Department of Fisheries
Faculty of Fisheries

Curriculum
for
M. S. in Fisheries Technology
Session: 2020-2021

University of Rajshahi
Rajshahi, Bangladesh

UNIVERSITY OF RAJSHAHI
DEPARTMENT OF FISHERIES
FACULTY OF FISHERIES

Curriculum for M. S. in Fisheries Technology
Session: 2020-2021

Examinations: Semester-1 Examination: June 2026
Semester-2 Examination: December 2026
Semester-3 Examination: June 2027

Part A

1. **Title of the Academic Program: M. S. in Fisheries Technology**
2. **Name of the University:** University of Rajshahi
3. **Vision of the University:**
   To pursue enlightenment and creativity for producing world-class human resources to cater for the needs of changing time.
4. **Mission of the University:**
   M1. To ensure a world-class curriculum with talented academicians and conducive academic and research environment for generation and dissemination of knowledge.
   M2. To maintain international standards in education with focus on both knowledge and skills, and humanitarian and ethical values to meet the needs of the society and state.
   M3. To develop strategic partnerships with leading national and international universities, and organizations for academic as well as research collaborations.
5. **Name of the Program Offering Entity (POE):** Department of Fisheries,
   Faculty of Fisheries, University of Rajshahi, Bangladesh.
6. **Vision of the Program Offering Entity (POE):**
   Vision of the M. S. in Fisheries Technology program
   Sustainable fisheries harvest and post-harvest activities for ensuring nutrition, food safety and security.
7. **Mission of the Program offering Entity (POE):**
   Mission of the M. S. in Fisheries Technology Program
   To achieve academic and research excellence to
   a) Promote sustainable technology in culture and capture fisheries
   b) Providing quality products for national and international market
   c) To establish small and large-scale fisheries industry.
8. **Objective of the Program Offering Entity (POE)**
   To offer fisheries education to obtain B. Sc. Fisheries (Hons.), Master of Science (MS in Fisheries Biology and Genetics, MS in Aquaculture, MS in Fisheries Management and MS in Fisheries Technology), MPhil and PhD degree in Fisheries; to conduct teaching and research in various fields of Fisheries to increase the fish production and to meet the nutrient requirement.
9. **Name of the Degree:** M. S. in Fisheries Technology
10. **Description of the Program:**

The Department of Fisheries is established in 2000 under the Faculty of Agriculture in the University of Rajshahi. Later on the department is included under newly formed Faculty of Fisheries in 2020. This department was started with three academic and three non-academic staffs with limited infrastructure facilities by enrolling twenty students. At present, the number of seats for student admission in B. Sc. Fisheries (Honours) level is fifty per year. Now, there are twenty academic staff specialized in different aspects of fisheries sector to enrich education and research in this department. In addition, twenty non-academic staffs are currently working for supporting the department. The department has already demonstrated its outreach excellence through establishing linkages with different donors, associations and industries for research, extension and developmental activities in fisheries sector.

The academic curriculum of the department is being offered in English. The department introduced sixteen theoretical and four presentation courses in M. S. in Fisheries Technology level including fishing technology, preservation, processing, fishery by-products, biochemistry, biotechnology, analytical techniques, industrial

management, packaging, quality control and marketing of fish and fishery products.

11. Graduate Attributes (Based on need assessment):

(a) Communicator,
(b) Innovator,
(c) Problem solver,
(d) Leader,
(e) Team builder,
(f) Self- motivated,
(g) Entrepreneur,
(h) Ethically aware,
(i) Digitally skilled,
(j) Multi-tasker and
(k) Adaptable

12. Program Educational Objectives (PEO) of the M. S. in Fisheries Technology Program

PEO1: To give post graduate students a comprehensive insight into harvest and post-harvest fisheries activities.

PEO2: To have basic understanding of the fishing technology, processing and quality control of fisheries resources.

PEO3: To conduct basic and applied research in different aspects of harvest and post-harvest fisheries technology.

PEO4: To disseminate research findings on harvest and post-harvest fisheries technology for effective utilization of resources.

13. Program Learning Outcomes (PLOs)

At the end of the M. S. in Fisheries Fisheries Technology Program, the graduates will be able to-

PLOs	Program Learning Outcomes (PLOs)
PLO1	Describe and explain different fishing theories, fishing gears and crafts, fishing stimuli and fish detecting techniques.
PLO2	Know the chemical compositions of fish and shellfish, post-mortem changes, flavour and taste compounds and toxin production in fish and shellfish for selecting proper preservation methods of fisheries resources.
PLO3	Describe and apply the principles of fish preservation in handling and processing of fish and fishery products for sustainable utilization of fisheries resources.
PLO4	Define and apply the quality control systems for producing quality fish and fishery products for national and international markets.

14. Mapping between Mission and PEO

Mission	Program Educational Objectives (PEOs)			
	PEO1	PEO2	PEO3	PEO4
M1	X	X	●	●
M2	X	X	●	●
M3	X	X	X	X

X Strong contribution ● Weak contribution □ No contribution

15. Mapping PLOs with the PEOs

PEOs	Program Learning Outcomes (PLOs)			
	PO1	PO2	PO3	PO4
PEO1	X	X	X	X
PEO2	X	●	X	X
PEO3	X	●	X	X
PEO4	X	X	X	X

X Strong contribution ● Weak contribution □ No contribution

16. Mapping courses with PLOs

Course Code	Course Title	PLOs			
		PLO1	PLO2	PLO3	PLO4
0831-561	Modern Fishing Technology	X	●	●	●
0831-562	Fish Preservation Technology	●	X	X	●
0831-563	Fish Processing Technology	●	X	X	●
0831-564	Advanced Fisheries Microbiology	●	●	X	X
0831-565	Fish Processing Biochemistry	●	X	X	X
0831-566	Research Methodology in Fisheries Technology	●	X	X	●
0831-567	Biotechnology in Fish Processing	●	X	X	●
0831-568	Aquatic Environment and Pollution	●	●	X	X
0831- 569	Research Defense-1	X	X	X	X
0831-661	Advanced Fishery Products Technology	●	X	X	X
0831-662	Quality Control of Fishery products	●	X	X	X
0831-663	Advanced Fishery By-product Technology	●	X	X	X
0831-664	Fishery Products Packaging	●	X	X	X
0831-665	Industrial Fishery Management	X	X	X	X
0831-666	Analytical Techniques in Fish Processing	●	X	X	X
0831-667	Fishery Products Marketing	●	●	X	X
0831-668	Fish Health Management	●	X	X	X
0831- 669	Research Defense-2	X	X	X	X
0831-761	Thesis	●	X	X	X
0831-762	Thesis Defense	●	X	X	X

X Strong contribution ● Weak contribution □ No contribution

Part B

17. Structure of the curriculum

The M. S. in Fisheries Technology courses shall consist of compulsory, optional, research defence, thesis, and thesis defence. The compulsory courses are of 16 credits, optional courses 8 credits, research defence 4 credits, thesis 8 credits, and thesis defence 4 credits with an aggregate credit of 40 credits. The research work of the thesis should be carried out from the beginning of Semester-1.

M. S. in Fisheries Technology Semester-1 Examination shall be held at the end of the First Semester having 14 credits, covering six theoretical courses (four compulsory and two optional) including class test and attendance. In addition, a research defence on the problem statement, hypothesis, objectives, expected outcomes, and methodology of the proposed research work will be held at the end of the semester having 2 credits.

M. S. in Fisheries Technology Semester-2 Examination shall be held at the end of the Second Semester having 14 Credits covering six theoretical courses (four compulsory and two optional) including class test and attendance. In addition, a research defence on findings or progress of proposed research work will be held at the end of the semester having 2 Credits.

M. S. in Fisheries Technology Semester-3 Examination shall be held at the end of the Third Semester having 12 Credits, covering thesis and thesis defence performances based on research work.

18. Semester wise distribution of courses

DETAILED BREAKS UP OF COURSES

M. S. in Fisheries Technology Semester-1 Examination, June 2026

Course Code	Course Title	Credit
Compulsory		
0831-561	Modern Fishing Technology	2
0831-562	Fish Preservation Technology	2
0831-563	Fish Processing Technology	2
0831-564	Advanced Fisheries Microbiology	2

Optional (any two)		
0831-565	Fish Processing Biochemistry	2
0831-566	Research Methodology in Fisheries Technology	2
0831-567	Biotechnology in Fish Processing	2
0831-568	Aquatic Environment and Pollution	2
Research Work		
0831-569	Research Defense-1	2
	Total	**14**

M. S. in Fisheries Technology Semester-2 Examination, December 2026

Course Code	Course Title	Credit
Compulsory		
0831-661	Advanced Fishery Products Technology	2
0831-662	Quality Control of Fishery products	2
0831-663	Advanced Fishery By-product Technology	2
0831-664	Fishery Products Packaging	2
Optional (any two)		
0831-665	Industrial Fishery Management	2
0831-666	Analytical Techniques in Fish Processing	2
0831-667	Fishery Products Marketing	2
0831-668	Fish Health Management	2
Research Work		
0831- 669	Research Defense-2	2
	Total	**14**

M. S. in Fisheries Technology Semester-3 Examination, June 2027

Course Code	Course Title	Credits
0831-761	Thesis	8
0831-762	Thesis Defense	4
	Total	**12**
	Grand Total	**40**

Part C
19. Description of the courses

M. S. in Fisheries Technology Semester-1 Examination, June 2026

COMPULSORY COURSES

0831-561: Modern Fishing Technology

Credit: 2

Full Marks: 100 [Theory 70, Class Test 20 (written and/or oral) and Attendance 10]
Time: 3 hours (Seven questions to be set and five to be answered)

Course Description:

This course is a theoretical course and prerequisite to complete the MS in Fisheries Technology degree. The course covers the modern fishing aids, traditional fishing gears & crafts and engines used in fishing. The course is designed to strengthen the student's existing knowledge on modern fishing aids used for fish location, detection and attraction. This course can also teach them about different traditional fishing gears and crafts along with design & construction of commercial fishing boat. In addition, this course also focuses on the operation and maintenance of different engines used in fishing industry.

Learning Outcomes:

At the end of the course the students will be able to- i) Identify fishing gears, crafts and engines ii) Gather knowledge about the effective and low cost fishing method and location of fishing grounds and iii) preserve fishing gear and crafts using different methods.

At the end of the course, the students will be able to-

CLOs	Course Learning Outcomes	Lectures
CLO1	Describe the modern fishing aids in terms of navigation, fish location, detection and attraction	3
CLO2	Design and operate the commercial fishing methods such as trawl fishing, seining, gill netting, long lining, trap fishing, and pump fishing.	4
CLO3	Describe and differentiate the traditional fishing crafts and gears used in the inland and coastal waters of Bangladesh.	4
CLO4	Design and describe the construction of boat in terms of materials, timber seasoning and treatment, tools for boat care; maintenance the boats against corrosion, marine fouling, and boring.	3
CLO5	Explain the types of marine engines, diesel engines, engine power, engine mounting, propeller, and liftable propulsion system; operate and maintenance of marine engines	2

Mapping CLOs with PLOs

CLOs	PLOs			
	PLO1	PLO2	PLO3	PLO4
CLO1	X	●	●	X
CLO2	X	●	●	X
CLO3	X	●	●	●
CLO4	X	●	●	●
CLO5	X	●	●	●

X Strong contribution ● Weak contribution □ No contribution

Lesson Plan

CLOs	Course Contents	Teaching Strategy	Assessment Strategy
CLO1	Modern fishing aids: Navigation, fish location, detection, and attraction.	- Lectures followed by discussion - Participatory question-answer	**Total: 100** Attendance: 10 In course Examination/ Tutorial/Quiz/
CLO2	Commercial fishing methods: Design and operation of trawl fishing, seining, gill netting, long lining, trap and pump fishing.	- Lectures followed by discussion - Participatory question-answer - Online resources	
CLO3	Survey of traditional fishing crafts and gears	- Lectures followed by discussion	

	used in the inland and coastal waters of Bangladesh.	- Participatory question-answer - Online resources	Class Test: 20 Final Examination: 70
CLO4	Planning and design of boat: Design and construction, materials, timber seasoning and treatment, tools for boat care, and maintenance of boats, corrosion, marine fouling, boring prevention and control of fouling, echo-sounder, fish finder.	- Lectures followed by discussion - Participatory question-answer - Online resources	
CLO5	Marine engine: Types of engines, diesel engines, selection of engine power, engine mounting, propeller, and liftable propulsion system. Engine protection, operation, and maintenance.	- Lectures followed by discussion - Participatory question-answer - Online resources	

Recommended books/literature:

- Fish Catching Methods of the World (3rd ed). A. V. Brandt (1984). Fishing News (Books) Ltd. Surrey, England.
- Modern Fishing Gears of the World. Vol. I-III. H. Kristyonsson (ed) (1962). Fishing News Books Ltd. London.
- How to make and set nets. E. Garner (1962). Fishing News Books Ltd. London.
- Harvest and Post-harvest Technology of Fish. Rabindran (ed) (1985). Soc. Fish. Technol. India.
- Commercial Fishing Methods and Introduction to Vessels and Gears. J. C. Sainsbury (1975). Fishing News (Books) Ltd. London.

