Patuakhali Science and Technology University
Faculty of Fisheries

Outcome-based Curriculum

Part: A

1. Title of the Academic Program

Bachelor of Science in Fisheries (Honours)

Program Overview	
Degree	Bachelor of Science in Fisheries (Honours)
Abbreviated form of the Degree	B. Sc. Fisheries (Hons.)
Discipline/Program Offering Entity (POE)	Faculty of Fisheries
Faculty	Fisheries
Awarding Institution	Patuakhali Science and Technology University
Location	Patuakhali, Bangladesh
Bangladesh National Qualifications Framework (BNQF) Level	7
International Standard Classification of Education (ISCED) Code	0831
Mode of Study	Full Time
Language of Study	English
Applicable Session	2023-24 and onwards

2. Name of the University

Patuakhali Science and Technology University

3. Vision of the University

Patuakhali Science and Technology University aspires to be a home of excellence for producing competent professionals with improved knowledge and skills to meet national and global challenges

4. Mission of the University

The mission of Patuakhali Science and Technology University is to provide cutting-edge education, research, training and develop entrepreneurship at both undergraduate and postgraduate levels for creating skilled and enlightened personnel to serve the nation.

5. Name of the Program Offering Entity (Department/Faculty/Institute)

Faculty of Fisheries

6. Vision of the Program Offering Entity

To be a center of excellence in fisheries education, research and outreach services through technological innovation and sustainable development of aquatic resources.

7. Mission of the Program Offering Entity

M1. Produce competent fisheries graduates through advanced teaching-learning and research.

M2. Develop and adopt new technologies in various fisheries industries and livelihood programs in relation to national strategic plan.

M3. Address national and global issues of safe food and nutritional security through sustainable utilization of aquatic resources.

M4. Establish linkages with national and international institutions for enhancing human resource development and social services.

8. Objectives of the Program Offering Entity

- To enhance students' acquisition of the understanding of basic natural science concepts, which are applicable to fisheries
- Toproduce competent fisheries graduates with advanced theoretical knowledge and hands-on experience on various farming practices to boost up the aquaculture production
- To produce graduates with skills in research methodology needed to diagnose and approach aquaculture problems related to nutrition and disease
- To enable new genetically based strategies to tackle key challenges regarding sustainable production, exploitation, food security, welfare, and governance of fisheries sector
- To generate knowledge and research based skilled graduate with responsible fishing, safe and quality fish and fishery products to meet-up nutritional security and enhance export earnings.
- To provide education for the sustainable development and rational utilization of fishery resources
- To produce graduates with advanced knowledge on sustainable utilization of renewable marine resources
- To produce graduates with ICT-based knowledge compatible with fourth industrial revolution (4IR)

9. Name of the Degree

Bachelor of Science in Fisheries (Honours)

10. Description of the Program

Welcome to the Faculty of Fisheries at Patuakhali Science and Technology University (PSTU), Dumki, Patuakhali, Bangladesh. PSTU is one of leading university for the fisheries education which is, situated in the southwestern coastal region at Patuakhali district of Bangladesh. The journey of the faculty commenced with the vision to produce quality graduates equipped with up-to-date knowledge, skills, and research experiences, thus to overcome different challenges in numerous aspects of fisheries. The faculty offers

BSc in Fisheries (honors) degree, and eventually MS, and PhD degrees under each department. Considering the significance of different major fields of Aquaculture, Fisheries, Coastal, and Marine sector of the country,the faculty structurally consist of five departments– viz. Department of Aquaculture, Department of Fisheries Biology and Genetics, Department of Fisheries Management, Department of Fisheries Technology, and Department of Marine Fisheries and Oceanography. Major strengths of the faculty of fisheries are its energetic-skilledfaculty members, outcome-based curriculum, well-equipped classrooms and several research laboratories for undergraduate and post-graduate research, experimental fish farms, and easyaccess to coastal and marine resources of the Bay of Bengal. These opportunities enable fisheries students to explore their interests and enhance their professional skills and capabilities, particularly through technological interventions, study tours, and field-lab-based research work. The faculty is conducting numerous cutting-edge researches in collaboration with and funded by different national and international agencies. Moreover, the faculty encourages and facilitates students' co-curriculum activities. The graduates from this faculty have already gained recognition in achieving higher degree (MS and PhD) with prestigious foreign scholarship, and also entrepreneurship development and employee in the private-public sectors of Bangladesh. In the coming days, the faculty will lead to explore the marine sector of Bangladesh by establishing the 'Institute of Marine Fisheries Research' at Kuakata Patuakhali which is under ministerial process of the government. Finally, the PSTU faculty of fisheries is contributing to climate resilience fisheries production, sustainable utilization of inland, coastal and marine resources, socio-economic development, employment opportunities, nutritional security, food safety, and export earning of the country consequently achieving the blue economy, sustainable development goal, and smart Bangladesh.

