



KHULNA UNIVERSITY, KHULNA

School: Life Science **Discipline:** Fisheries and Marine Resource Technology **Program:** Bachelor of Science in Fisheries
Year: 2nd **Term:** I **Examination Year:** 2026 **Session:** 2024-2025
Course Code: 0831 06 FMRT 2101 **Course Title:** Fisheries Microbiology
Total Marks: 60 **Time:** 3.0 hrs **Credit:** 3.0

- The figures in the margin indicate full marks. The questions are of equal value.
- Use separate answer script for each section.

SECTION-A

There are **FOUR** questions in this section. Answer any **THREE** questions.

- Q.1 a) Who are Archaea, and how are they classified within the tree of life? [L1, CLO1] 02
b) Provide evidence to justify that Archaea are considered extremophiles. [L5, CLO1] 02
c) How can microscopic algae be used as bioindicators for monitoring both past and present environmental conditions? [L4, CLO1] 03
d) Discuss the structural differences between prokaryotic and eukaryotic rRNA. [L4, CLO1] 03
- Q.2 a) Describe the significance of capsules and slime layers of bacteria. [L2, CLO1] 02
b) What are the functional roles of bacterial pili in microbial physiology and interaction? [L2, CLO1] 02
c) "The C-ring of the bacterial flagellar motor plays a key role in regulating directional switching of rotation."- Justify this statement. [L5, CLO1] 03
d) What is chemotaxis? [L1, CLO1,2] 01
e) Define pathogenicity and virulence with suitable examples. [L1,2; CLO1,2] 02
- Q.3 a) Biofilm is often described as a "city of bacteria."- Justify. [L5, CLO2] 02
b) "Iron acquisition represents a biological battlefield between bacteria and the host"- Justify this statement. [L5, CLO2] 03
c) How do secretion systems regulate the virulence of bacteria? [L3, CLO2] 02
d) Explain that some bacteria can work in our advantages. [L5, CLO1,5] 03
- Q.4 a) What is quorum sensing? [L1, CLO6] 01
b) How does quorum sensing regulate bacterial virulence? Justify your answer with suitable examples. [L5, CLO6] 03
c) A shrimp farm with a stocking density of 30 kg m⁻³ is fed daily at 2.5% of the total body weight using feed containing 35% protein. Calculate the amount of carbohydrate required daily to maintain an efficient biofloc system. [L6, CLO6] 04
d) Why are species richness and evenness important for maintaining the functionality and stability of microbial communities? [L3, CLO6] 02

SECTION-B

There are **FOUR** questions in this section. Answer any **THREE** questions.

- Q.5 a) What is microbial growth control? Classify physical methods used in microbial control. [L1,2; CLO2] 03
- b) What is TDT and D-value? Explain the concept of microbial death kinetics. [L2; CLO2] 03
- c) Define antibiotics. Clarify how antibiotics inhibit bacterial cell wall and protein biosynthesis. [L4; CLO2] 04
- Q.6 a) What is a microbial growth curve? Discuss the different phases of the microbial growth curve. [L1,2; CLO2] 04
- b) Illustrate the methods used for short-term and long-term preservation of microbial cultures. [L2; CLO2] 03
- c) A bacterial population initially contains 100 cells with a generation time of 20 minutes. Calculate the population after 2 hours. [L5; CLO2] 03
- Q.7 a) How do microorganisms cause disease? Briefly describe the foodborne diseases and the agents. [L1,2; CLO3] 04
- b) What are food contaminants? Differentiate between food-borne infections and food-borne intoxications with suitable examples. [L1,2; CLO3] 03
- c) Discuss the organism profile, associated illness, implicated foods, and preventive measures of *Clostridium* species. [L5; CLO3] 03
- Q.8 a) What are reactive oxygen species (ROS)? Analyze the roles of superoxide dismutase and catalase in protecting microbial cells against oxidative damage. [L4; CLO2] 03
- b) Define membrane filtration and Most Probable Number (MPN). Explain the principles and procedures of membrane filtration methods. [L1,2; CLO2] 04
- c) "Microorganisms are the major contributors to fish spoilage." - Explain and justify the statement with suitable examples. [L5; CLO6] 03



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School: Life Science

Discipline: Fisheries and Marine Resource Technology

Program: Bachelor of Science in Fisheries

Year: 2nd

Term: 1st

Examination Year: 2026

Session: 2024-2025

Course Code: 0831 06 FMRT 2103

Course Title: Fish Physiology

Total Marks: 60

Time: 3.0 hrs

Credit: 3.0

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- Use separate answer script for each section.