0831-562: Fish Preservation Technology

Credit: 2

Full Marks: 100 [Theory 70, Class Test 20 (written and/or oral) and Attendance 10]
Time: 3 hours (Seven questions to be set and five to be answered)

Course Description:

This course is a theoretical course and prerequisite to complete the MS in Fisheries Technology degree. The course covers the principles of fish preservation, mechanism of spoilage and quality assessment, commercial handling of fish and shellfish, value addition of wet fish and preservation by chilling and freezing. The course is designed to strengthen the student's existing knowledge on fish spoilage mechanism. This course can also teach them about fish preservation by chilling and freezing method as well as the storage and transportation of preserved fishes. This course also focuses on the freshness assessment of fish and shellfish.

Learning Outcomes:

At the end of the course, the students will be able to-i) Know the commercial handling process of fish and shellfish ii) Explain the chilling and freezing methods iii) Understand the value addition and packaging of wet fish.

At the end of the course, the students will be able to-

CLOs	Course Learning Outcomes	Lectures
CLO1	States principles of fish preservation; Explain technological, chemical and bacteriological problems related to fish preservation.	2
CLO2	Explain the mechanism of rigor mortis in fish; explain the effect of rigor-mortis on fish preservation; describe the bacteriological and chemical basis for deteriorative changes in fish.	3
CLO3	Apply good practices in onboard and onshore handling & preparation of wet fish; practice live fish transportation; apply packaging system for preserved fish.	3
CLO4	Illustrate the basic principles of cold preservation; outlines the characteristics of refrigerating media; explain the mechanism of heat transfer; describe the chilling and freezing methods; design of freezing plant; prepare chilled and frozen fish products.	2
CLO5	Plan and design of fish cold storage and refrigerated fishing vessels and refrigerated transport system.	3
CLO6	Assess the quality by the sensory, chemical and bacteriological methods for fishery products.	2

Mapping CLOs with PLOs

CLOs	PLOs			
	PLO1	PLO2	PLO3	PLO4
CLO1	●	X	X	X
CLO2	●	X	X	X
CLO3	●	X	X	X
CLO4	●	X	X	X
CLO5	X	●	X	X
CLO6	●	X	X	X

X Strong contribution ● Weak contribution □ No contribution

Lesson Plan

CLOs	Course Contents	Teaching Strategy	Assessment Strategy
CLO1	General principles of fish preservation. Technological, chemical and bacteriological problems related to fish preservation.	- Lectures followed by discussion - Participatory question-answer	**Total: 100** Attendance: 10 In course Examination/ Tutorial/Quiz/ Class Test: 20 Final Examination: 70
CLO2	Rigor-mortis: Mechanisms of rigor-mortis. Effect of rigor-mortis on fish preservation. Bacteriological and chemical basis for deteriorative changes in fish.	- Lectures followed by discussion - Participatory question-answer - Online resources	
CLO3	Commercial handling of fresh fish: Onboard and onshore handling of wet fish; good practice in wet fish preparation; live carriage of fish, Packaging materials and methods of packaging for preserved fish. Shelf-life consideration of fresh fish.	- Lectures followed by discussion - Participatory question-answer - Online resources	
CLO4	Refrigeration and freezing preservation: Basic principles of cold preservation. Characteristics of refrigerating media. Mechanism of heat transfer. Chilling and freezing of fish. Manufacture of ice and design of freezing plants. Production of chilled and frozen fillets, fish sticks, etc.	- Lectures followed by discussion - Participatory question-answer - Online resources	
CLO5	Storage and distribution of chilled and frozen fishery products. Planning and design of commercial fishery cold storage and refrigerated fishing vessels, transportation of fish.	- Lectures followed by discussion - Participatory question-answer - Online resources	
CLO6	Measuring the degree of freshness of fish. Importance of freshness test in fish preservation. Sensory, chemical and bacteriological methods.	- Lectures followed by discussion - Participatory question-answer - Online resources	

Recommended books/literature:

- 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.
- Hall, G. M. 1992. Fish Processing Technology. Blackie Academic & Professional. An Imprint of Chapman & Hall, London.
- Nowsad, A. K. M. A. 2007. Participatory Training of Trainers: A New Approach Applied in Fish Processing. Bangladesh Fisheries Research Forum. Bangladesh.
- Rogenstein, Joe M. 1991. Introduction to Fish Technology. An Osprey Book, Van Nostrand Reinhold, New York.
- Mansur, M.A. 2012. Fisheries Studies: Part-II. Botomul (Publisher), Dhaka.
- Brogstrom, G. (Editor). 1965. Fish as Food. Vols. I-IV. Academic press, London.
- 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.
- Govinda, T. K. 1985. Fish Processing Technology. Oxford and IBH Publishing Co., New Delhi.
- Ravindran, K., N. Nair, I. A. Perigreen, P. A. Panicker, and M. Thomas. 1985. Harvest and Post-harvest Technology of Fish. Society of Fisheries Technologists, India.
- Tanikawa, E. 1985. Marine Products in Japan. Koseikaku Co., Ltd., Tokyo, Japan.
- Wheaton, F. W. and T. B. Lawson. 1985. Processing of Aquatic Food Products, Wiley and Sons, New York.

0831-563: Fish Processing Technology

Credit: 2

Full Marks: 100 [Theory 70, Class Test 20 (written and/or oral) and Attendance 10]
Time: 3 hours (Seven questions to be set and five to be answered)

Course Description:

This course is a theoretical course and prerequisite to complete the MS in Fisheries Technology degree. The course covers the different processing and packaging methods of fish and shellfish and planning& design of fish processing plant. The course is designed to strengthen the student's knowledge on fish processing methods such as drying, smoking, salting, canning, fermentation and irradiation. This course can also teach them the chemical, physical and thermal properties of fish muscle. In addition, this course also focuses on the preparation of fish mince and mince based fishery products.

Learning Outcomes:

At/by the end of the course, the students will be able to-i) Know the fish processing methods including drying, smoking, salting, canning, irradiation etc. ii) Select the proper packaging for fish and fishery products &iii)Make an idea to establish fish processing plant.

At the end of the course, the students will be able to-

CLOs	Course Learning Outcomes	Lectures
CLO1	Describe the structure of fish in terms of physical proportion, chemical composition and thermal properties of constituents	4
CLO2	Apply the fish drying techniques with its storage; explain the physical and biochemical changes during drying and spoilage of dried fishery products; know the effects of illegal application of pesticides in dry fish.	2
CLO3	Describe and apply the principles and techniques of fish salting; explain the ripening of salted; explain the spoilage and apply the preventive measures.	2
CLO4	Describe and apply the principles and techniques with storage of fish smoking; outlines the characteristics of wood smoke, and smoke flavorings; explain the changes in fish during smoking.	3
CLO5	Describe and apply the principles and techniques of fish fermentation; explain the changes in constituents during fish fermentation.	2
CLO6	Describe and apply the principles and techniques of irradiation of fish in terms of sources of radiation, measurement of irradiation energy, radiation dose; explain the effect of irradiation on fish & fishery products; describe the detection of irradiation in foods.	2
CLO7	Describe and apply the principles and techniques of fish canning in terms of heat penetration and process evaluation and storage; examine the cans and canned products.	2
CLO8	Describe and apply the principles and techniques of fish mince and surimi in terms of gelation of fish muscle; explain the changes in muscle during heat processing.	2

Mapping CLOs with PLOs

CLOs	PLOs			
	PLO1	PLO2	PLO3	PLO4
CLO1	●	X	X	X
CLO2	●	X	X	X
CLO3	●	X	X	X

CLO4	●	X	X	X
CLO5	●	X	X	X
CLO6	●	X	X	X
CLO7	●	●	X	X
CLO8	●	X	X	X

X Strong contribution ● Weak contribution □ No contribution

Lesson Plan

CLOs	Course Contents	Teaching Strategy	Assessment Strategy
CLO1	Fish as raw material: Structure of fish and physical proportion, chemical composition, physical and thermal properties of constituents.	- Lectures followed by discussion - Participatory question-answer	**Total: 100** Attendance: 10 In course Examination/ Tutorial/Quiz/ Class Test: 20 Final Examination: 70
CLO2	Drying and dehydration: Principles and techniques; physical and biochemical changes in dried fishery products; quality and spoilage of dried fish; illegal application of pesticides in dry fish and their lethal and sub-lethal effects; use of salt in dry fish. Packaging and storage.	- Lectures followed by discussion - Participatory question-answer - Online resources	
CLO3	Salting and marinating of fish: Principles and techniques, the ripening of salted and marinated products, spoilage and their prevention.	- Lectures followed by discussion - Participatory question-answer - Online resources	
CLO4	Smoking: Principles and techniques, characteristics of wood smoke, smoke flavorings; changes in fish during smoking. Shelf-life and storage of smoke fish.	- Lectures followed by discussion - Participatory question-answer - Online resources	
CLO5	Fermentation: Principles and techniques, semi-fermentation and complete fermentation; changes in constituents during fish fermentation.	- Lectures followed by discussion - Participatory question-answer - Online resource	
CLO6	Irradiation: Principles and techniques, sources of radiation, radiation process, measurement of irradiation energy, radiation dose, the effect of irradiation on fish & fishery products, and detection of irradiation in foods.	- Lectures followed by discussion - Participatory question-answer - Online resources	
CLO7	Canning: Principles and techniques, heat penetration and process evaluation, the examination of cans and canned products. Storage of canned fish.	- Lectures followed by discussion - Participatory question-answer - Video	
CLO8	Fish mince and surimi: Principles and techniques, gelation of fish muscle; changes in muscle during heat processing.	- Lectures followed by discussion - Participatory question-answer	

Recommended books/literature:

- Hall, G. M. 1992. Fish Processing Technology. Blackie Academic & Professional, An Imprint of Chapman & Hall. London.
- Rogenstein, Joe M. 1991. Introduction to Fish Technology. An Osprey Book, Van Nostrand Reinhold, New York.
- Stansby, M. E. 1990. Industrial Fishery Technology. Reinhold Publ. Corp., New York.
- 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
- Nowsad, A. K. M. A. 2007. Participatory Training of Trainers: A New Approach Applied in Fish Processing. Bangladesh Fisheries Research Forum. Bangladesh.