11. Graduate Attributes (based on need assessment)

Fundamental Skill Domain

- Demonstrate knowledge and critical understanding of the well-established principles of fisheries field of studyapply knowledge and skills in addressing issues/solving problems with minimal supervision;
- Demonstrate professional knowledge and practical skills in both technical and management to lead a team in inexperienced environment.

Thinking Skill Domain

- Evaluate critically the appropriateness of different approaches to solving problems in the field of fisheries;
- Display advanced digital literacy which is adequate to perform complex tasks and bring about solutions; and
- Demonstrate the ability to incorporate entrepreneurial skills in planning daily activities;

Personal Skill Domain

- Demonstrate social, professional, environmental and ethical practice/ values;
- Exercise substantial degree of autonomy and significant responsibility in making judgments/ decisions
- Show-case global knowledge and competencies to fulfil employment, entrepreneurial and lifelong learning skills; and
- Contribute significantly to the society.

Social Skill Domain

- Communicate spontaneously and interact effectively and clearly, ideas, information, problems and solutions as a team to peers, experts and non-experts with language flexibility.

12. Program Educational Objectives (PEOs)

The graduates will

PEO1. Possess knowledge and skills in fisheries education and research for application under national and global realistic constraints

PEO2. Advance professional career through team work, ethical behavior, leadership and effective communication

PEO3. Able to analyze and solve problems in the fields of fisheries through innovation and ICT based contemporary knowledge

PEO4. Be life-long learners for successful entrepreneurship development and career advancement

PEO5. Equip with innovative and eco-friendly technology for the sectorial and community development

13. Program Learning Outcomes (PLOs)

After completion of the program graduates will be able to

PLOs	LO Domains*
PLO1: apply knowledge and skills to solve current and future challenges in the field of Fisheries.	FS
PLO2: conduct cutting-age research to better the local economy and global creation of knowledge.	TS
PLO 3: deliver hands-on experience on various farming practices to boost-up the production and development of safe & nutrient rich diversified aquatic	FS

food products.	
PLO4: generate sector-wise expertise for doing research with minimal supervision.	PS
PLO5: communicate in the local and global contexts with academic and professionals' expertise	SS
PLO6: create university-industry-farmers linkage for effective utilization of produced knowledge.	SS
PLO7: adopt of ICT-based knowledge to analyze problems and find out solutions.	TS
PLO8: ensure high ethical standards in social, professional, environmental and industrial levels.	PS
PLO9: demonstrate the ability to entrepreneurial and managerial skills.	TS
PLO10: Disseminate fisheries innovation through training, organizing seminar/workshop and publishing scientific articles.	SS

***Learning Outcome domains:** FS- Fundamental Skills; PS- Personal Skills; TS- Thinking Skills; SS- Social Skills

14. Mapping mission of the university/faculty with PEOs

Alignment/mapping of PEO with mission statement

PEO/Mission	M1	M2	M3	M4
PEO 1	H	L	M	
PEO 2		M	H	M
PEO 3	M	H	H	
PEO 4		L	M	L
PEO 5	L	H	L	H

H- High; M- Medium; L- Low

15. Mapping PLOs with the PEOs

PLO/PEO	PEO1	PEO2	PEO3	PEO4	PEO5
PLO1: apply knowledge and skills to solve current and future challenges in the field of Fisheries.	H	M	M		
PLO2: conduct cutting-age research to better the local economy and global creation of knowledge.	M		H		
PLO 3: deliver hands-on experience on various farming practices to boost-up the production and development of safe & nutrient rich diversified aquatic food products.	H	M	M	L	
PLO4: generate sector-wise expertise for doing research with minimal supervision.	M	M	M	H	
PLO5: communicate in the local and global	M	M			H

contexts with academic and professionals' expertise					
PLO6: create university-industry-farmers linkage for effective utilization of produced knowledge.	M	H		M	H
PLO7: adopt of ICT-based knowledge to analyze problems and find out solutions.	M	M	H		M
PLO8: ensure high ethical standards in social, professional, environmental and industrial levels.	M	H		M	L
PLO9: demonstrate the ability to entrepreneurial and managerial skills.	M	M	M	H	M
PLO10: Disseminate fisheries innovation through training, organizing seminar/workshop and publishing scientific articles.	M	M	M	L	H