SECTION-A

There are **FOUR** questions in this section. Answer any **THREE** questions.

- Q.1 a) What is meant by Fish Physiology? What is the importance of studying Fish physiology? [L1; CLO1] 02
- b) Distinguish between herbivorous and detritivorous fish. [L4; CLO2] 03
- c) Explain the digestion and absorption process of proteins in fish. [L2; CLO2] 05
- Q.2 a) Distinguish between isometric and allometric growth of fish. [L4; CLO3] 03
- b) "Environmental manipulation can play a significant role in maintaining fish growth" - Justify this statement. [L5; CLO3] 04
- c) How do you determine the growth rate by analyzing fish scale? [L1; CLO3] 03
- Q.3 a) 'All swimming is locomotion but all locomotion is not swimming', do you agree with this statement or not? Justify. [L5; CLO4] 04
- b) Differentiate between the movement of Anguilliform and Carangiform fish. [L4; CLO4] 03
- c) What is drag? How does fish minimize drag for swimming? [L2; CLO4] 02
- d) What are the functions of pectoral fin of fish? [L1; CLO4] 01
- Q.4 a) Differentiate between Electroreceptors and Chemoreceptors of fish. [L4; CLO5] 03
- b) "The lateral line system is involved in 'distant touch' of fish"- Justify this statement. [L5; CLO5] 03
- c) Discuss the functions of metabolic hormones in fish. [L2; CLO6] 04

SECTION-B

There are **FOUR** questions in this section. Answer any **THREE** questions.

- Q.5 a) What is meant by internal and external respiration? [L1; CLO7] 02
- b) Explain that gills play a vital role to extract O₂ from water. [L2; CLO7] 04
- c) Describe the auxiliary respiratory structures in air breathing teleost fishes. [L5; CLO7] 04
- Q.6 a) What is blood? Write down the functions of fish blood. [L1; CLO8] 03
- b) Schematically show the blood circulation pathways throughout the fish body. [L4; CLO8] 04
- c) Write a short note on "Blood formation organs" in fish. [L4; CLO7] 03
- Q.7 a) Depending on migration, how many types of fishes are available in nature? [L1; CLO9] 03
- b) Describe the problems faced by catadromous fishes during migration. [L3; CLO9] 04
- c) How do the catadromous fishes overcome the problems faced during migration? [L4; CLO9] 03
- Q.8 a) What is "Semelparity"? How does it differ from "Iteroparity"? [L1; CLO10] 02
- b) Describe the spermatogenesis stages of a teleost. [L2; CLO10] 04
- c) Discuss various gross anatomical stages of a fish reproductive annual cycle. [L3; CLO10] 04



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Discipline: Fisheries and Marine
Resource Technology

Program: Bachelor of Science in
Fisheries

Year: 2nd

Term: I

Examination year: 2026

Session: 2024 - 2025

Course Code: 0831 06 FMRT-2105

Course Title: Fish Nutrition and Feed Formulation

Total Marks: 60

Time: 3 hours

Credit: 03

*The figure in the margin indicates full marks.

*Use separate answer script for each section.

SECTION – A

[There are **FOUR** questions in this section. Answer any **THREE** questions.]

- Q.1 a) Define ‘Fish nutrition’ and ‘Fish feed formulation’. [L1; CLO1] 03
b) Why is studying feeding habit of fish related to fish nutrition and feed formulation processes? [L2; CLO2] 02
c) “Nutrients are essential for fish growth”; based on this perspective, illustrate how feeding and balanced nutrition are linked to quality fish. [L2; CLO2] 05
- Q.2 a) Distinguish among ‘natural food’, ‘supplementary feed’, and ‘artificial feed’. [L2; CLO2] 03
b) Interpret why fish meal is used in fish feed formulation though it is expensive compared to other protein-source ingredients. [L4; CLO2] 03
c) Enlist most common fish feed additives. Justify why additives are used in manufacturing feed. [L5; CLO3] 2+2=04
- Q.3 a) What is meant by energetics? [L1; CLO3] 01
b) Diagrammatically narrate energy flow in a fish. [L2; CLO3] 04
c) Narrate the factors influencing the basal metabolic rate of aquatic animals. [L2; CLO3] 02
d) What is meant by ‘retained energy’? State the significance of retained energy in fish feeding management. [L4; CLO3] 1+2=03
- Q.4 a) What is dietary energy? Outline the major dietary energy sources for fishes. [L1,2; CLO3] 1+2=03
b) Narrate how fatty acid requirements vary between freshwater and marine water fish species. [L4; CLO3] 03
c) Criticize the major challenges of including plant ingredients in fish feed, and suggest the measures to mitigate the challenges. [L5; CLO3] 04

SECTION – B

[There are **FOUR** questions in this section. Answer any **THREE** questions.]

