshall(Editor) (2019) Bioinformatics and Functional Genomics. CALLISTO REFERENCE. 20p.
16. Om P. Rajora(Editor) (2019) Population Genomics: Concepts, Approaches and Applications 1st ed. Springer. 822p.

17. Daniel L. Hartl(2018) Essential Genetics and Genomics. Jones & Bartlett Learning; 7 edition (November 14, 2018). 632p.
18. Tore Samuelsson (2012) Genomics and Bioinformatics 1st Edition. Cambridge University Press. 356p.
19. Jeremy Ramsden (2015) Bioinformatics, AnIntroducion. Springer, 2015.
20. Cummings, B. (2006) Discovering Genomics, Proteomics, and Bioinformatics, 2nd ed. Publisher: IEEE

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Course Profile *(Profile of xx Number of Courses)*

Course Code: **AQ 4203** **Course Title: Larval and Broodstock Nutrition**

Credit: **2** **Contact Hours:** **32** **Level:** **4** **Semester:** **2**

Course offering department(s): **Department of Aquaculture**

Rationale:

In order to obtain quality seeds for the enhancement of fish production the fisheries graduate ought to have knowledge of nutrition of brood fish and larvae as quality of seeds depends on quality of broods.

Course Learning Outcomes (CLO):

CLO 1: Explain the nutritional aspects of larval development

CLO 2: Describe the digestive process of larvae

CLO 3: Enumerate the nutritional status of larvae

CLO 4: Prepare good quality diets for broodstock

CLO 5: Illustrate different feeding systems for larvae and broodfish

Mapping CLO with PLO

CLO/ PLO	PLO 1	PLO 2	PLO 3	PLO 4	PLO 5	PLO 6	PLO 7	PLO 8	PLO 9	PLO 10
CLO 1	✓	✓								✓
CLO 2	✓	✓	✓					✓		
CLO 3	✓	✓	✓				✓		✓	
CLO 4		✓			✓	✓				
CLO 5	✓	✓		✓		✓		✓	✓	

Summary of Course Content

Content	Aligned CLO	No. of lectures
Larval development: Nutritional profile of egg yolk. Mechanism of egg yolk utilization. Degradation of egg yolk platelets and granules. Utilization of egg protein and amino acids lipid utilization. Influence of abiotic factors on yolk absorption.	CLO 1	9
Digestive system in larvae: Ontogenesis of digestive systems, digestion and absorption of protein and lipid; mechanism of transition from endogenous to exogenous nutrition. Weaning diets and importance.	CLO 2	5
Nutritional status of larvae: Nutritional requirements, deficiency symptoms and survival.	CLO 3	3
Broodstock development: effect of nutrition on fecundity, fertilization, embryo development, larval quality.	CLO 4	4
Broodstock diets: Special ingredients for gonadal development and ingredients affecting gonadal development. Effective feeding periods for optimum broodstock performance.	CLO 4	5
Feeding methods: Manual, mechanical and automatic feeding; feeding devices and strategies, Larval feeding behaviour and feed management. Economics of larval and broodstock feed and feeding.	CLO 5	5
Class Test		1
Total		32

Teaching Strategy:

Lecture, Multi-media, Video clipping, Demonstration.

Assessment Strategy:

Written exam, Quiz, Viva-voce, Field trip, Assignment.

Recommended books and other resources:

1. CIFE, 1993. Training Manual on Culture of Live Food Organisms for Aqua Hatcheries. Central Institute of Fisheries Education, Versova, Mumbai.

2. De Silva, S. S. and Anderson, T. A. 1995. Fish Nutrition in Aquaculture. Chapman and Hall Aquaculture Series, London.

3. Guillame, J., Kaushik, S., Berqot, P. and Metallier, R. 2001. Nutrition and Feeding of Fish and Crustaceans. Springer Praxis Publishing, Chichester,U. K.

4. Hagiwara, A., Snell, T. W., Lubzens, E. and Tamaru, C. S. 1997. Live Food in Aquaculture. Proceedings of the Live Food and Marine Larviculture Symposium. Kluwer Academic Publishers, London.

5. Halver, J. E. and Hardy, R. W. 2002. Fish Nutrition. Academic Press, London.

6. Lovell, R. T. 1998. Nutrition and Feeding of Fishes. Kluwer Academic Publishers.

8. Halver J. E. 1989. Fish Nutrition, Academic Press, San Diego, California.

9. Lovell, R. T. 1998. Nutrition and Feeding of Fishes, Kluwer Academic Publishers.

10. Muir, J. F. and Robert, D. (Eds.). 1968. Recent Advances in Aquaculture Vol.II. Blackwell Science.

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B. Sc. Fisheries (Hons.)