*H- high; M- medium; L- low

16. Mapping courses with the PLOs

Course Code and Course Title	PLO 1	PLO2	PLO3	PLO4	PLO5	PLO 6	PLO7	PLO8	PLO9	PLO10
Level-1 Semester I										
AQC 111 Freshwater Aquaculture	√	√	√							
AQC 112 Freshwater Aquaculture			√	√		√				√
FBG 111 Fisheries Zoology	√	√	√		√				√	
FBG 112 Fisheries ZoologySessional	√	√	√						√	
FMN 111Aquatic Ecology	√		√		√	√			√	√
FMN112 Aquatic Ecology Sessional	√		√			√				√
FST 111 Fishing Technology	√	√	√	√	√	√	√	√	√	√
FST 112 Fishing Technology Sessional	√	√		√		√	√	√		√
MFO 111 Marine Biology	√	√	√		√				√	
MFO 112 Marine Biology Sessional	√	√	√						√	
LAN 111 Communicative English							√	√		
Level-1 Semester II										
AQC 121 Coastal Aquaculture and Mariculture	√	√	√							
AQC 122 Coastal Aquaculture and Mariculture Sessional	√		√	√						√
FBG 121 Ichthyology	√	√		√	√	√		√	√	√
FBG 122 Ichthyology Sessional	√	√	√	√	√				√	√
FMN121 Limnology	√		√		√	√			√	√
FMN122 Limnology Sessional	√		√			√			√	
MFO 121 Coastal and Marine Ecosystem	√	√	√		√				√	
CIT 127 Fundamental of Computer Science and IT	√		√	√	√	√	√			√
CIT 128 Fundamental of Computer Science and IT Sessional	√		√	√	√	√	√			√
BCM 121 Biochemistry	√	√	√	√	√	√		√		√
BCM 122Biochemistry Sessional	√	√	√	√		√	√	√		√

Course Code and Course Title	PLO 1	PLO2	PLO3	PLO4	PLO5	PLO 6	PLO7	PLO8	PLO9	PLO10
Level-2 Semester I										
AQC 211 Live Food Culture	√	√	√			√				
AQC 212 Live Food Culture sessional	√	√		√						
FBG211 Fish Biodiversity and Systematics	√		√	√	√	√	√			√
FBG212 Fish Biodiversity and Systematics sessional	√	√	√	√	√	√	√	√	√	√
FMN211 Water Quality Management	√		√			√			√	√
FMN212 Water Quality Management Sessional	√		√	√		√		√	√	√
FST 211 Fisheries Microbiology	√	√	√	√		√		√		√
FST 212 Fisheries Microbiology Sessional	√	√	√	√	√	√	√	√	√	√
MFO 211 Physical and Geological Oceanography	√	√	√		√			√	√	√
MFO 212 Physical and Geological Oceanography Sessional	√	√	√		√				√	
ECO 211 Introduction to Sociology	√	√	√		√	√	√	√	√	√
Level-2 Semester II										
AQC 221 Fish Parasitology	√	√	√							
AQC 222 Fish Parasitology Sessional	√	√	√			√				
FBG221 Fish Physiology	√	√		√	√	√	√	√		√
FBG222 Fish Physiology Sessional	√	√	√	√	√	√	√	√		√
FMN221 Inland Fisheries Management	√		√		√			√	√	√
FMN222 Inland Fisheries Management Sessional	√	√		√	√	√		√		
FST 221 Fish Food Properties, Losses and Wastes	√	√		√		√	√			
MFO 221 Biological and Chemical Oceanography	√	√	√		√				√	
MFO 222 Biological and Chemical Oceanography Sessional	√	√	√		√				√	
STT 221 Statistics										
STT 222 Statistics Sessional										

Course Code and Course Title	PLO 1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8	PLO9	PLO1 0
Level-3 Semester I										
AQC 311 Fish Pathology	√	√	√		√	√				
AQC 312 Fish Pathology Sessional			√	√	√	√				√
GED 311 Principles of Genetics	√	√	√	√	√				√	√
GED 312 Principles of Genetics Sessional	√	√	√	√					√	√
FMN 311 Hilsa Fisheries Management and Conservation	√	√	√	√	√			√	√	√
FST 311 Fish Processing Technology	√			√	√	√				√
FST 312 Fish Processing TechnologySessional	√	√		√	√	√				√
MFO 311 Blue Economy and Sustainable Development	√	√	√		√	√			√	
ECO 312 Fundamentals of Economics	√	√	√	√		√	√	√	√	
Level-3 Semester II										

AQC 321 Aquatic Animal Health Management	√	√	√		√	√				
AQC 322 Aquatic Animal Health Management Sessional	√		√		√	√				
GED 321 Farm Design and Construction	√		√		√		√			
GED 322 Farm Design and Construction Sessional	√		√	√	√		√			
FBG 321 Fisheries Biotechnology	√	√	√	√	√	√			√	
FMN321 Fish Population Dynamics	√	√		√	√				√	√
FMN322 Fish Population Dynamics Sessional	√			√			√			
FST 321 Fishery Products and By-products Technology	√	√		√					√	√
FST 322 Fishery Products and By-products Technology Sessional	√	√		√				√	√	
GED 323 Law of the Sea and Ocean Governance	√	√	√		√				√	