- Q.5 a) How are feed ingredients classified based on their nutritive value? Discuss. [L2; CLO4] 04
b) Why is the aquaculture sector currently exploring novel protein sources as substitutes for fishmeal? [L4; CLO4] 02
c) List six potential ingredients that can be used as alternatives to fishmeal. [L3; CLO4] 02
d) Point out the nutritional benefits of fermentation in improving the quality of plant protein. [L1; CLO4] 02

- Q.6 a) Suppose you are a fish feed expert. A feed manufacturing entrepreneur seeks your expertise in developing a diet for catfish that is enriched with 40% protein (DMB) using the following ingredients, which have specified protein and moisture content:

Ingredients	% Protein (RMB)	% Moisture	Cost (BDT/kg)
Fish meal (FM)	65	10	140
Rapeseed meal (RM)	35	08	75
Soybean meal (SM)	46	12	80
Wheat flour (WF)	15	07	35
Corn flour (CF)	08	12	28
Rice bran (RB)	12	10	30

- i. Which feed ingredients from the list will you select as the most cost-effective sources for protein supplementary feed ingredients (PSFI) and basal feed ingredients (BFI) for the diet? [L6; CLO4] 02
- ii. Develop the diet using the 'Pearson Square' method, ensuring that the inclusion of FM does not exceed 30% of the PSFI and RB is incorporated at 10% in the final diet. [L6; CLO4] 08
- Q.7 a) Identify the major factors considered when selecting feed ingredients for fish diets. [L4; CLO5] 02
- b) Discuss the complete process of feed manufacture from grinding to storage. [L2; CLO5] 04
- c) Why are extruded pellets able to float? [L4; CLO5] 02
- d) Explain the negative effects of over-mixing and under-mixing on quality of fish feed. [L5; CLO5] 02
- Q.8 a) Define proximate composition. Enlist the categories of proximate analysis along with their constituents for evaluating fish diets. [L1; CLO6] 03
- b) Why is the water stability of pellets important in aquaculture feeds? [L3; CLO6] 02
- c) Explain the significance of conducting feeding trials for biological evaluation of fish diets. [L4; CLO6] 03
- d) Write down the concept of studying nutrigenomics in the context of fish diet assessment. [L2; CLO6] 02



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Resource Technology

Program: Bachelor of Science in
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Year: 2nd

Term: I

Examination year: 2026

Session: 2024 - 2025

Course Code: 0831 06 FMRT-2107

Course Title: Shellfish Biology

Total Marks: 60

Time: 3 hours

Credit: 03

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*Use separate answer script for each section.

SECTION – A

[There are **FOUR** questions in this section. Answer any **THREE** questions.]

- Q.1 a) Do you consider shrimp as a fish? Explain your opinion. [L3; CLO1] 03
b) Mention five scientific and common names of carideae and penaeid shrimp for each. [L1; CLO1,2] 05
c) 'Octopus and squid belong to shellfish'-justify this statement. [L4; CLO1] 02
- Q.2 a) Write down the appendages of giant freshwater prawn with their functions. [L3; CLO1] 04
b) Why is moulting regard as an essential part of life cycle of crustacea? [L1; CLO1,2] 02
c) Describe the moulting process of giant freshwater prawn. [L2; CLO1] 03
d) Mention the factors affecting the duration of moulting cycle of giant freshwater prawn. [L2; CLO1] 01
- Q.3 a) Mention the key development for identification of larval stages of *Macrobrachium rosenbergii*. [L1; CLO1] 05
b) Write down the taxonomic status and distribution of *Penaeus monodon*. [L1; CLO2] 03
c) How can you identify male and female *P. monodon* observing their external features? [L2; CLO2] 02
- Q.4 a) Briefly describe the internal reproductive organs of both male and female *P. monodon* with their suitable images. [L2; CLO2] 05
b) Describe the food habit of *P. monodon*. [L1; CLO2] 03
c) What are the major functions of hepatopancreas of shrimp? [L2; CLO2] 02

SECTION – B

[There are **FOUR** questions in this section. Answer any **THREE** questions.]