- Mansur, M.A. 2012. Fisheries Studies: Part-II. Botomul (Publisher), Dhaka.
- Brogstrom, G. (Ed). 1965.Fish as Food. Vols. I-IV. Academic press, London.
- Clucas, I. J. (Editor) 1985. Fish Handling, Preservation and Processing in the Tropics. 2nd edition. Tropical Development and Research Institute, London, Overseas Development Administration, U.K.
- Govinda, T. K. 1985. Fish Processing Technology. Oxford and IBH Publishing Co., New Delhi.
- Kreuzer, R. 1969. Technology of Fish Utilization. Fishing News (Books) Ltd., London.
- Ravindran, K., N. Nair, I. A. Perigreen, P. A. Panicker and M. Thomas. 1985. Harvest and Post-harvest Technology of Fish. Society of Fisheries Technologists, India.
- Tanikawa, E. 1985. Marine Products in Japan. Koseikaku Co., Ltd., Tokyo, Japan.
- Wheaton, F. W. and T. B. Lawson. 1985. Processing of Aquatic Food Products, Wiley and Sons, New York.

0831-564: Advanced Fisheries Microbiology

Credit: 2

Full Marks: 100 [Theory 70, Class Test 20 (written and/or oral) and Attendance 10]

Time: 3 hours (Seven questions to be set and five to be answered)

Course Description:

This course is a theoretical course and prerequisite to complete the MS in Fisheries Technology degree. The course covers the microbial contamination & spoilage and food safety and the role of microorganism in fish and fishery products. The course is designed to strengthen the student's existing knowledge on spoilage mechanism of fish and shellfish and seafood borne illness. This course can also teach them about microbial spoilage of fish mince and value added fishery products. This course also focuses the sanitation and hygiene of fish processing plant.

Learning Outcomes:

At/by the end of the course, the students will be able to i) know about contamination & spoilage of fish and fishery products, i) know about the ensure of safety of fish and fishery products. Knowledge gained from this course will be useful for studying other courses like- Fish processing, Quality control, Fish pathology etc.

At the end of the course, the students will be able to-

CLOs	Course Learning Outcomes	Lectures
CLO1	States the importance of microbiology in fisheries; explain the fish as a substrate for microorganisms.	3
CLO2	Define and describe the contamination and spoilage of fish; outlines of microorganisms of cold, temperate and tropical regions; outlines the chemical changes caused by microorganisms in fish.	4
CLO3	Illustrate the microorganisms related to harvesting, onboard handling; apply the sanitation procedure in fishing vessel; explain the effects of preservation and processing on microorganisms.	4
CLO4	Explain the effects of microorganisms on the processing of crustacean shrimp, prawn, crawfish and crab; enlist the naturally occurring micro-flora on crustaceans; explain the effect of handling and processing on micro-organisms.	3
CLO5	Describe the microbiological aspects of mince, surimi, and value-added products; mention the effect of processing on micro-organisms.	2
CLO6	Explain and effects of the seafood safety in terms of seafood transmitted zoonoses, non-indigenous bacterial pathogens, indigenous pathogens, natural toxins.	2
CLO7	Explain the microbiology of food plant sanitation in terms of sources of contamination, micro-flora in supplies, infrastructure implications, staff, clothing, working premises, drainage maintenance.	4

Mapping CLOs with PLOs

CLOs	PLOs			
	PLO1	PLO2	PLO3	PLO4
CLO1	●	●	X	X
CLO2	●	X	X	X

CLO3	X	X	X	X
CLO4	●	X	X	X
CLO5	●	●	X	X
CLO6	●	●	X	X
CLO7	X	X	X	X

X Strong contribution ● Weak contribution □ No contribution

Lesson Plan

CLOs	Course Contents	Teaching Strategy	Assessment Strategy
CLO1	Importance of microbiology in fisheries. Fish as a substrate for microorganisms.	- Lectures followed by discussion - Participatory question-answer	**Total: 100** Attendance: 10 In course Examination/ Tutorial/Quiz/ Class Test: 20 Final Examination: 70
CLO2	Microorganisms and fish spoilage: Contamination, number, and kinds of micro-organisms, quality changes caused by micro-organisms in fish.	- Lectures followed by discussion - Participatory question-answer - Online resources	
CLO3	Microbiology of finfish and finfish processing: Harvesting and onboard handling, fishing vessel sanitation, the effect of processing on micro-organisms, the effect of preservation.	- Lectures followed by discussion - Participatory question-answer - Online resources	
CLO4	Microbiology of crustacean shrimp, prawn, crawfish and crab) processing: Naturally occurring micro-flora, microbiological changes through the distribution system, micro-organisms associated with spoilage and public health concern, the effect of handling and processing on micro-organisms.	- Lectures followed by discussion - Participatory question-answer - Online resources	
CLO5	Microbiology of mince, surimi, and value-added products: General microbiological aspects, the effect of processing on microorganisms.	- Lectures followed by discussion - Participatory question-answer - Online resources	
CLO6	Seafood safety: Seafood transmitted zoonoses, non-indigenous bacterial pathogens, indigenous pathogens, natural toxins.	- Lectures followed by discussion - Participatory question-answer - Online resources	
CLO7	Microbiology of food plant sanitation: Sources of contamination, micro-flora in supplies, infrastructure implications, staff, clothing, working premises, drainage maintenance.	- Lectures followed by discussion - Participatory question-answer - Video	

Recommended books/literature:

- Frazier, W. C. and D. C. Westhoff. 1990. Food Microbiology. 3rd edition. McGraw –Hill Book Co., New York, London.
- Nickerson, T. J. and A. J. Sinskey. 1977. Microbiology of Food and Food Processing. Elsevier, New York, Oxford, Amsterdam.
- Ward, D. R. and C. R. Hackney. 1991. Microbiology of Marine Food Products. An AVI Book, Van Nostrand Reinhold, New York.
- Mansur, M.A. 2010. Fisheries Studies: Part-I. Botomul (Publisher), Dhaka.
- Brook, T. D. 1974. Biology of Micro-organisms. Prentice Hall Inc., Englewood cliffs, New Jersy.
- Burrows, W. 1985. Textbook of Microbiology. 22nd Edition. W. B. Saunders Co., Philadelphia and London.
- Hans Hanrik Huss. 1988. Fresh fish Quality and Quality Changes. FAO Fisheries Series, No. 29. Food and Agricultural Organization of the United Nations, Danish International Development Agency, Rome.
- Huss, Hans H., M. Jakobsen and J. Liston. 1992. Quality Assurance in the Fish Industry. Development in Food

Science 30. ELSEVIER. Amsterdam, London, New York, Tokyo.
- Ravindran, K., N. Nair, I. A. Perigreen, P. A. Panicker and M. Thomas. 1985. Harvest and Post-harvest Technology of Fish. Society of Fisheries Technologists, India.
- Stansby, M. E. 1990. Industrial Fishery Technology. Reinhold Publ. Corp., New York.

OPTIONAL COURSES

0831-565: Fish Processing Biochemistry

Credit: 2

Full Marks: 100 [Theory 70, Class Test 20 (written and/or oral) and Attendance 10]

Time: 3 hours (Seven questions to be set and five to be answered)

Course Description:

This course is a theoretical course and prerequisite to complete the MS in Fisheries Technology degree. The course covers the chemistry of fish food including the chemical composition, nutritive value, nature and characteristics of different chemical components of fish and shellfish which ultimately determine the food quality, processability and shelf life of fish or shellfish products. The course is designed to strengthen knowledge in details of the nutritional components of fish and fishery products. This course can also teach them the effects of processing on nutritional compositions. This course also focuses the tastiness and chemical contaminants of fish and shellfish.

Learning Outcomes:

At/by the end of the course, the students will be able toi) Know about the chemical composition of fish and shellfish ii) Understand the post mortem changes in fish& iii) Know about the flavor compound and bio-toxin production in fish and shellfish.

At the end of the course, the students will be able to-

CLOs	Course Learning Outcomes	Lectures
CLO1	Describe the chemical and nutritional composition and nutritive value of fish; explain the seasonal variation of essential nutrients.	4
CLO2	Explain the role of different body constituents such as lipids, proteins, carbohydrates, pigmentation, flavour compounds, minerals in governing fish quality and processability.	
CLO3	Describe the mechanism of rigor mortis; explain the factors influencing the rigor mortis; illustrate the effects of rigor mortis in keeping quality of whole fish and fillet.	3
CLO4	Outlines the protein composition; explain the muscle protein in terms of water holding capacity, coagulation property, extractability and pH under various storage conditions.	2
CLO5	Outline the lipid profile in representative fish species (*Hilsa*); explain the factors affecting changes in fatty acid composition and spoilage of fatty acids; compare the health benefit of fatty acids of fish with others.	3
CLO6	Describe vitamin and minerals in terms of composition, their variation in different organs in small fish, farmed fish and marine fish; explain the effect of processing and storage on vitamin and mineral content.	2
CLO7	Outline and apply fat and water soluble vitamins in fish and shellfish and effect of processing and preservation on vitamin content.	2
CLO8	Describe the origin of taste, taste &flavour active compound in fish.	3
CLO9	Describe and explain the contaminants and toxins in fish with their residual effects	3

Mapping CLOs with PLOs

CLOs	PLOs			
	PLO1	PLO2	PLO3	PLO4
CLO1	●	X	X	X
CLO2	●	X	X	X
CLO3	●	X	X	X
CLO4	●	X	X	X
CLO5	●	X	X	X
CLO6	●	X	X	X

CLO7	●	X	X	X
CLO8	●	X	X	X
CLO9	●	X	X	X

X Strong contribution ● Weak contribution □ No contribution

Lesson Plan

CLOs	Course Contents	Teaching Strategy	Assessment Strategy
CLO1	Fish as food material: Chemical and nutritional aspects, the chemical composition of fish and seasonal variations of essential nutrients; Nutritional values.	- Lectures followed by discussion - Participatory question-answer	**Total: 100** Attendance: 10 In course Examination/ Tutorial/Quiz/ Class Test: 20 Final Examination: 70
CLO2	Role of body constituents in governing fish quality and processability: Lipids, proteins, carbohydrates, pigmentation, flavour compounds and minerals.	- Lectures followed by discussion - Participatory question-answer - Online resources	
CLO3	Post-mortem changes in fish: Degradation of organic phosphates and carbohydrates. Biophysical mechanism of rigor-mortis. Factors influencing the rigor-mortis. Relationship between rigor-mortis and keeping quality of whole fish and fillet.	- Lectures followed by discussion - Participatory question-answer - Online resources	
CLO4	Characteristics of muscle proteins: Protein composition, physical, thermal and polymerization properties of fish muscle proteins, changes in water holding capacity, coagulation property, extractability and pH of fish muscle proteins under various storage conditions.	- Lectures followed by discussion - Participatory question-answer - Online resources	
CLO5	Lipid in fish: Lipid profile in representative fish species (*Hilsa*)-essential fatty acids, mono- and poly-unsaturated fatty acids; factors affecting changes in fatty acid composition, spoilage of fatty acids, the health benefit of fish fatty acids.	- Lectures followed by discussion - Participatory question-answer - Online resources	
CLO6	Vitamins and minerals in fish: Composition and their variation in different organs in small fish, farmed fish and marine fish; effect of processing and storage on vitamin and mineral content.	- Lectures followed by discussion - Participatory question-answer - Online resources	
CLO7	Tastiness in fish: The origin of taste, taste and flavor active compounds in fish.	- Lectures followed by discussion - Participatory question-answer	
CLO8	Chemical contaminants and toxins in fish: residual effects.	- Lectures followed by discussion - Participatory question-answer	

Recommended books/literature:

- Borgstrom, G. (ed.) 1965. Fish as food. Vol. I-IV, Academic Press, London.
- Clucas, I. J. and A. R. Ward. 1996. Post-harvest Fisheries Development: A guide to handling, preservation, processing and quality. NRI, UK.
- Williams, R. T. 1970. Biochemistry of fish. Cambridge University Press.
- West E. S. and W. R. Todd. 1961. Textbook of Biochemistry, The Macmillan Company, NY, USA.
- Clucas, I.J. (editor), 1982. Fish handling, preservation and processing in the topics. Part I and II. 2nd Edition, TDRI, London. ODA, UK
- Deman. J. M. 1990. Principles of Food chemistry. 2nd Edition. Van Nostrand Reinhold.
- Nowsad AKM A., Mohanty, B.P., Hoq, M. E. and Thilshed, S.H.. 2012. Nutritional values, Consumption and Utilization of Hilsa. The WorldFish Center-Bangladesh-Proc. Reg. Workshop on Hilsa: Potential for Aquaculture, 16-17 September 2012. Dhaka, Bangladesh.