Course Code and Course Title	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8	PLO9	PLO10
Level-4 Semester I										
AQC 411Fish Nutrition	√	√	√							
AQC 412 Fish Nutrition sessional			√	√		√				√
FBG 411Genetics and Fish Breeding	√	√		√	√	√			√	√
FBG 412Genetics and Fish Breeding Sessional	√	√	√	√	√	√			√	√
GED 411 Research Methodology	√			√	√		√		√	√
GED 413Food Safety and Ethics	√	√		√	√	√				√
MFO 411 Coastal and Marine Pollution	√	√	√		√				√	
ARD 417 Extension Education for Fisheries	√		√		√				√	√
ARD 418 Extension Education for Fisheries Sessional		√	√	√	√	√		√	√	√
Level-4 Semester II										
AQC 421 Fish Feed Technology	√	√	√					√		
AQC 422 Fish Feed Technology sessional			√	√						√
AQC 423 Fish Pharmacology	√		√		√	√				
FBG 421 Broodstock and Hatchery Management	√	√	√	√	√	√	√	√		√
FBG 422 Broodstock and Hatchery Management sessional	√	√	√		√	√		√		√
GED 421 Climate Science and Sustainable Fisheries	√		√		√	√		√	√	√
FST 421 Quality Control of Fish and Fishery Products	√	√		√		√				√
FST 422 Quality Control of Fish and Fishery Products Sessional	√	√		√		√				√
GED 423 Marine GIS and Remote Sensing	√	√	√			√	√		√	

Part: B

17. Structure of the Curriculum

a) Duration of the Program	Year: 04	Semester: 08
b) Admission Requirements	The HSC or an equivalent degree will be required for entrance to this program for applicants. The proper authority periodically sets or modifies additional terms and conditions.	
c) Graduating Credits / Total Minimum Credit Requirement to Complete the Program	152	
d) Total Class Weeks in a Term*	14	
e) Minimum CGPA Requirements for Graduation	2.00	
f) Maximum Academic Years of Completion	7 Years	

g1) Area-wise Credit Distribution

Area	Course Type	Number of Courses	Credits	Total Credits
General Education (GED) Courses	Theory	14	35	40
	Practical	6	6	
Core/Compulsory Courses	Theory	33	81	109
	Practical	27	27	
Optional/Elective Courses	Theory			
	Practical			
Capstone course/Internship/ Thesis/Projects	Practical	1	3	3
Total				152

g2) Category of Courses

Area	Course Type	Course Title (number in the parenthesis indicates the credit value)	Credits
General Education (GED) Courses	Theory	1. Communicative English (2) 2. Fundamental of Computer Science and IT (1) 3. Biochemistry (3) 4. Introduction to Sociology (2) 5. Statistics (3) 6. Principles of Genetics (3) 7. Fundamental of Economics (3) 8. Farm Design and Construction (3) 9. Law of the Sea and Ocean Governance (2) 10. Research Methodology (2) 11. Food Safety and Ethics (2) 12. Extension Education for Fisheries (3) 13. Climate Change and Sustainable Fisheries (3) 14. Marine GIS and Remote Sensing (2)	34
	Practical	1. Fundamental of Computer Science and IT Sessional (1) 2. Extension Education for Fisheries Sessional (1) 3. Biochemistry Sessional (1) 4. Statistics Sessional (1) 5. Principles of Genetics Sessional (1) 6. Farm Design and Construction Sessional (1)	6
Core/ Compulsory Courses	Theory	1. AQC 111 Freshwater Aquaculture (3) 2. FBG 111 Fisheries Zoology (2) 3. FMN 111 Aquatic Ecology (2) 4. FST 111 Fishing Technology (2) 5. MFO 111 Marine Biology (2) 6. AQC 121 Coastal Aquaculture and Mariculture (3) 7. FBG 121 Ichthyology (3) 8. FMN 121 Limnology (3) 9. MFO 121 Coastal and Marine Ecosystem (2) 10. AQC 211 Live Food Culture (2) 11. FBG 211 Fish Biodiversity and Systematics (2) 12. FMN 211 Water Quality Management (2) 13. FST 211 Fisheries Microbiology (3) 14. MFO 211 Physical and Geological Oceanography (3) 15. AQC 221 Fish Parasitology (2) 16. FBG 221 Fish Physiology (2) 17. FMN 221 Inland Fisheries Management (3) 18. FST 221 Fish Food Properties, Losses and Wastes (2) 19. MFO 221 Biological and Chemical Oceanography (3) 20. AQC 311 Fish Pathology (2) 21. FMN 311 Hilsa Fisheries Conservation and Management (2) 22. FST 311 Fish Processing Technology (3) 23. MFO 311 Blue Economy and Sustainable Development (3)	82