- Q.5 a) Narrate the identifying characters of lobster with suitable diagram. [L1; CLO5] 04
b) Differentiate between male and female reproductive organs of *Panulirus polyphagus*. [L2; CLO5] 03
c) List six lobster species, providing their scientific names and geographic distributions. [L1; CLO5] 03
- Q.6 a) How will you identify male and female mud crab? Explain with diagram. [L1; CLO6] 03
b) Narrate the food and feeding habit of mud crab. [L2; CLO6] 03
c) Narrate your ideas regarding the life cycle of mud crab. [L2; CLO6] 04
- Q.7 a) Enlist six commercially important oysters with their scientific name. [L1; CLO7] 03
b) Differentiate between oyster and mussel. [L3; CLO7] 03
c) Describe the feeding mechanism of mussel with appropriate diagram. [L2; CLO7] 04
- Q.8 a) Mention the food and feeding habit of abalone. [L1; CLO8] 03
b) Describe the life cycle of abalone with suitable diagram. [L1; CLO8] 04
c) Write down the shedding process of turtles. [L5; CLO9] 03



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Discipline: Fisheries and Marine
Resource Technology

Program: Bachelor of Science in
Fisheries

Year: 2nd

Term: I

Examination year: 2026

Session: 2024-25

Course Code: 0831 06 FMRT-2109

Course Title: Fundamentals of Aquaculture

Credit: 03

Time: 3 hours

Marks: 60

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*Use separate answer script for each section.

SECTION – A

[There are **FOUR** questions in this section. Answer any **THREE** questions.]

- Q.1 a) According to the FAO, what is meant by aquaculture? [L1; CLO1] 02
b) Discuss the present status and national production trends of capture fisheries and aquaculture in Bangladesh. [L2; CLO 1,5] 03
c) Explain the contribution of different universities offering fisheries education in promoting sustainable aquaculture in Bangladesh. [L2; CLO1] 03
d) What are the major constraints to aquaculture expansion in Bangladesh? [L1; CLO5] 02
- Q.2 a) Distinguish between polyculture and integrated multi-trophic aquaculture (IMTA). [L4; CLO2] 02
b) Compare extensive, semi-intensive, and intensive aquaculture systems in terms of management, stocking density, production and economic return. [L4; CLO2] 04
c) Discuss the principles of two promising climate-smart aquaculture technologies to be adopted in coastal Bangladesh highlighting their environmental and economic benefits. [L2; CLO2] 04
- Q.3 a) What is meant by organic aquaculture? State the principles of organic aquaculture. [L2; CLO2] 03
b) Explain the key ecological, biological and socio-economic factors that are taken into account when selecting an appropriate aquaculture site. [L2; CLO3] 04
c) Analyze the environmental considerations in selecting sites for cage and pen farming. [L4; CLO3] 03
- Q.4 a) Write down the major biological characteristics that should be considered when selecting aquaculture species. [L2; CLO4] 03
b) What is meant by exotic species? Provide your arguments for and against introduction of an exotic fish species. [L2; CLO4] 04
c) Provide a chart showing the composition of six carp fish species for stocking in a culture pond. [L3; CLO4,6] 03

SECTION – B

[There are **FOUR** questions in this section. Answer any **THREE** questions.]

- Q.5 a) Explain the importance of drying ponds during pond preparation prior to fish stocking. [L3; CLO7] 02
b) List the different types of lime used in aquaculture. Discuss which type of lime is most suitable for pond soil preparation and justify your choice. [L3; CLO7] 03
c) Compare biological and chemical methods to control weeds in terms of sustainability and environmental impact. [L3; CLO7] 02
d) Discuss the daily fluctuations of pH in pond ecosystems and the controlling methods for both acidic and alkaline conditions. [L5; CLO7] 03
- Q.6 a) What are probiotics, prebiotics and synbiotics? [L1; CLO8] 03
b) Point out the roles of synbiotics in sustainable aquaculture. [L2; CLO8] 02