0831-566: Research Methodology in Fisheries Technology

Credit: 2

Full Marks: 100 [Theory 70, Class Test 20 (written and/or oral) and Attendance 10]
Time: 3 hours (Seven questions to be set and five to be answered)

Course Description:

This course is a theoretical course and prerequisite to complete the MS in Fisheries Technology degree. The course covers the research methodologies with special reference to designing research, thesis writing and drafting scientific papers and its publication. The course is designed to strengthen the knowledge in research design, field works and lab works. This course can also teach them about research outputs in terms of thesis, scientific articles etc. This course also focuses on the project proposal writing and implementation.

Learning Outcomes:

Upon completion of this course, the student would be able to (i) identify research problems (ii) design, collection and analyse qualitative and quantitative data. (ii) employ appropriate statistical methods for data analysis; and (iii) prepare and publish scientific paper.

At the end of the course, the students will be able to-

CLOs	Course Learning Outcomes	Lectures
CLO1	State the introduction to research methodology; describe the fisheries technology research in terms of terminologies, research advisor, problems on research, importance and scope of studying of research methodology.	3
CLO2	Explain and implement the principle, field layout, sampling design, measurement and scaling technique, methods of data collection etc.	2
CLO3	Explain and apply the access to the field, site visit, data/sample collection, data records and sample preservation.	2
CLO4	Explain and implement the sample maintenance, different measurements.	3
CLO5	Write research proposal or synopsis in different steps; research background including importance, problem statement and objective, methodology including a time frame, expected findings and citation.	2
CLO6	Explain and write a thesisconsisting the abstract, introduction, problem statement, review of literature, methodology, results, discussion, recommendation and citation.	2
CLO7	Explain and write scientific article consists of abstract, introduction, problem statement, hypothesis methodology, results, discussion, recommendation and citation.	3
CLO8	Explain and write a project proposal, project progress report and final report writing.	2
CLO9	Explain and write reference for journal papers, books, proceedings, conference paper, electronic documents, unpublished documents.	2
CLO10	Explain and write assignment along with presentation on thesis title, introduction including importance and objects and methodology.	2

Mapping CLOs with PLOs

CLOs	PLOs			
	PLO1	PLO2	PLO3	PLO4
CLO1	●	X	X	X
CLO2	●	X	X	X
CLO3	●	X	X	X
CLO4	●	X	X	X
CLO5	●	●	●	X
CLO6	●	●	●	X
CLO7	●	●	●	X
CLO8	●	●	●	X
CLO9	●	●	●	X
CLO10	●	●	●	X

X Strong contribution ● Weak contribution □ No contribution

Lesson Plan

CLOs	Course Contents	Teaching Strategy	Assessment Strategy
CLO1	An introduction to research methodology: Fisheries technology research and terminologies, Research advisor, Problems on research, Importance and Scope of studying of research methodology.	- Lectures followed by discussion - Participatory question-answer	
CLO2	Research design: Principle, field layout, Sampling design, Measurement and Scaling technique, Methods of Data collection etc.	- Lectures followed by discussion - Participatory question-answer - Online resources	
CLO3	Fieldworks: Access to the field, Site visit, Data/Sample collection, Data records and Sample preservation etc.	- Lectures followed by discussion - Participatory question-answer - Online resources	**Total: 100** Attendance: 10 In course Examination/ Tutorial/Quiz/ Class Test: 20 Final Examination: 70
CLO4	Lab works: Sample maintenance, Marking/Tagging, Different measurements etc.	- Lectures followed by discussion - Participatory question-answer - Online resources	
CLO5	Research proposal writing/Synopsis writhing: Research background including importance, problem statement and objective, Methodology including a time frame, Expected findings, citation.	- Lectures followed by discussion - Participatory question-answer - Online resources	
CLO6	Thesis writing: Abstract, introduction, problem statement, hypothesis, methodology, review of literature, results, discussion, Recommendation and citation	- Lectures followed by discussion - Participatory question-answer - Online resources	
CLO7	Scientific article writing: Abstract, introduction, problem statement, hypothesis methodology, results and discussion, Recommendation and citation.	- Lectures followed by discussion - Participatory question-answer - Video	
CLO8	Project proposal writing, Project progress report and final report writing.	- Lectures followed by discussion - Participatory question-answer - Video	
CLO9	Reference writing: journal papers, books, proceedings, conference paper, electronic documents, unpublished documents, etc.	- Lectures followed by discussion - Participatory question-answer - Video	
CLO10	Assignment: Presentation on thesis title, introduction including importance and objects and methodology.	- Lectures followed by discussion - Participatory question-answer - Video	

Recommended books/literature:

- Kothari CR (2004) Research Methodology - Methods and Techniques (2nd Edition). New Age International Publishers.
- Kumar R (2010) Research Methodology: A Step-by-Step Guide for Beginners (Third Edition). SAGE Publications Ltd
- Berg BL (2001) Qualitative research methods for social sciences. 4th ed. USA: Allyn & Bacon.
- Booth WC, Colomb GG and Williams JM (2003) The craft of research. 2nd ed. Chicago: The University of Chicago Press.
- Burton S and Steane P (eds) (2004) Surviving your thesis. London: Routledge
- Dawson C (2002) Practical research methods: a user-friendly guide to mastering research techniques and

projects. Oxford: How To Books Ltd.
- Given LM (ed) (2008) The Sage encyclopedia of qualitative research methods, volumes 1 & 2. California, Thousand Oaks: Sage Publications.
- Yin RK (2011) Qualitative research from start to finish. New York: The Guilford Press.
- Walliman N (2011) Research methods: the basics. Oxon: Routledge.
- SeltmanHj (2014) Experimental design and analysis. Carnegie Mellon University.
- Modern Language Association of America (2009) MLA handbook for writers of research papers. 7th ed. New York: Modern Language Association of America.

0831-567: Biotechnology in Fish Processing

Credit: 2

Full Marks: 100 [Theory 70, Class Test 20 (written and/or oral) and Attendance 10]
Time: 3 hours (Seven questions to be set and five to be answered)

Course Description:

This course is a theoretical course and prerequisite to complete the MS in Fisheries Technology degree. The course covers the biotechnological techniques and application used in fish processing industry.The course is designed to strengthen the knowledge on fish proteases and their uses. This course can also teach them about the application enzyme technology on fishery products development. This course also focuses on seafood waste management by biotechnological knowledge.

Learning Outcomes:

At/by the end of the course, the students will be able to- know the fish processing and recovery methods of proteases, fish protein hydrolysate, fish sauce, crustacean waste components; select the proper packaging for fish and fishery products; know the microbiological techniques with proper sampling.

At the end of the course, the students will be able to-

CLOs	Course Learning Outcomes	Lectures
CLO1	Outline the general properties, application, selection criteria of proteases from aquatic organisms; classify the fish proteases and their application in seafood industry	3
CLO2	Describe and apply the principle of producing fish protein hydrolyzates by microorganisms	3
CLO3	Describe and apply the principles and techniques of fish sauce production; explain microbial and chemical changes occurred during sauce fermentation.	3
CLO4	Describe and apply the principles and techniques with crustacean waste recovery; explain application of crustacean waste components	2
CLO5	Describe the modern seafood packaging systems; apply the principles of shelf life extension and pathogen control by packaging.	3
CLO6	Describe and apply the microbial techniques used for sampling, sample preparation and viable cell counts inseafood preservation.	2
CLO7	Describe and apply the principles of recovery of protein, colour and flavour compounds from seafood waste; outline the application seafood waste	2

Mapping CLOs with PLOs

CLOs	PLOs			
	PLO1	PLO2	PLO3	PLO4
CLO1	●	●	X	X
CLO2	●	X	X	X
CLO3	●	X	X	X
CLO4	●	●	●	X
CLO5	●	●	X	X
CLO6	●	X	X	X
CLO7	●	X	X	X

X Strong contribution ● Weak contribution □ No contribution

Lesson Plan

CLOs	Course Contents	Teaching Strategy	Assessment Strategy
CLO1	Proteases from aquatic organisms: general properties and application of proteases; criteria for selection a protease in industry; classification of fish proteases and traditional applications of proteases in the seafood industry.	- Lectures followed by discussion - Participatory question-answer	**Total: 100** Attendance: 10 In course Examination/ Tutorial/Quiz/ Class Test: 20 Final Examination: 70
CLO2	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.	- Lectures followed by discussion - Participatory question-answer - Online resources	
CLO3	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.	- Lectures followed by discussion - Participatory question-answer - Online resources	
CLO4	Applications of crustacean wastes in biotechnology; quality and composition of crustacean waste; recovery of crustacean waste components and application of crustacean waste components.	- Lectures followed by discussion - Participatory question-answer - Online resources	
CLO5	New packaging technology for seafood preservation: packaging for seafood; modern food packaging; shelf-life extension and pathogen control.	- Lectures followed by discussion - Participatory question-answer - Online resources	
CLO6	Rapid method and automation for seafood microbiology: improvements in sampling and sample preparation; alternative method for the viable cell count procedure; new microbial techniques; new and novel techniques.	- Lectures followed by discussion - Participatory question-answer - Online resources	
CLO7	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.	- Lectures followed by discussion - Participatory question-answer	

Recommended books/literature:

- Adams, M.R. and C.F.A Hope. 1989. Rapid methods in food microbiology. Elsevier, Amsterdam.
- Adams, M.R., R.D Cook and P. Rattagol. 1985 Fermented fish products of Southeast Asia. Trop. Sc., 25, 61-73.
- 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 wates. Proceedings of the Iternational Conference of Fish By-products, (ed. S. Keller) University of Alaska Fairbanks, Alaska, pp. 79-85.
- Fujita, T. 1990. Seafood products, in Food Packaging (ed. T. Kadoya) Academic press, New York.
- Martin, A. M. 1994. Fisheries Processing; Biotechnological applications. Chapman & Hall.
- 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.

0831-568: Aquatic Environment and Pollution

Credit: 2

Full Marks: 100 [Theory 70, Class Test 20 (written and/or oral) and Attendance 10]
Time: 3 hours (Seven questions to be set and five to be answered)

Course Description:

This course is a theoretical course and prerequisite to complete the MS in Fisheries Technology degree. The course covers the aquatic environments and their pollution status. The course is designed to strengthen knowledge on environmental principles related to management of aquatic ecosystem. This course can also teach them about the environmental degradation with their remedial action. This course also focuses on industrial pollution and algal toxicity.

Learning Outcomes:

At the end of the course, the students will be able to understand i) environmental principles to the management of aquatic ecosystems, and ii) effects of environment and pollution on fisheries resources.