		24. AQC 321 Aquatic Animal Health Management (2) 25. FBG 321 Fisheries Biotechnology (2) 26. FMN 321 Fish Population Dynamics (3) 27. FST 321 Fishery Products and By-Products Technology (2) 28. AQC 411 Fish Nutrition (3) 29. FBG 411 Genetics and Fish Breeding (3) 30. MFO 411 Coastal and Marine Pollution (2) 31. AQC 421 Fish Feed Technology (3) 32. AQC 423 Fish Pharmacology (2) 33. FBG 421 Broodstock and Hatchery Management (2) 34. FST 421 Quality Control of Fish and Fishery Products (2)	
	Practical	1. AQC 112 Freshwater Aquaculture Sessional (1) 2. FBG 112 Fisheries Zoology Sessional (1) 3. FMN 112 Aquatic Ecology Sessional (1) 4. FST 112 Fishing Technology Sessional (1) 5. MFO 112 Marine Biology Sessional (1) 6. AQC 122 Coastal Aquaculture and Mariculture Sessional (1) 7. FBG 122 Ichthyology Sessional (1) 8. FMN 122 Limnology Sessional (1) 9. AQC 212 Live Food Culture Sessional (1) 10. FBG 212 Fish Biodiversity and Systematics Sessional (1) 11. FMN 212 Water Quality Management Sessional (1) 12. FST 212 Fisheries Microbiology Sessional(1) 13. MFO 212 Physical and Geological Oceanography Sessional (1) 14. AQC 222 Fish Parasitology Sessional (1) 15. FBG 222 Fish Physiology Sessional (1) 16. FMN 222 Inland Fisheries Management Sessional (1) 17. MFO 222 Biological and Chemical Oceanography Sessional 18. AQC 312 Fish Pathology Sessional (1) 19. FST 312 Fish Processing Technology Sessional (1) 20. AQC 322 Aquatic Animal Health Management Sessional (1) 21. FMN 322 Fish Population Dynamics Sessional (1) 22. FST 322 Fishery Products and By-Products Technology Sessional (1) 23. AQC 412 Fish Nutrition sessional (1) 24. FBG 412 Genetics and Fish Breeding Sessional (1) 25. AQC 422 Fish Feed Technology sessional (1) 26. FBG 422 Broodstock and Hatchery Management Sessional (1) 27. FST 422 Quality Control of Fish and Fishery Products Sessional (1)	27
Optional/ Elective	Theory		
	Practical		
Capstone Courses	Practical	1. Thesis/Research	3
		2. Internship	

Total	152

18. Year/Level/Semester/Term wise distribution of courses

a. First Year/Level/Semester/Term courses

Semester-1	**Credit hour**
AQC 111 Freshwater Aquaculture	3
AQC 112 Freshwater Aquaculture Sessional	1
FBG 111 Fisheries Zoology	2
FBG 112 Fisheries Zoology Sessional	1
FMN 111 Aquatic Ecology	2
FMN 112 Aquatic Ecology Sessional	1
FST 111 Fishing Technology	2
FST 112 Fishing Technology Sessional	1
MFO 111 Marine Biology	2
MFO 112 Marine Biology Sessional	1
LAN 111 Communicative English	2
	18

Semester- II	**Credit hour**
AQC 121 Coastal Aquaculture and Mariculture	3
AQC 122 Coastal Aquaculture and Mariculture Sessional	1
FBG 121 Ichthyology	3
FBG 122 Ichthyology Sessional	1
FMN 121 Limnology	3
FMN 122 Limnology Sessional	1
MFO 121 Coastal and Marine Ecosystem	2
CIT 127 Fundamental of Computer Science and IT	1
CIT 128 Fundamental of Computer Science and IT Sessional	1
BCM 121 Biochemistry	3
BCM 122 Biochemistry Sessional	1
	20

b. Second Year/Level/Semester/Term courses

Semester-1	**Credit hour**
Compulsory	
AQC 211 Live Food Culture	2
AQC 212 Live Food Culture Sessional	1
FBG 211 Fish Biodiversity and Systematics	2
FBG 212 Fish Biodiversity and Systematics Sessional	1
FMN 211 Water Quality Management	2
FMN 212 Water Quality Management Sessional	1
FST 211 Fisheries Microbiology	3
FST 212 Fisheries Microbiology Sessional	1
MFO 211 Physical and Geological Oceanography	3
MFO 212 Physical and Geological Oceanography Sessional	1
ECO 211 Introduction to Sociology	2

Semester- II	**Credit hour**
Compulsory	
AQC 221 Fish Parasitology	2
AQC 222 Fish Parasitology Sessional	1
FBG 221 Fish Physiology	2
FBG 222 Fish Physiology Sessional	1
FMN 221 Inland Fisheries Management	3
FMN 222 Inland Fisheries Management Sessional	1
FST 221 Fish Food Properties, Losses and Wastes	2
MFO 221 Biological and Chemical Oceanography	3
MFO 222 Biological and Chemical Oceanography Sessional	1
STT 221 Statistics	3
STT 222 Statistics Sessional	1