Course Profile :

Course Code: FM 4203 **Course Title: Hilsa Shad Assessment and Management**

Credit: 2 **Contact Hours: 32** **Level: 4** **Semester: 2**

Course Offering Department (s) : Department of Fisheries Management

Rationale:

This course is to expose students to basic concepts of hilsa shad *Tenualosa ilisha* stock assessment, and to provide skills in sustainable fisheries management of the valuable species both in inland and marine habitats of Bangladesh.

Course learning Outcomes (CLO):

CLO1. Discuss Occurrence, distribution and abundance of hilsa shad.

CLO2. Explain Hilsa shad stock surveys.

CLO3. Explain Data analyses and stock assessment.

CLO4. Discuss Status of hilsa fisheries in both inland and marine waters.

CLO5. Describe sustainable management of hilsa shad.

Mapping CLO with PLO:

	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8	PLO9	PLO10
CLO1	√	√	√							
CLO2	√	√				√		√		
CLO3	√	√				√		√		
CLO4	√	√					√	√		
CLO5	√	√				√	√	√		

Course contents:

Course contents	Aligned CLO	No. of Lectures
1. Introduction: Occurrence, distribution and abundance of hilsa shad *Tenualosa ilisha*, migrations and their patterns.	**CLO 1**	**2**
2. Hilsa shad stock surveys: Distribution and abundance data, biological data, environmental data, and financial information from both inland and marine waters.	**CLO 2**	**6**
3. Data analyses and stock assessment: Catch per unit effort, stock size by area, length frequency distribution, size relationships, gear selectivity, growth parameters, maturity and spawning season, recruitment, mortality, and yield	**CLO 3**	**8**

estimations.		
4. Status of hilsa fisheries in both inland and marine waters.	**CLO 4**	**8**
5. Approaches for sustainable management of hilsa shad: Action plan, jatka protection, declaration of sanctuaries, ban on spawning hilsa catch, economic incentives for hilsa conservation, impacts of management interventions, and needs for regional cooperation.	**CLO 5**	**8**

Teaching strategy: Lectures, Problem based learning, Interactive learning, Q/A session, Group studies and Discussion.

Assessment Strategy: MCQ Test, Written test, Quiz, Oral test, Assignment and Presentation.

Learning Resources:

Text books:

11. King, M. 1995. Fisheries Biology, Assessment and Management. Fishing News Books. 342 pp.
12. Ricker, W. E. 1975. Computation and interpretation of biological statistics of fish populations. Bull. Fish. Res. Board Can. 191: 382 pp.
13. Sparre, P., E. Ursin, and S. C. Venema. 1989. Introduction to tropical fish stock assessment. Part 1&2. FAO Fisheries Technical Papers. No. 306.1&2. Rome, FAO.

References:

15. Alam, M.S. 2012. 'Hilsa fisheries management in Bangladesh: A paradigm in natural resource conservation', 224-238 pages. In Anon. (ed.) Hilsa: Status of fishery and potential of aquaculture, Proceedings of the Regional Workshop held in Dhaka, 16-17 September 2012. The WorldFish, Bangladesh and South Asia Office, Dhaka, p 238.
16. Mazid, M.A. and S.J.M. Blaber 1998. Proceedings of BFRI/ACIAR/CSIRO workshop on hilsa fisheries research in Bangladesh held on 3-4 March at Bangladesh Agricultural Research Council, Dhaka, Bangladesh.
17. Mohammed, E.Y. 2014. Economic incentives for marine and coastal conservation: prospects, challenges and management implications. pp 270.
18. Mome MA 2007: The potential of the artisanal hilsa fishery in Bangladesh: an economically-efficient fisheries policy. Fisheries Training Programme Final Project Report, United Nations University, Iceland. pp. 57.

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Course profile :

Course Code:	**FT 4203**	**Course Title:**	**Fishery Industry Management and System Analysis**		
Credit: 2.0	**Contact Hours: 32**	**Level:**	**4**	**Semester:**	**2**

Course offering department(s): **Department of Fisheries Technology**

Rationale:
Fishery production and products manufacture is a vibrant industry of diversified production and process, that has great importance and influence on the economy of Bangladesh. The students being the important stake of the industry need genuine skill development and acquisition of knowledge on overall planning and management of capital investment, production operation and process development. Fish trading, market promotion and exports promotion are also major areas which the students of fisheries should explore.

Course Learning Outcomes (CLOs)
CLO 1: Describe industries: artisanal, industrial and commercial fishing, utilization of catch.
CLO 2: Planning and design of different fish processing and allied plants.
CLO 3: Analyze management of production, R&D, funds and SOP.
CLO 4: Explicate fishery trades and markets.