At the end of this course, the students will able to-

CLOs	Course Learning Outcomes	Lectures
CLO1	Outlines the aquatic environments.	2
CLO2	Describe the importance of aquatic environment maintenance.	3
CLO3	Describe the environmental principles related to the management of the aquatic ecosystem.	3
CLO4	Outlines the limiting factors for the aquatic environment.	2
CLO5	Outlines the effects of environmental degradation on fisheries resources.	3
CLO6	Describe the relationship between agriculture and the aquatic environment.	2
CLO7	Know the pollution status of aquatic environment through industrial development.	2
CLO8	Identify the algal pollution in aquatic environment.	2

Mapping CLOs with PLOs

CLOs	PLOs			
	PLO1	PLO2	PLO3	PLO4
CLO1	●	●	●	X
CLO2	●	●	●	X
CLO3	●	●	●	X
CLO4	●	X	●	X
CLO5	●	X	X	X
CLO6	●	X	X	X
CLO7	●	X	X	X
CLO8	●	●	X	X

X Strong contribution ● Weak contribution □ No contribution

Lesson Plan

CLOs	Course Contents	Teaching Strategy	Assessment Strategy
CLO1	Concept of the aquatic environment.	- Lectures followed by discussion - Participatory question-answer	**Total: 100** Attendance: 10 In course Examination/ Tutorial/Quiz/ Class Test: 20 Final Examination: 70
CLO2	Importance of aquatic environment maintenance.	- Lectures followed by discussion - Participatory question-answer	
CLO3	Environmental principles related to the management of the aquatic ecosystem.	- Lectures followed by discussion - Participatory question-answer	
CLO4	Limiting factors for the aquatic environment.	- Lectures followed by discussion - Participatory question-answer	
CLO5	Environmental degradation and fisheries resources.	- Lectures followed by discussion - Participatory question-answer	
CLO6	Agriculture and the aquatic environment.	- Lectures followed by discussion - Participatory question-answer	

CLO7	Aquatic environment and pollution through industrial development.	- Lectures followed by discussion - Participatory question-answer	
CLO8	Algal pollution in aquatic environment.	- Lectures followed by discussion - Participatory question-answer	

Recommended books/literature:

- Rand, G.M. and S.R. Petrocelli. 1985. Fundamentals of Aquatic Toxicology. Hemisphere, Washington, D.C.
- Calow, P. (ed.) 1995. Handbook of Ecotoxicology. Blackwell Scientific Publication, Inc., Cambridge.
- Forbes, V.E. and T. L. Forbes. 1994. Ecotoxicology in Theory and Practice. Chapman and Hall Publishers. London. UK.
- Furness, R.W. and P.S. Rainbow (eds.) 1990. Heavy Metals in the Marine Environment. CRC Press, Inc., Florida. 256 pp.
- Moriarty, F. 1993. Ecotoxicology: The Study of Pollutants in Ecosystems. Academic Press, London. 289 pp.
- Falconer, I.R. 1993. Algal Toxins in Sea Food and Drinking Water. Academic Press. 224 pp.
- Laws, E.A. 2000. Aquatic Pollution: An Introductory Text. 3rd Edition. Wiley. 639 pp.

Research Work

0831-569: Research Defense-1

Credit: 2

Full Marks: 100

This course is a part of research and prerequisite to complete the MS in Fisheries Technology degree. At the beginning of the Semester-1, all students will be attached with the academic staff as a supervisor. Students will face a research defense based on the problem statement, hypothesis, objective, expected outputs and limitations, review of the literature and methodology of the proposed research.

M. S. in Fisheries Technology Semester-2 Examination, December 2026

COMPULSORY COURSES

0831-661: Advanced Fishery Products Technology

Credit: 2

Full Marks: 100 [Theory 70, Class Test 20 (written and/or oral) and Attendance 10]

Time: 3 hours (Seven questions to be set and five to be answered)

Course Description:

This course is a theoretical course and prerequisite to complete the MS in Fisheries Technology degree. The course covers the different fishery products with their uses and processing methods. The course is designed to teach them the production process of different value added fishery products. This course can also teach them about preparation of surimi based fishery products. This course also focuses on the overall utilization of fish and shellfish by producing products.

Learning Outcomes:

At the end of the course, the students will be able to- i) Know the different fishery products and their uses ii) Know the processing methods of fishery products & iii) Ensure the proper utilization of fish and shellfish.

At the end of the course, the students will be able to-

CLOs	Course Learning Outcomes	Lectures
CLO1	Describe the world fisheries resources and their utilization, scientific and technological development of fishery products.	3
CLO2	Produce the frozen fish fillets, breaded fishery products, value-added frozen shrimp and fish products.	4
CLO3	Categorize salted fish, shellfish, seaweed, fish roe; describe the process of salted hilsha in Bangladesh; categorize and describe the dried fishery products; differentiate and describe the production process of cold & hot smoked products, seasoned-smoked products; describe the production process of shrimp smoking in Bangladesh.	4
CLO4	Describe the production process of canning of small fish (whole), Salmon and tuna canning, canned shellfish (crab, shrimp, and squid).	3
CLO5	Describe the process of fermented fish paste or fish pickles, liquid fermented fish sauce, cured fermented products, semi-fermented product (Shidalshutki in Sylhet).	2
CLO6	Describe the concepts of marinades; differentiate and describe thecold, cooked & fried –marinades with their manufacturing process, spoilage, and quality control.	2
CLO7	Describe the surimi based products in terms of raw materials selection, preparation of Surimi, process evaluation; briefly describe the surimi based products (kamaboko, chikuwa, agemono, crab-meat analog, shrimp analog, beef analog and other fabricated products).	2
CLO8	Describe the preparation of fish sausage and ham, fish ball, fish stick, fish finger and fish burger.	2

Mapping CLOs with PLOs

CLOs	PLOs			
	PLO1	PLO2	PLO3	PLO4
CLO1	X	●	●	X
CLO2	●	X	X	X
CLO3	●	X	X	X
CLO4	●	X	X	X
CLO5	●	X	X	X
CLO6	●	X	X	X
CLO7	●	X	X	X
CLO8	●	X	X	X

X Strong contribution ● Weak contribution □ No contribution

Lesson Plan

CLOs	Course Contents	Teaching Strategy	Assessment Strategy
CLO1	World fisheries resources and their utilization, scientific and technological development of fishery products.	- Lectures followed by discussion - Participatory question-answer	
CLO2	Frozen fishery products: Frozen fish fillets, breaded fishery products, value-added frozen shrimp and fish products.	- Lectures followed by discussion - Participatory question-answer - Online resources	
CLO3	Cured fishery products: Salted fish - types of salted fish, shellfish, seaweed, fish roe, Salted hilsha in Bangladesh. Dried fish: sun-dried products, salt, boiled, broiled, freeze and seasoned -dried products, dried seaweed. Smoked fish: cold & hot smoked products, seasoned-smoked products, and shrimp smoking in Bangladesh.	- Lectures followed by discussion - Participatory question-answer - Online resources	**Total: 100** Attendance: 10 In course Examination/ Tutorial/Quiz/ Class Test: 20 Final Examination: 70
CLO4	Canned products: Canning of small fish (whole), Salmon and tuna canning, canned shellfish (crab, shrimp, and squid).	- Lectures followed by discussion - Participatory question-answer - Online resources	
CLO5	Fermented products: Fermented fish paste or fish pickles, liquid fermented fish sauce, cured fermented products, semi-fermented product (Shidalshutki in Sylhet).	- Lectures followed by discussion - Participatory question-answer - Online resources	
CLO6	Fish marinades: Concepts of marinades, cold, cooked & fried –marinades, manufacturing process, spoilage, and quality control.	- Lectures followed by discussion - Participatory question-answer - Online resources	
CLO7	Surimi based products: Raw materials selection, preparation of Surimi, process evaluation, surimi based products (kamaboko, chikuwa, agemono, crab-meat analog, shrimp analog, beef analog etc.).	- Lectures followed by discussion - Participatory question-answer - Video	
CLO8	Paste products: Fish sausage and ham, fish ball, fish stick, fish finger and fish burger.	- Lectures followed by discussion - Participatory question-answer	

Recommended books/literature:

- Hall, G. M. 1992. Fish Processing Technology. Blackie Academic &Professional, An Imprint of Chapman & Hall, London.
- Stansby, M. E. 19990. Industrial Fishery Technology. Reinhold Publ. Corp., NY.
- Tanikawa, E. 1985. Marine products of Japan. KoseishaKoseikaku Co. Ltd. Tokyo, Japan.
- Borgstrom, G. (Editor) 1965. Fish as Food. Vol. I-IV. Academic Press, London.
- Lanier, T. C. and C. M. Lee (ed.) 1992. Surimi processes Technology, Marcel Dekker, Inc., New York, USA.
- Rogenstein, J. M. 1991. Introduction to fish Technology. An Osprey Book. VanNostrand Reinhold, New York.
- Wheaton, F. W. and T. B. Lawson. 1985. Processing of aquatic food products. Wily and Sons New York.

0831-662: Quality Control of Fishery Products

Credit: 2

Full Marks: 100 [Theory 70, Class Test 20 (written and/or oral) and Attendance 10]

Time: 3 hours (Seven questions to be set and five to be answered)

Course Description:

This course is a theoretical course and prerequisite to complete the MS in Fisheries Technology degree. The course covers the quality, quality program, quality organization, quality assessment and official inspection

practices. The course is designed to strengthen existing knowledge of students on application of different quality control program such as GMP, SOP, SSOP, HACCP used in fish and fishery products. This course can also teach them the standard specifications of fish products such as BSTI, Codex and ICMSF standards. This course also focuses the Bangladesh food laws along with EU, FDA, ITC, WTO, Japan standards for exporting fish and fishery products.

Learning Outcomes:

At the end of the course, the students will be able to- i) Know the basic concepts of quality and quality control ii) Know the application of modern approaches for quality control such as food laws, HACCP, Traceability and specific standards etc, iii) Determine the quality indicators in fish and fishery products iv) Know the official inspection procedure in industry level.

At the end of the course, the students will be able to-

CLOs	Course Learning Outcomes	Lectures
CLO1	Know the history of quality control, the traditional approach to quality control and the importance of quality programmes; describe and apply the modern approach to quality control such as GMPs (Good Manufacturing Practices), SOP (Standard Operating Procedure), SSOP (Sanitation Standard Operating Procedure).	3
CLO2	Identify and explain the quality deterioration and quality defects in raw materials and finished products in terms of causes and effects, factors, and practical means of prevention.	3
CLO3	Explain and assess the quality by the sensory, mechanical, instrumental, chemical, and microbial methods for fishery products.	4
CLO4	Explain the industrial quality control, official inspection, requirements and licensing.	3
CLO5	Explain and apply the hygiene and safety aspects of quality assurance, HACCP system, and traceability system in the fish processing industry.	3
CLO6	States the standard specification of fishery products under different organization such as CodexAlimentarius commission (CAC), International Organization of Standardization (ISO-9000-4), International Commission of Microbiological Specification (ICMS), and Bangladesh Standard Testing Institute (BSTI).	3
CLO7	Describe and apply food laws and regulations for fish and fishery products in Bangladesh; Outlines the requirement of exportable fish and fishery products by EU, FDA, ITC, UNCTAD/WTO, Japanand other fish and fishery products importing countries.	3

Mapping CLOs with PLOs

CLOs	PLOs			
	PLO1	PLO2	PLO3	PLO4
CLO1	●	●	●	X
CLO2	●	●	●	X
CLO3	●	X	X	X
CLO4	●	●	●	X
CLO5	●	●	●	X
CLO6	●	●	●	X
CLO7	●	●	●	X

X Strong contribution ● Weak contribution □ No contribution

Lesson Plan

CLOs	Course Contents	Teaching Strategy	Assessment Strategy
CLO1	General principles of quality control: The history of quality control, the traditional approach to quality control. The modern approach to quality control.GMPs (Good Manufacturing Practices), SOP (Standard Operating Procedure), SSOP (Sanitation Standard Operating Procedure). The importance of quality programmes.	- Lectures followed by discussion - Participatory question-answer	**Total: 100** Attendance: 10 In course Examination/ Tutorial/Quiz/ Class Test: 20 Final Examination: 70

CLO2	Quality deterioration and quality defects in raw materials and finished products: Causes and effects, factors affecting deterioration, practical means of prevention.	- Lectures followed by discussion - Participatory question-answer - Online resources	
CLO3	Methods of assessing the quality of fish and fishery products: Sensory methods, mechanical, instrumental, chemical and microbiological methods.	- Lectures followed by discussion - Participatory question-answer - Online resources	
CLO4	Organization of quality control and official inspection: Industrial quality control, official inspection, and requirements, licensing.	- Lectures followed by discussion - Participatory question-answer - Online resources	
CLO5	Industrial and commercial aspects of quality control: Hygiene and safety aspects of quality assurance; setting up the HACCP system in a seafood processing plant, quality systems and audit checking; Traceability in the fish processing industry.	- Lectures followed by discussion - Participatory question-answer - Online resources	
CLO6	Standard specification of fish and fishery products: Bangladesh Standard and Testing Institute (BSTI), International Commission of Microbiological Specifications (ICMS); International Standard Organization (ISO-9000), Codex Alimentarius commission (CAC).	- Lectures followed by discussion - Participatory question-answer - Online resources	
CLO7	Food Laws and Regulations: General food law & regulations, FDA of America; European Union (EU) laws; International Trade Center (ITC), UNCTAD/WTO, Japan and requirement of other fish and fishery products importing countries.	- Lectures followed by discussion - Participatory question-answer - Video	