	19

	20

c. Third Year/Level/Semester/Term Courses

Semester-1	**Credit hour**
Compulsory	
AQC 311 Fish Pathology	2
AQC 312 Fish Pathology Sessional	1
GED 311 Principles of Genetics	3
GED 312 Principles of Genetics Sessional	1
FMN 311 Hilsa Fisheries Conservation and Management	2
FST 311 Fish Processing Technology	3
FST 312 Fish Processing Technology Sessional	1
MFO 311 Blue Economy and Sustainable Development	3
ECO 312 Fundamentals of Economics	3
	19

Semester- II	**Credit hour**
Compulsory	
AQC 321 Aquatic Animal Health Management	2
AQC 322 Aquatic Animal Health Management Sessional	1
GED 321 Farm Design and Construction	3
GED 322 Farm Design and Construction Sessional	1
FBG 321 Fisheries Biotechnology	2
FMN 321 Fish Population Dynamics	3
FMN 322 Fish Population Dynamics Sessional	1
FST 321 Fishery Products and By-Products Technology	2
FST 322 Fishery Products and By-Products Technology Sessional	1
GED 323 Law of the Sea and Ocean Governance	2
	18

d. Fourth Year/Level/Semester/Term courses

Semester-1	**Credit hour**
Compulsory	
AQC 411 Fish Nutrition	3
AQC 412 Fish Nutrition sessional	1
FBG 411 Genetics and Fish Breeding	3
FBG 412 Genetics and Fish Breeding Sessional	1
GED 411 Research Methodology	2
GED 413 Food Safety and Ethics	2
MFO 411 Coastal and MarinePollution	2
ARD 417 Extension Education for Fisheries	3
ARD 418 Extension Education for Fisheries Sessional	1

Semester- II	**Credit hour**
Compulsory	
AQC 421 Fish Feed Technology	3
AQC 422 Fish Feed Technology sessional	1
AQC 423 Fish Pharmacology	2
FBG 421 Broodstock and Hatchery Management	2
FBG 422 Broodstock and Hatchery Management Sessional	1
GED 421 Climate Change and Sustainable Fisheries	3
FST 421 Quality Control of Fish and Fishery Products	2
FST 422 Quality Control of Fish and Fishery Products Sessional	1
GED 423 Marine GIS & Remote Sensing	2
FoF 421 Undergraduate Thesis	3

	18		**20**

e. **Undergraduate Thesis**

Rules of Undergraduate Thesis

1. At the tenure of Level-4, Semester-II, Students have to be pertinent with Undergrade Thesis weighting 3.0 credit to enhance research concentration. The Course Code of Undergrade Thesis is FOF 421
2. The Marks Undergrade Thesis will be carried as follows.

SL. No.	Evaluation	Marks
1.	Supervisor's Evaluation (Experiment conduct, Scientific Thinking, Writing etc).	30
2.	Undergrade Thesis Evaluation	40
3.	Undergrade Thesis Oral presentation	30
Total Marks		**100**

3. The Contents and Marks distribution of Undergrade Thesis will be according to following
format:

SL. No.	Undergrade Thesis Format	Marks
a.	Abstract	5
b.	Introduction	5
c.	Materials & Methods	6
d.	Results	6
e.	Discussion	8
f.	Conclusion	5
g.	Reference	5
Total Marks		**40**

4. The Marks Distribution of Oral Presentation will be carried as follows.

SL. No.	Area	Marks
	Welcome Address	2
	Speaking or Presentation Skill	5
	Information Delivery	5
	Summary/ Conclusion & Recommendation	5
	Slide Presentation	5
	Open discussion	8
Total Marks		**30**

Part C

19. Course Description

Course Code: 0831AQC 111	**Level 1**	**Semester-I**
Course Title: Freshwater Aquaculture		
Course Status: Core		
Credit: 3.0		
Prerequisite(s): None		
Rationale	This course is designed to provide the students with the knowledge of pond construction, pond preparation, Fish seed production, pond aquaculture, and GAqP's. It includes learning about the various aquaculture systems such as Biofloc, RAS, IPRS, IMTA, bottom clean raceway, cage& pen culture, Integrated Aquaculture.	

	By the end of the course, the students will be able to:		**Mapping with PLOs**
Course Learning Outcomes (CLOs)	CLO1	Illustrate site selection criteria and pond preparation strategies for freshwater aquaculture	PLO_1, PLO_2, PLO_3
	CLO2	Outline fish seed production methods and nursery management	PLO_1, PLO_2, PLO_3
	CLO3	Demonstrate culture systems of different commercial freshwater fish species	PLO_1, PLO_2, PLO_3
	CLO4	Design aquaculture systems- Biofloc, RAS, IPRS, IMTA, Bottom clean raceway, cage & pen culture, Integrated Aquaculture	PLO_1, PLO_2, PLO_3
	CLO5	Evaluate good aquaculture practices to ensure safe fish production	PLO_1, PLO_2, PLO_3