- c) Why can repeated use of disinfectants create a 'cycle of damage' in aquaculture ponds? [L5; CLO7] 02
- d) A pond measures 300 feet in length, 100 feet in width, and has a depth of 2 meters. The fish farmer was advised to apply bleaching powder containing 65% chlorine at a rate of 1 ppm in the pond. However, when he visited the market, he found only a product containing 40% chlorine. What quantity of this 40% bleaching powder is needed to achieve the desired application rate of 1 ppm in the pond? [L6; CLO7] 03
- Q.7 a) Interpret the interrelationship among pH, dissolved oxygen, temperature, ammonia, and carbon dioxide in an aquaculture pond. [L2; CLO8] 03
- b) How do overfeeding and high stocking density affect water quality parameters in aquaculture ponds? [L4; CLO8] 02
- c) Explain the potential changes in pond water quality that may occur when fish exhibit reduced feeding and surface gasping after heavy rainfall. [L5; CLO8] 03
- d) Which chemical would you recommend to eliminate predatory fish without harming shrimp in an aquaculture pond, and why? [L4; CLO8] 02
- Q.8 a) List the factors that should be considered in determining the appropriate fish stocking density in a pond. [L4; CLO8] 02
- b) Identify the precautions to be considered when stocking fingerlings in a fish pond. [L3; CLO8] 02
- c) Write down the importance of regular fish sampling in aquaculture ponds. [L1; CLO8] 02
- d) Analyze the possible factors contributing to slow growth and poor feed conversion despite regular feeding, and suggest appropriate solutions to overcome these problems. [L4; CLO8] 04



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School: Life Science	Discipline: Fisheries and Marine Resource Technology	Program: Bachelor of Science in Fisheries
Year: 2 nd	Term: I	Examination Year: 2026
Course Code: 0831 06 FMRT 2111	Course Title: Fisheries Systematics and Evolution	Session: 2024-2025
Total Marks: 60	Time: 3.0 hrs	Credit: 2.0

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- Use separate answer script for each section.

SECTION-A

There are **FOUR** questions in this section. Answer any **THREE** questions.

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|-----|--|----|
| Q.1 | a) What do you understand by systematics and evolution? [L1, CLO1] | 02 |
| | b) State the principles of systematics and evolution. [L2, CLO1] | 03 |
| | c) Discuss the contributions of systematics to other branches of biology. [L5, CLO1] | 05 |
| Q.2 | a) Why is studying taxonomy important in fisheries biology? [L2, CLO2] | 02 |
| | b) State the major taxonomic groups of fish with suitable example. [L2, CLO2] | 03 |
| | c) Illustrate the taxonomic characters of a typical bony fish. [L2, CLO2] | 05 |
| Q.3 | a) Define the terms Taxon, Phenon and Category. [L1, CLO1] | 03 |
| | b) Describe different methods used in systematics for classification of fishes. [L5, CLO3] | 05 |
| | c) Why should morphometric measurements be expressed as ratios of standard length in fish taxonomy? [L2, CLO3] | 02 |
| Q.4 | a) State the concept of evolution. List out the theories of organic evolution. [L2, CLO4] | 02 |
| | b) Why is natural selection considered as the fundamental mechanism of evolution? Discuss. [L6, CLO4] | 04 |
| | c) Distinguish the key aspects of convergent evolution and divergent evolution. [L4, CLO4] | 04 |

SECTION-B

There are **FOUR** questions in this section. Answer any **THREE** questions.

- | | | |
|-----|---|----|
| Q.5 | a) What is the significance of studying crustacean morphology in taxonomic classification? [L2, CLO1,2,5] | 01 |
| | b) Describe the methods and techniques used for the morphological identification of <i>Macrobrachium rosenbergii</i> . [L2, CLO5] | 03 |
| | c) "Multivariate analysis is a reliable tool for the morphological identification of crustaceans"- Justify this statement. [L5, CLO5] | 03 |
| | d) What is a species? Explain why the species concept is considered problematic in systematic biology. [L1,5; CLO6] | 03 |
| Q.6 | a) How does the concept of evolutionary intermediacy pose challenges to the biological species concept? [L3, CLO6] | 02 |

	b)	Explain how anagenesis contributes significantly to the emergence of a new species. [L5, CLO6]	02
	c)	"Speciation involves the study of genetic changes and the evolution of reproductive isolation mechanisms."- Justify this statement. [L5, CLO6]	03
	d)	Critically evaluate the statement: "Species are interbreeding natural populations that are reproductively isolated from other such groups." [L5, CLO6]	03
Q.7	a)	Differentiate between sympatric and allopatric speciation. [L4, CLO6]	02
	b)	What is meant by phylogenetic systematics? [L1, CLO7]	02
	c)	Describe the role of phylogenetic trees in understanding evolutionary relationships among organisms. [L4, CLO7]	03
	d)	Discuss the comparative insights that can be obtained from a phylogenetic tree. [L6, CLO7]	03
Q.8	a)	"Phylogenetic trees provide most meaningful insights in biology to compare species or genes"- Justify this statement. [L5, CLO7]	03
	b)	Describe the basic features of zoological nomenclature. [L2, CLO8]	03
	c)	What is meant by a type species? [L1, CLO8]	01
	d)	Evaluate the significance of type species in systematic biology. [L5, CLO8]	03