Recommended books/literature:

- Introduction to Fishery By-products. M. Windson and S. Barlow (1911). Fishing News Books Ltd.
- Control of Fish Quality. J. J. Connell (1980). Fishing News Books Ltd.
- Fundamentals of Quality Control for the Food Industry. A. Kramer and B. A. Twigg (1966). The AVI Publ. Co. Inc. West port.
- Marine Products in Japan. E. Tanikawa (1985). Koseisha Co. Ltd. Tokyo.
- Fish as Food. vol. I-IV. G. Borgstrom (editor) (1965). Academic press, London.
- The Freezing Preservation of Foods. Donald (editor) (1968). The AVI Publ. Co. Inc.
- The Technology of fish Utilization. R. Krenzer (1965). Fishing News Books Ltd. London.
- Harvests and Post-harvest Technology of Fish. K. Rabindran (editor) (1985). Society of Fisheries Technologists, India.
- Industrial Fishery Technology. M. E. Stausby (1963). Reinhold Publ. Corp. New York.
- Introduction to Fishery By-Products. M. Windsor and S. Barlow (1981). Fishing News Books Ltd. Farnham, Surrey, England.
- Technological Control in the Fish Processing Industry. G. V. Gerasimov and M. T. Antonova (1979). Amerind Publishing Co. Pvt. Ltd. New Delhi, Bombay, Calcutta, New York.
- Participatory Training of Trainers: A New Approach Applied in Fish Processing by Dr. A. K. M. NowsadAlam, 2007. Bangladesh Fisheries Research Forum (BFRF).

0831-663: Advanced Fishery By-product Technology

Credit: 2

Full Marks: 100 [Theory 70, Class Test 20 (written and/or oral) and Attendance 10]
Time: 3 hours (Seven questions to be set and five to be answered)

Course Description:

This course is a theoretical course and prerequisite to complete the MS in Fisheries Technology degree. The course covers the different fishery by-products with their uses and processing methods. The course is designed to enhance the existing knowledge of students about the process of fishery by-products such as fishmeal, fish oil, fish silage, hydrolysate etc. This course can also teach them the processing and utilization of specialty products such as gelatine, fish glue, fish skin, chitin, pearl essence, pearl etc. This course also focuses on processing and utilization of nutraceutical products such as agar, alginate, iodine, insulin etc.

Learning Outcomes:

At the end of the course, the students will be able to- i) Know the different fishery byproducts and their uses ii) Know the processing methods of fishery byproducts & iii) Ensure the proper utilization of fish and shellfish.

At the end of the course, the students will be able to-

CLOs	Course Learning Outcomes	Lectures
CLO1	Explain the scope of fishery by-product production, raw materials, abundance.	2
CLO2	Explain the processing, preservation, quality deterioration and utilization of fishmeal	2
CLO3	Describe the processing, preservation, quality deterioration and utilization of fish oils.	2
CLO4	Discuss the processing, preservation, quality deterioration and utilization of fish silage	2
CLO5	Explain the Processing, preservation, nutritive value, deterioration and utilization of fish hydrolysate and fish protein concentrate	2
CLO6	Describe and prepare the specialty products: Gelatin, fish glue, caviar, roe and milt, leather, chitin, chitosan, dried shark's fin, fish maws/Isinglass, ambergris, pearl essence, pearl, ornamental shell, tortoise shell and coral products.	4
CLO7	Define and discuss the processing methods of the nutraceutical and pharmaceutical products: agar, alginic acid and alginate, iodine, mannitol, insulin.	3
CLO8	Explain the extraction, storage and utilization of the taste and flavor active compounds in seafood	3

Mapping CLOs with PLOs

CLOs	PLOs			
	PLO1	PLO2	PLO3	PLO4
CLO1	●	●	●	X
CLO2	●	X	X	X
CLO3	●	X	X	X
CLO4	●	X	X	X
CLO5	●	●	X	X
CLO6	●	●	X	X
CLO7	●	●	X	X
CLO8	●	●	X	X

X Strong contribution ● Weak contribution □ No contribution

Lesson Plan

CLOs	Course Contents	Teaching Strategy	Assessment Strategy
CLO1	Scope of fishery by-product production, raw materials, abundance.	- Lectures followed by discussion - Participatory question-answer	**Total: 100** Attendance: 10 In course Examination/ Tutorial/Quiz/ Class Test: 20 Final
CLO2	Fishmeal, fish scrap and other seafood waste meal: Processing, quality deterioration, preservation, utilization, and nutritional value.	- Lectures followed by discussion - Participatory question-answer - Online resources	
CLO3	Fish oils: Fish oil processing – dry rendering	- Lectures followed by discussion	

	and wet rendering methods; nutritive value; quality deterioration and preservation of fish oil.	- Participatory question-answer - Online resources	Examination: 70
CLO4	Fish silage: Processing, preservation and utilization; quality and nutritional value.	- Lectures followed by discussion - Participatory question-answer - Online resources	
CLO5	Fish hydrolyzate and fish protein concentrate (FPC): Processing, nutritive value, deterioration, and preservation.	- Lectures followed by discussion - Participatory question-answer - Online resources	
CLO6	Specialty products: Gelatin, fish glue, caviar, roe and milt, leather, chitin, chitosan, dried shark's fin, pearl essence, pearl, ornamental shell, tortoise shell, and coral products.	- Lectures followed by discussion - Participatory question-answer - Online resources	
CLO7	Nutraceutical and pharmaceutical products: Agar, alginic acid and alginate, iodine, mannitol, insulin.	- Lectures followed by discussion - Participatory question-answer	
CLO8	Taste and flavor active compounds in seafood: extraction, storage, and utilization	- Lectures followed by discussion - Participatory question-answer	

Recommended books/literature:

- Hall, G. M. 1992. Fish Processing Technology. Blackie Academic & Professional, An Imprint f Chapman & Hall. London.
- Lanier, T. C. and C. M. Lee (ed.) 1992. Surimi Process Technology, Marcel Dekker, Inc., New York.
- Tanikawa, E. 1985. Marine products of Japan. KoseishaKosikaku Co., Ltd. Tokyo, Japan.
- Stansby, M. E. 1962. Industrial Fishery technology. Reinhold Publishing Corp., New York.
- Wheaton, F. w. and T, B. Lawson. 1985. Processing of aquatic food products. Wiley and Sons, New York.
- Ravindran, K., N. Nair., I. A. Parigreen., P. A. Panicker and M. Thomas. 1985. Harvest and post-harvest Technology of fish. Society of Fisheries Technologists, India.
- Stansby, M. E. 1990. Industrial Fishery Technology. Reinhold Publ. Corp., NY.
- Tanikawa, E. 1985. marine products of Japan. KosheishaKoseikaku Co., Ltd, Tokyo, Japan.
- Frazier, W. C. and D. C. Westhoff. 1990. Food Microbiology. 3rd Edition. McGraw Hill Book Co., New York, London.
- Kiss, I. (Ed.) 1984. Testing Methods in Microbiology. Elsevier Science Pub; Netherlands.

0831-664: Fishery Products Packaging

Credit: 2

Full Marks: 100 [Theory 70, Class Test 20 (written and/or oral) and Attendance 10]
Time: 3 hours (Seven questions to be set and five to be answered)

Course Description:

This course is a theoretical course and prerequisite to complete the MS in Fisheries Technology degree. The course covers the different packaging materials and methods for wet fish and value added fish products. The course is designed to enhance the existing knowledge of students about the function, utilization, special needs of packaging and packaging materials. This course can also teach them packaging needs for different fish and fishery products. This course also focuses on modern packaging techniques such as vacuum, MAP, HPP etc.

Learning Outcomes:

At the end of the course, the students will be able to-i) know the fish packaging materials, ii) select the proper packaging for fish and fishery products, iii) modern packaging techniques used for shelf life extension.

At the end of the course, the students will be able to-

CLOs	Course Learning Outcomes	Lectures
CLO1	State and explain the function of packaging, utility, special needs in food packaging, toxicological aspect of food packaging, environmental impact and legislation.	3
CLO2	Choose and explain the packaging materials such as plastic, copolymers, ionomers,	4

	laminates and other constituents of plastics.	
CLO3	Explain the packaging needs for fish and fishery products such as fresh fish, frozen fish, dried fish, salted/smoked fish, canned fish, fish pickle, fish curry.	4
CLO4	Define the modified atmosphere packaging in terms of MAP, CAP, vacuum packaging, and hyperbaric storage; describe the methods of packaging and utility; explain the role and effects of gases such as carbon dioxide, nitrogen, oxygen in self-life extension and on pathogenic bacteria	3
CLO5	Define and explain the high-pressure processing (HPP) with its principle; explain the HPP equipment, packaging materials, HPP foods in the market, International regulations of HPP foods; clarify the effects on meat constituents, effects on meat microorganism.	2

Mapping CLOs with PLOs

CLOs	PLOs			
	PLO1	PLO2	PLO3	PLO4
CLO1	●	X	X	X
CLO2	●	●	X	X
CLO3	●	●	X	X
CLO4	●	X	X	X
CLO5	●	●	X	X

X Strong contribution ● Weak contribution □ No contribution

Lesson Plan

CLOs	Course Contents	Teaching Strategy	Assessment Strategy
CLO1	The function of packaging, utility, special needs in food packaging, toxicological aspect of food packaging, environmental impact and legislation.	- Lectures followed by discussion - Participatory question-answer	**Total: 100** Attendance: 10 In course Examination/ Tutorial/Quiz/ Class Test: 20 Final Examination: 70
CLO2	Packaging materials: Plastic, copolymers, ionomers, laminates and other constituents of plastics.	- Lectures followed by discussion - Online resources	
CLO3	Packaging needs for fish and fishery products: Fresh/feed fish, frozen fish, dried fish, salted/smoked fish, canned fish, fish pickle, fish curry.	- Lectures followed by discussion - Participatory question-answer - Online resources	
CLO4	Modified atmosphere packaging: Definition of MAP, CAP, vacuum packaging, and hyperbaric storage. Methods of packaging and utility. Role of gases in self-life extension: carbon dioxide, nitrogen, oxygen. Effect of gases on pathogenic bacteria.	- Lectures followed by discussion - Participatory question-answer - Online resources	
CLO5	High-pressure processing (HPP): definition, the basic principle of HPP, HPP equipment, packaging materials, effects on meat constituents, effects on meat microorganism, availability of HPP foods in the market, International regulations of HPP foods.	- Lectures followed by discussion - Participatory question-answer - Online resources	

Recommended books/literature:

- Gopa Kumar, K (1993). Fish packaging Technology, Materials and Methods. Concept Publishing Co., New Delhi.
- Paine, F. A. and Paine, H. Y. (1983) A Handbook on food packaging. Blackie Academic &Professional, London.
- Balachandran K. K. (2001) Post harvest Technology of fish and fish products. Daya publishing House, India.
- Brown, W. D., Watts, M. M., Heyer, D., Spruce, B. and price, R. J. (1980). Modified Atmosphere Storage of

Rock fish and silver salmon. Food. Sci, 45:93-96.
- Cann, C. D. Packing Fish in a Modified Atmosphere, Torry Advisory Note No. 88. Ministry of Agriculture, Fisheries and food, London.