Course Contents		**CLOs**
1	Introduction: Definition & terminologies, aims and history of aquaculture, present status, scope, problems and prospects of aquaculture in Bangladesh.	CLO1 and CLO 5
2	Liming, Fertilization, and Aquatic weeds: Objectives of liming and fertilization, Types of lime and Fertilizer, Application of lime and fertilizers. Types of Aquatic weeds, alternative use, preparation of compost using aquatic weeds. Methods of controlling weeds and predators in Aquaculture.	CLO2 and CLO 5
3	Nursery management: Sources of natural fish seed, packing and transportation of fry and live fish, causes of fish mortality during transportation, pond nursery management	CLO2 and CLO 5
4	Culture of important freshwater species: Carps, freshwater prawn, climbing	CLO2

	perch, pangasius catfish, other catfishes, tilapia, snakeheads, and small indigenous species (SIS – pabda, gulsha, molaetc)	and CLO 5
5	Integrated Aquaculture &Organic aquaculture: Introduction, development status of organic aquaculture, organic production in aquaculture, multi-tropic aquaculture, aquaponics, current status and emerging international organic aquaculture standards, market outlook and consumer trends	CLO2 and CLO 5
6	Concept of good aquaculture practices: (GAqP's): GAqP's and food safety, setting up GAqP's-for farm input and production management.	CLO3 and CLO 5
7	Modern Aquaculture Technique: Cage and pen aquaculture, Biofloc, RAS, IPRS, IMTA, Bottom clean raceway.	CLO4 and CLO 5

Mapping CLOs with the Teaching-Learning and Assessment Strategy		
CLOs	**Teaching-Learning Strategy**	**Assessment Strategy**
CLO1	Lecture, presentation, Question-Answering	Quiz, Short and Narrative question.
CLO2	Lecture, Assignment, presentation, Question-Answering	Quiz, Assignment, Presentation,Short and Narrative question
CLO3	Lecture, Assignment, presentation, Question-Answering	Assignment, Presentation, Short and Narrative question
CLO4	Lecture, Assignment, presentation, Question-Answering	Assignment, Presentation, Short and Narrative question
CLO5	Lecture, Group discussion, Question-Answering	Short and Narrative question

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

	England.

Assessment Pattern

CIE- Continuous Internal Evaluation (40 Marks)					
Bloom's Category Marks (out of 40)	**Class test (10)**	**Assignment submission (05)**	**Presentation (05)**	**Quizzes (10)**	**Attendance (10)**
Remember				05	
Understand	2			05	
Apply	4	01			
Analyze	4				
Evaluate		02			10
Create		01	05		

SSE- Semester End Examination (60 Marks)	
Bloom's Category	**Tests**
Remember	5
Understand	10
Apply	15
Analyze	15
Evaluate	10
Create	5

Course Code: 0831 AQC 112	Level-1	Semester-I
Course Title: Freshwater Aquaculture Sessional		
Course Status: Core		
Credit: 1.0		
Prerequisite(s): None		
Rationale	The course will provide the students a hands-on experience on aquatic weeds, fish seeds, nursery pond management, use of anesthetics, fry transportation, fish hatchery and fish farm visit.	

	By the end of the course, the students will be able to:		**Mapping with PLOs**
Course Learning Outcomes (CLOs)	CLO1	Identify common aquatic weeds and algae.	PLO_3
	CLO2	Differentiate the seeds of commercially important fish and shrimp species.	PLO_3, PLO_4
	CLO3	Prepare a nursery and a stocking pond.	PLO_3, PLO_{10}
	CLO4	Explain the transportation system of fry, fingerlings and live fish, use of anesthetics.	PLO_3, PLO_{10}
	CLO5	Investigate the current scenario of aquaculture by visiting fish hatchery/fish farm.	PLO_6

Course Contents		**CLOs**
1	Identification of common aquatic weeds of aquaculture.	CLO1
2	Identification of important seeds of aquaculture fish and shrimp species.	CLO2
3	Preparation, fertilization and management of a nursery pond.	CLO3
4	Preparation, liming, fertilization and management of a culture pond.	CLO3
5	Transportation of fry, fingerlings and live fish.	CLO4
6	Case study: Visit to hatchery and fish farms and preparation of case study report.	CLO5

Mapping CLOs with the Teaching-Learning and Assessment Strategy		
CLOs	**Teaching-Learning Strategy**	**Assessment Strategy**
CLO1	Lecture, Demonstration, group discussion, Question-Answering	Quiz, Identification, Short and Narrative question,Practical Note book, Viva voce.
CLO2	Lecture, Demonstration, group discussion, Question-Answering	Quiz, Identification, Short and Narrative question. Practical Note book, Viva voce
CLO3	Lecture, Demonstration, group discussion, Question-Answering	Short and Narrative question, Practical Note book, Viva voce.
CLO4	Lecture, Demonstration, group discussion,	Short and Narrative question,

	Question-Answering	Practical Note book, Viva voce.
CLO5	Lecture, Field visit, group discussion, Question-Answering	Report writing,Short and Narrative question, Practical Note book, Viva voce.