Mapping CLO with PLO

CLO/PLO	PLO 1	PLO 2	PLO 3	PLO 4	PLO 5	PLO 6	PLO 7	PLO 8	PLO 9	PLO 10
CLO 1	✓			✓						
CLO 2		✓		✓	✓					
CLO 3		✓		✓	✓	✓				✓
CLO 4	✓			✓						

Course Content	Aligned CLO(s)	No of Lectures
1. **Introduction:** Status and prospects of fishery industries and industrial products, employment and markets.	CLO 1 & 2	6
2. **Fishing industry:** Inland and marine capture fishing, Artisanal, industrial and commercial fishing, Inputs and investments, Catches and utilization, cost-effective fishing, individual fishing and co-operative fishing.	CLO 2 & 3	4
3. **Planning and design of different fish processing plants:** Preparation and planning phase, Capital cost and operating cost, Cost-effective design and layout/mathematical modeling, Designing and layout of freezing plant, cannery, drying plant/yard, surimi plant,	CLO 1, 2 & 3	7

	fish sausage and ham industry, fish meal and oil industry, smoking plant, diversified value-added/analog product plant, etc.		
4.	**Plant management and operation:** Production wing, Quality control wing and R & D wing; Capital, human resource and production management; process operation and cost effectiveness; maintenance of quality control/assurance system and plant sanitation and hygiene, Standard operating procedures (SOP).	CLO 2 & 3	4
5.	**Management of specialized processing industry:** shrimp industry, hilsa industry, cannery, salting industry.	CLO 1 & 2	4
6.	**Fish trading:** Domestic and international fishery markets and trade; Supply and value chain, value chain analysis, Trade barriers in fisheries, Good practices in fishery trade.	CLO 1, 2 & 3	3
7.	**Market promotion and export:** Coordination and linkage, Certification, International lobbying, publicity and buyers satisfaction, Role of Export Promotion Bureau.	CLO 1, 2, 3 & 4	3
8.	**Waste management in fishery industry**: Solid waste and liquid waste management; Wastes recycling/treatment plants: concept of total utilization, shrimp shell, crab shell resource and composition, conventional uses, feeds and manure, conversion to useful materials like chitin, chitosan, glucosamine and use of peptides, protein isolate, etc.	CLO 1, 2, 3 & 4	
	Class test		1
	Total		**32**

Teaching Strategy

Class Lectures, Problem based learning, Interactive learning, Group discussion, Web based learning

Assessment Strategy

Strategic Questioning, MCQ test, Written test, Oral test, Assignment, Presentation

Recommended books and other resources:

1. Clucas, I. J. and A. R. Ward. 1996. Post-harvest Fisheries Development: A guide to handling, preservation, processing and quality. Natural Resource Institute, UK.
2. Stansby, M. E. 1990. Industrial Fishery Technology. Reinhold Publ. Corp., New York.
3. Nowsad, AKM. A. 2014. Post-harvest Fishery Losses and Mitigation Measures. BAU Department of Fisheries Technology, 340 p.
4. Claucas, I. J. (Editor) 1985. Fish Handling, Preservation and Processing in the Tropics. Part-I and II. 2nd edition. Tropical Development and Research Institute, London, Overseas Development Administration, U.K.
5. Hall, G. M. 1992. Fish Processing Technology. Blackie Academic & Professional, An Imprint of Chapman & Hall. London.
6. Wheaton, F. W. and T. B. Lawson. 1985. Processing of Aquatic Food Products, Wiley and Sons, New York.
7. Tanikawa, E. 1985. Marine Products in Japan. Koseikaku Co., Ltd., Tokyo, Japan.

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Course Profile :

Course Code: MFS 4201 Course Title: Blue Economy

Credit: 2 Contact Hours: 32 Level: 4 Semester: 2

Course Offering Department (s) : Department of Marine Fisheries Science

Rationale:

This course aims to give the basic concepts of blue economy and the relationship between the blue economy and sustainable fisheries development.

Course Learning Outcomes:

CLO1. Explain what is blue economy.

CLO2. Describe its origin and relationship to blue Growth.

CLO3. Explain the difference between blue economy and the green economy concepts.

Mapping CLO with PLO:

	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8	PLO9	PLO10
CLO1	√						√			
CLO2	√		√		√					√
CLO3	√	√		√		√			√	

Course contents:

	Course contents	**Aligned CLO**	**No. of Lectures**
1.	Introduction: Blue Economy concept; Principles of blue economy; Blue Planet	CLO1, CLO2	2
2.	The Blue Economy a framework for sustainable development on fisheries context	CLO1, CLO2	5
3.	The Blue Economy –Opportunities: Fisheries and blue Biotechnology	CLO1, CLO3	8
4.	Sustainable Development Goals (SDGs), Bangladesh	CLO1, CLO3	8

	marine fisheries in relation to SDG14		
5.	Climate change and managing carbon budgets- Acidification, Blue Carbon	CLO1, CLO2	8
6.	Class test		1

Teaching strategy: Lectures, Problem based learning, Interactive learning, Group studies and Discussion, practical.
Assessment Strategy: MCQ Test, Written test, Assignment.

Learning Resources:

1. The Blue Economy by Gunter Pauli
2. Introduction to the blue economy by Mrs. Kelly Hoareau. http://creativecommons.org/licenses/by-sa/4.0.