OPTIONAL COURSES

0831-665: Industrial Fishery Management

Credit: 2

Full Marks: 100 [Theory 70, Class Test 20 (written and/or oral) and Attendance 10]

Time: 3 hours (Seven questions to be set and five to be answered)

Course Description:

This course is a theoretical course and prerequisite to complete the MS in Fisheries Technology degree. The course covers the industrial management systems of different fisheries activities and sustainable development of fish processing industry. The course is designed to enhance the existing knowledge of students about the design and management of different fisheries related industries. This course can also teach them about fish trading sector including domestic and international. This course also focuses on waste management and sustainability in fish processing industries.

Learning Outcomes:

At the end of the course, the students will be able to- i) know the management system of different fishery sub-sectors, ii) know the fish trading at industrial scale, iii) follow the sustainable development of fish processing industry.

At the end of the course, the students will be able to-

CLOs	Course Learning Outcomes	Lectures
CLO1	State and describe the fishery industry and industrial products, employment and market.	3
CLO2	Describe the management of fishery industry in terms of artisanal & industrial fishing, catch and utilization, cost-effective fishing, individual fishing, co-operative fishing, inputs and manpower.	3
CLO3	Planand design of different fish processing plants such as Freezing plant, Cannery, Fish drying plant, Surimi plant, Fish sausage, and Ham industry, Fish meal, and oil industry, Smoking plant, Value-added, and Analog plant.	3
CLO4	Explain and apply the plant management and operation in different aspects such as Production wing, Quality control wing and R & D wing, Capital management, human resource management, and production management, process operation, capital cost and operating cost, maintenance of quality control system and plant sanitation and hygiene.	3
CLO5	Describe and apply the management practices of different processing industries: Shrimp industry, Hilsa industry, Canning industry, Salting industry.	3
CLO6	Describe the fish trading in domestic and international along with trade barriers in fisheries market	3
CLO7	Describe and apply the waste management in fishery industry in terms of Solid waste and liquid waste,total utilization of Shrimp shell, crab shell resource, and composition, conventional uses, feeds and manure, conversion to useful materials like chitin, chitosan, glucosamine and use of protein isolate.	3
CLO8	Describe the sustainability in the fish processing industry in terms of sustainability concepts in the fish processing industry, sustainable tools such as carbon footprinting, carbon labelling, life cycle assessment (TCA), and the supply chain.	2

Mapping CLOs with PLOs

CLOs	PLOs			
	PLO1	PLO2	PLO3	PLO4
CLO1	X	●	X	X
CLO2	X	●	●	●

CLO3	●	●	X	X
CLO4	●	●	X	X
CLO5	●	●	X	X
CLO6	●	●	X	X
CLO7	●	X	X	X
CLO8	●	X	X	X

X Strong contribution ● Weak contribution □ No contribution

Lesson Plan

CLOs	Course Contents	Teaching Strategy	Assessment Strategy
CLO1	Fishery industry and industrial products, employment and market.	- Lectures followed by discussion - Participatory question-answer	**Total: 100** Attendance: 10 In course Examination/ Tutorial/Quiz/ Class Test: 20 Final Examination: 70
CLO2	Management of fishery industry: Artisanal & industrial fishing- catch and utilization, cost-effective fishing, individual fishing, co-operative fishing, inputs, and manpower.	- Lectures followed by discussion - Participatory question-answer - Online resources	
CLO3	Planning and design of different fish processing plants: Freezing plant, Cannery, Fish drying plant, Surimi plant, Fish sausage, and Ham industry, Fish meal, and oil industry, Smoking plant, Value-added, and Analog plant.	- Lectures followed by discussion - Participatory question-answer - Online resources	
CLO4	Plant management and operation: Production wing, Quality control wing and R & D wing; Capital management, human resource management, and production management; process operation, capital cost and operating cost; maintenance of quality control system and plant sanitation and hygiene.	- Lectures followed by discussion - Participatory question-answer - Online resources	
CLO5	Management of different processing industries: Shrimp industry, Hilsa industry, Canning industry, Salting industry.	- Lectures followed by discussion - Participatory question-answer - Online resources	
CLO6	Fish trading: Domestic and international; trade barriers in fisheries. Market	- Lectures followed by discussion - Participatory question-answer	
CLO7	Waste management in fishery industry: Solid waste and liquid waste; the 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 protein isolate.	- Lectures followed by discussion - Participatory question-answer - Video	
CLO8	Sustainability in the fish processing industry: Definition, sustainability concepts in the fish processing industry, sustainable tools; carbon footprinting, carbon labelling, life cycle assessment (TCA), and the supply chain.	- Lectures followed by discussion - Participatory question-answer - Video	

Recommended books/literature:

- Clucas, I. J. and A. R. Ward. 1996. Post-harvest Fisheries Development: A guide to handling, preservation, processing and quality. NRI, UK.
- Stansby, M. E. 1990. Industrial Fishery Technology. Reinhold Publ. Corp., NY.
- Tanikawa, E. 1985. Marine Products in Japan. Koseikaku Co., Ltd., Tokyo.
- 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.
- Hall, G. M. 1992. Fish Processing Technology. Blackie Academic & Professional, An Imprint of Chapman & Hall. London.
- Nowsad, AKMA. 2010. Post-harvest Loss Reduction in Fisheries in Bangladesh. FAO-NFPCSP-PR#5 Final report, FAO, Dhaka
- Wheaton, F. W. and T. B. Lawson. 1985. Processing of Aquatic Food Products, Wiley and Sons, New York.

0831-666: Analytical Techniques in Fish Processing

Credit: 2

Full Marks: 100 [Theory 70, Class Test 20 (written and/or oral) and Attendance 10]
Time: 3 hours (Seven questions to be set and five to be answered)

Course Description:

This course is a theoretical course and prerequisite to complete the MS in Fisheries Technology degree. The course covers the basic principles of different analytical techniques for fish and fishery products. The course is designed to enhance the existing knowledge of students about the principles of different techniques such as centrifugation, spectroscopy, electrophoretic, chromatographic. This course can also teach them on different biochemical and microbiological analytical techniques. This course also focuses on hygiene and sanitation of fish processing industries.

Learning Outcomes:

At the end of the course, the students will be able to- i) know the basic principles of different biochemical techniques ii) knowthe basic principles of different microbiological analysis.

At the end of the course, the students will be able to-

CLOs	Course Learning Outcomes	Lectures
CLO1	Explain the general principles of separation of micro and macro molecules, selection of appropriate tools for analysis of fish samples; Outlines of common techniques involved in biochemical analysis.	2
CLO2	Explain the centrifugation techniques in terms of types, concept of Svedberg unit, analytical ultracentrifuge.	3
CLO3	Describe and apply the quality test for fish and fishery products such as Free fatty acid value, peroxide value, iodine value, K-value, Thiobarbituric acid reactive substance (TBARS) value, non-protein nitrogen, trimethyl amine, total volatile base nitrogen, preparation of myofibril, myosin and actin, ATPase assay in fish muscle.	3
CLO4	Describe the spectroscopic techniques with their principles such as UV, Visible and IR spectroscopy, spectrofluorimetry, flame photometry, atomic absorption spectrophotometry, ICP- AES, mass spectrometer.	2
CLO5	Explain the electrophoretic techniques with general principles and classification such as Paper electrophoresis, Native and reduced PAGE, IEF, capillary electrophoresis, 2D Gel electrophoresis.	2
CLO6	Describe the chromatographic Techniques with its general principles, types, chromatography -adsorption, partition, ion-exchange, molecular sieve, affinity; explain the gas chromatography, thin layer chromatography. Gas chromatography, High performance Liquid chromatography, LC MS-MS.	2
CLO7	Design and manage a food microbiological laboratory in terms of concern, siting, and servicing of the laboratory, equipment, assessment of risk and control measures, chemical and biological safety cabinets, laboratory philosophy.	2
CLO8	Explain and apply the methods for the microbiological examination of fish and fishery products in terms of sampling, enumeration, isolation, characterization, and identification of microorganisms.	2
CLO9	Describe and apply the assessment method of microbiological quality of fish and fishery products such as fresh fish, frozen fish, heated canned fish products, cured fish	2

	and fermented products.	
CLO10	Describe and apply microbiology of factory hygiene and sanitation in terms of factory buildings infrastructural implications, safety and maintenance.	2

Mapping CLOs with PLOs

CLOs	PLOs			
	PLO1	PLO2	PLO3	PLO4
CLO1	●	X	X	X
CLO2	●	X	X	X
CLO3	●	X	X	X
CLO4	●	X	X	X
CLO5	●	X	X	X
CLO6	●	X	X	X
CLO7	●	X	X	X
CLO8	●	X	X	X
CLO9	●	●	X	X
CLO10	●	●	●	X

X Strong contribution ● Weak contribution □ No contribution

Lesson Plan

CLOs	Course Contents	Teaching Strategy	Assessment Strategy
CLO1	General principles of separation of micro and macro molecules, selection of appropriate tools for analysis of fish samples. Outlines of common techniques involved in biochemical analysis.	- Lectures followed by discussion - Participatory question-answer	**Total: 100** Attendance: 10 In course Examination/ Tutorial/Quiz/ Class Test: 20 Final Examination: 70
CLO2	Centrifugation techniques: Types of centrifugation, concept of Svedberg unit, analytical ultracentrifuge.	- Lectures followed by discussion - Participatory question-answer - Online resources	
CLO3	Quality test for fish and fishery products: Free fatty acid value, peroxide value, iodine value, K-value, Thiobarbituric acid reactive substance (TBARS) value, non-protein nitrogen, trimethyl amine, total volatile base nitrogen, preparation of myofibril, myosin and actin, ATPase assay in fish muscle.	- Lectures followed by discussion - Participatory question-answer - Online resources	
CLO4	Spectroscopic techniques: Principles, UV, Visible and IR spectroscopy, spectro-fluorimetry, flame photometry, atomic absorption spectrophotometry, ICP- AES, mass spectrometer.	- Lectures followed by discussion - Participatory question-answer - Online resources	
CLO5	Electrophoretic techniques: General principles, Classification, Paper electrophoresis, Native and reduced PAGE, IEF, capillary electrophoresis, 2D Gel electrophoresis.	- Lectures followed by discussion - Participatory question-answer - Online resources	
CLO6	Chromatographic Techniques: General principles, types of chromatography - adsorption, partition, ion-exchange, molecular sieve, affinity, gas chromatography, thin layer chromatography. Gas chromatography, High performance Liquid chromatography, LC MS-MS.	- Lectures followed by discussion - Participatory question-answer - Online resources	

CLO7	Design and management of a food microbiological laboratory: Need for concern, siting, and servicing of the laboratory, equipment, assessment of risk and control measures, chemical and biological safety cabinets, laboratory philosophy.	- Lectures followed by discussion - Participatory question-answer - Video	
CLO8	Methods for the microbiological examination of fish and fishery products: Sampling, enumeration, isolation, characterization, and identification of microorganisms.	- Lectures followed by discussion - Participatory question-answer - Video	
CLO9	Assessment of microbiological quality of fish and fishery products: fresh fish, frozen fish, heated canned fish products, cured fish and fermented products.	- Lectures followed by discussion	
CLO10	Microbiology of factory hygiene and sanitation: Factory buildings infrastructural implications, safety and maintenance.	- Participatory question-answer	

Recommended books/literature:

- AOAC (Association of Official Analytical Chemists) 1980. Official methods of analysis of Association of Official Analytical Chemists. Washington, USA.
- B.S. Larsen & C.N. McEwen, (1988), Mass Spectrometry of Biological materials. Marcel Dekker Inc.
- G.W. Ewing, (1997), Analytical Instrumentation Handbook, Marcel Dekker Inc.
- Harrigan, W. F. and R. W. A. Park. 1991. Making safe food: A management guide for Microbiological quality. Academic Press. Harcourt Brace Jpvanovich, Publishers.
- J.A, Peary. 1981. Introduction to Analytical Gas Chromatography, Marcel Dekker Inc.
- Nickerson, J. T. and A. J. Sinskey. 1977. Microbiology of food and food processing. Elsevier, New York, Oxford, Amsterdam.
- Pare, J. R. J. & Belanger, J.M.R. 1997. Instrumental Methods In Food Analysis. Elsvier.
- Robyt, J. F. & White, B. J. 1990. Biochemical Techniques Theory & practice, Waveland Press, Inc.
- Wilson, R H. 1994. Spectroscopic Techniques for Food Analysis. VCH publishers, Inc.

0831-667: Fishery Products Marketing

Credit: 2

Full Marks: 100 [Theory 70, Class Test 20 (written and/or oral) and Attendance 10]
Time: 3 hours (Seven questions to be set and five to be answered)

Course Description:

This course is a theoretical course and prerequisite to complete the MS in Fisheries Technology degree. The course covers the fish market, market segmentation, consumer behavior, marketing research and ethical considerations in national and global fish marketing. The course is designed to enhance the existing knowledge of students about the concepts of market and marketing. This course can also teach them on the pricing, placing, marketing cost and consumer behaviour. This course also focuses on exiting problems of fish and fishery products marketing and the mitigations measures.

Expected Outcomes:

Upon completion of this course the students will be able to (i) understand core concepts of fish marketing and its importance in business and society; (ii) develop marketing strategies based on fish product, price, place and promotion objectives; (iii) communicate the unique marketing mixes and selling propositions for fish product offerings; and (iv) identify and solve problems in fish marketing.

At the end of the course, the students will be able to-

CLOs	Course Learning Outcomes	Lectures
CLO1	Develop the basic concept of fish marketing	2
CLO2	Explain levels and types of products and life cycle of product	2

CLO3	Explain product pricing, its strategies and methods	3
CLO4	Explain and identify stakeholders involved in fish marketing	2
CLO5	Able to promote a product	2
CLO6	Describe the factors of marketing cost, margin and efficiency.	3
CLO7	Describe the consumers behavior and decision making process	3
CLO8	Outlines the problems in different marketing steps	3

Mapping CLOs with PLOs

CLOs	PLOs			
	PLO1	PLO2	PLO3	PLO4
CLO1	●	●	●	X
CLO2	●	●	●	X
CLO3	●	●	●	X
CLO4	●	●	●	X
CLO5	●	●	●	X
CLO6	●	●	●	X
CLO7	●	●	●	X
CLO8	●	●	●	X

X Strong contribution ● Weak contribution □ No contribution

Lesson Plan

CLOs	Course Contents	Teaching Strategy	Assessment Strategy
CLO1	Concepts of market and marketing; importance, basic function and approach to the study of marketing; marketing strategy; strategic planning, process, and marketing environment.	- Lectures followed by discussion - Participatory question-answer	**Total: 100** Attendance: 10 In course Examination/ Tutorial/Quiz/ Class Test: 20 Final Examination: 70
CLO2	Pricing product: Definition, objective, factors and developing steps of pricing, pricing strategy, general pricing methods, price adjustment, price discount, status of fish price, fish pricing method.	- Lectures followed by discussion - Participatory question-answer - Online resources	
CLO3	Placing product: Definition, qualities, and types of marketing channel; steps involved in selecting a channel, types of middlemen in the marketing channel, fish marketing channel; physical types and structure of the fish market.	- Lectures followed by discussion - Participatory question-answer - Online resources	
CLO4	Concept, importance, component and factors of marketing cost; concept, types, component and estimation ways of marketing margin, concept, form, performance indicator and measures for marketing efficiency.	- Lectures followed by discussion - Participatory question-answer - Online resources	
CLO5	Consumer buying behaviour: Factors affecting consumer behaviour and types of buying behaviour; buyer decision process.	- Lectures followed by discussion - Participatory question-answer - Online resources	
CLO6	Problems of fish and fishery products marketing: Problems from growers, traders, processors and consumer's point of view; mitigation measures of fish marketing problems.	- Lectures followed by discussion - Participatory question-answer - Online resources	

Recommended books/literature:

- Principle of Marketing-Philip Kotler
- Management of Marketing-Philip Kotler

- Principle of Marketing-A. S. Talukder and M. Z. H. Bhuiyan
- Agricultural Marketing in India-S.S. Acharya and N.L. Agarwal
- Food from the Sea: The Economics and Policies of Ocean Fisheries. F. W. Bell. (1978).

0831-668: Fish Health Management

Credit: 2

Full Marks: 100 [Theory 70, Class Test 20 (written and/or oral) and Attendance 10]

Time: 3 hours (Seven questions to be set and five to be answered)

Course Descriptions:

This course is a theoretical course and prerequisite to complete the MS in Fisheries Technology degree. The course covers the fish health and to develop effective fish and shrimp health management strategies to maintain the disease-free status for cultured stocks. The course is designed to enhance the existing knowledge of students about the sanitation practices in aquaculture. This course can also teach them on the diagnosis of fish diseases. This course also focuses on presentation and control measures against fish diseases.

Learning Outcomes:

At the end of this course, the students will be able to: i) Explain the major health related problems of fish and shrimp; ii) Perform clinical examination and basic laboratory tests to diagnose fish and shrimp diseases; iii) Know the prophylactic and therapeutic measures for the control of fish and shellfish diseases; iv) Know the pharmacodynamics and pharmacokinetics of select drugs; v) Plan and develop experimental trials on issues of health, infections, diagnosis, prevention and therapy of fish and shrimp diseases.

At the end of the course, the students will able to-

CLOs	Course Learning Outcomes	Lectures
CLO1	Define health management; know the objectives and basics of fish health management.	1
CLO2	Understand the sanitation practices for fish ponds and tanks, recirculation systems; water, diets, animals, hands, feet and equipment, new species, eggs, design facility.	2
CLO3	Know the effective principles of prophylaxis of fish disease.	2
CLO4	Describe the importance of history and records; understand the submission techniques of water and fish sample to the diagnostic laboratory.	2
CLO5	Know the principles and techniques of disease diagnosis.	3
CLO6	Describe the types of therapy and the therapeutic treatments.	2
CLO7	Know the methods of vaccination, factors determine how well a vaccine will work, the requirement for developing a vaccine.	3
CLO8	Explain the prevention and control ways of common fish diseases.	3
CLO9	Know the effects of intensification on shrimp health; understand the relationship between health and environment; describe the health hazards and their management.	3

Mapping CLOs with PLOs

CLOs	PLOs			
	PLO1	PLO2	PLO3	PLO4
CLO1	●	●	●	X
CLO2	●	●	●	X
CLO3	●	●	●	X
CLO4	●	X	●	X
CLO5	●	X	●	X
CLO6	●	X	●	X
CLO7	●	X	●	X
CLO8	●	X	●	X
CLO8	●	X	●	X

X Strong contribution ● Weak contribution □ No contribution

Lesson Plan

CLOs	Course Contents	Teaching Strategy	Assessment Strategy
CLO1	**Introduction of fish health management:** Definition and objectives of fish health management; the basic concept of fish health management.	- Lectures followed by discussion - Online resources	**Total: 100** Attendance: 10 In course Examination/ Tutorial/Quiz/ Class Test: 20 Final Examination: 70
CLO2	**Sanitation practices for aquaculture facilities:** Sanitation practices for fish ponds and tanks, recirculation systems; water, diets, animals, hands, feet and equipment, new species, eggs, design facility.	- Lectures followed by discussion - Online resources - Slide show	
CLO3	**Prophylaxis of fish disease:** Effective principles of prophylaxis of fish disease.	- Lectures followed by discussion - Online resources	
CLO4	**Submission of fish for diagnostic evaluation:** Importance of history and records, submission techniques of water and fish sample to the diagnostic laboratory, the value of the sample.	- Lectures followed by discussion - Online resources - Slid show	
CLO5	**Diagnosis of fish disease:** Principles of disease diagnosis, epidemiological and clinical diagnosis, postmortem examination, microbiological, histopathological and haematological methods.	- Lectures followed by discussion - Online resources - Slide show	
CLO6	**Therapy of fish disease:** Definition and types of therapy, chemotherapy, chemotheraputic treatment.	- Lectures followed by discussion - Online resources - Slide show	
CLO7	**Vaccination in aquaculture:** Definition and methods of vaccination, vaccines for fish, factors determine how well a vaccine will work, the requirement for developing a vaccine, vaccines and disease control.	- Lectures followed by discussion - Online resources	
CLO8	**Prevention and control of diseases:** Common infections and noninfectious diseases in fish.	- Lectures followed by discussion - Online resources	
CLO9	**Shrimp health maintenance:** Effects of intensification on shrimp health, the relationship between health and environment; health hazards and their management.	- Lectures followed by discussion - Online resources - Slide show	

Recommended books/literature:

- Fish Pathology (2nd edn.). R. J. Roberts (editor) (1989). Bailliers and Tindall, London.
- Fish Diseases vol. 1 and 2. W. Schaperclaus (1991). Oxanion Press Pvt. Ltd. New Delhi, Calcutta.
- Bacterial Pathogens; Diseases in Farmed and Wild Fish. B. Austin and D. A. Austin (1987). Ellis Horwood Ltd.
- Identification of Fish Pathogenic Bacteria. G. L. Bullock (1980). TFH Publication.

Research Work

0831-669: Research Defense-2

Credit: 2

Full Marks: 100

This course is a part of research and prerequisite to complete the MS in Fisheries Technology degree. Students will face defense based on their research progress or findings of the research work.

M. S. in Fisheries Technology Semester-3 Examination, June 2027

0831-761: Thesis

Credit: 8

Full Marks: 100 (Abstract-10, Introduction- 25, Methodology- 20, Results and Discussion-20, Conclusion and Recommendation-5 and Reference Citation-20 Marks).

This course is a part of research and prerequisite to complete the MS in Fisheries Technology degree. Thesis may be consist of Abstract, introduction (including problem statement, hypothesis, importance, objectives, limitations, and review of literature), methodology, results & discussion, conclusion & recommendation, and reference cited.

0831-762: Thesis Defense

Credit: 4

Full Marks: 100

This course is a part of research and prerequisite to complete the MS in Fisheries Technology degree. Students will face defense based on research findings including problem statement, hypothesis, importance, objectives, limitations, methodology, results & discussion, and recommendation.

Part D

20. Grading/Evaluation:

Eligibility for the Semester Final Examination:

Candidates having less than 60% attendance will not be allowed to fill up the examination form. Candidates having less than 75% to 60% attendance will be allowed to fill up the examination form on special grounds on such documentary evidence and the approval of special permission of Academic Committee but students will have to pay in addition to the examination fees, the requisite fee prescribed by the syndicate for the purpose.

Attendance marks will be allotted based on the following table –

Earned Percentage*	90 and above	85 to less than 90	80 to less than 85	75 to less than 80	70 to less than 75	65 to less than 70	60 to less than 65	less than 60
Marks	10	9	8	7	6	5	4	0

*Earned percentage should be calculated in the round figure according to the regular statistical method.

Semester final results will be published in GPA out of 4 on the basis of all courses and final result for the MS in Aquaculture degree will be published in CGPA out of 4 on the basis of all semester final examinations.

Grades will be awarded in accordance with provisions shown in the table as –

Numerical grade*	Letter Grade	Grade Point
80% or its above	A^+ (A plus)	4.00
75% to less than 80%	A (A regular)	3.75
70% to less than 75%	A^- (A minus)	3.50
65% to less than 70%	B^+ (B plus)	3.25
60% to less than 65%	B (B regular)	3.00
55% to less than 60%	B^- (B minus)	2.75
50% to less than 55%	C^+ (C plus)	2.50
45% to less than 50%	C (C regular)	2.25
40% to less than 45%	D	2.00
Less than 40%	F	0.00
Incomplete**	I	-

* Earned numerical grade should be calculated in round figure (once in a course) according to roundup statistical method.

** Absence from the final examination will be considered as incomplete with the letter grade "I".