Learning Materials	
Text Book	1. Huet, M. 1979. Textbook of Fish Culture: Breeding and Cultivation of Fish. Fishing News Books Ltd. Farnham, Surrey, England. 2. Pillay, T. V. R. 1993. Aquaculture: Principles and practices, Fishing News Books Black well Scientific Publications Ltd. Osney Weed Oxford OX2 OEL, U.K. 592 pp. 3. FAO (Food and Agricultural Organization) 1990. Farming Systems. Developments, Guidelines for the conduct of training course in farming systems development. FAO- United Nations. 4. Jhingran, V. G. 1977. Fish and Fisheries in India. Hindustan
Supplementary Readings	1. Jhingran, V. G. and R. S. V. Pullin 1985. A Hatchery Manual for Common, Chinese and Indian Major carps. Asian Development Bank, ICLARM, Manila, Philippines. 2. Karim, M. A. 1975. An Introduction of Fish Culture in Bangladesh, Ruby Press, Mymensingh, Bangladesh. 3. Kurian, C. V. and Sebastian, V. O. 1982. Prawns and Prawn Fisheries of India. Delhi, Hindustan Publishing Corporation (India) 186p. 2nd rev. ed. 4. Pillay, T. V. R. 1994. Aquaculture Development: Progress and Prospect. Fishing News Books Black well Scientific Publications Ltd. Oxford. 5. Pullin, R. S. V. and Lowe-McConnel, R. H. 1982. The Biology and Culture of Tilapias, ICLARM Conference Proceedings 7. 432 p. International Center for Living Aquatic Resource Management, Manila, Philippines. 6. Islam, M. A. 1985. MacherChashBabosthapana. Bangla Academy, Dhaka. 277 pp.

Assessment Pattern

CIE- Continuous Internal Evaluation (40 Marks)					
Bloom's Category Marks (out of 40)	**Class test (10)**	**Assignment (05)**	**Notebook/ Presentation (05)**	**Quizzes (10)**	**Attendance (10)**
Remember				05	
Understand	02			05	
Apply	04				
Analyze	04	01			
Evaluate		02			10
Create		02	05		

SEE- Semester End Examination (60 Marks)	
Bloom's Category	**Tests**
Remember	5
Understand	5
Apply	20
Analyze	10
Evaluate	10
Create	10

Course Code: 0831 FBG 111	**Year**: First	**Semester**: First
Course Title: Fisheries Zoology		
Course Status: Core		
Credit: 2.0		
Prerequisite(s): None		
Rationale	Students will understand the various kinds of invertebrates and vertebrates that are important in fisheries and aquaculture. Identification, internal and external morphology of economically and commercially important aquatic animals, as well as life history and adaptability information of selected aquatic animals will be covered in this course.	

	By the end of the course, the students will be able to:		**Mapping with PLOs**
Course Learning Outcomes (CLOs)	CLO1	Classify the key aquatic animal groups.	PLO_1, PLO_2 PLO_9
	CLO2	Explain the morphological features of aquatic animals	PLO_1, PLO_2 PLO_3
	CLO3	Depict the life history of selected aquatic animals	PLO_1, PLO_2
	CLO4	Illustrate the adaptive behavior of aquatic animals	PLO_1, PLO_2
	CLO5	Communicate scientific concepts in biology both verbally and in writing	PLO_5

Course Contents		CLOs
1	**Introduction:** General survey and classification of animals up to sub-class level with special emphasis on groups having fisheries importance and their economic significance.	CLO1 and CLO 5
2	**Functional morphology of aquatic invertebrates:** Functional morphology of the following aquatic invertebrates: Paramecium, Aurelia, Prawn, Mussels, Squid, and Starfish	CLO2 and CLO 5
3	**Life history:** Frogs, Crocodile, Turtle, Dolphin.	CLO2 and CLO 5
4	**Adaptation of aquatic animals:** Adaptation of animals to aquatic life with special reference to temperature, salinity, current, depth, light etc.	CLO4 and CLO 5

Mapping CLOs with the Teaching-Learning and Assessment Strategy

CLOs	Teaching-Learning Strategy	Assessment Strategy
CLO1	Lecturing, group discussion, presentation, assignment, Problem based learning, Question-Answering	Quiz, Assignment, One-minute paper, Short and Narrative question.
CLO2	Lecturing, Socratic method, presentation, Interactive learning, Question-Answering	Quiz, exit ticket, Short and Narrative question
CLO3	Lecturing, group discussion, Videotape, presentation, assignment, Question-Answering	Quiz, Assignment, Infographics, Short and Narrative question
CLO4	Lecturing, Fish bowl discussion, presentation, Question-Answering	Quiz, Assignment, observationShort and Narrative question
CLO5	Lecturing, group discussion, presentation, assignment, Question-Answering	Quiz, report, observation, Shortand Narrative question

Learning Materials	
Text Book	1. Jordan, E. L. and P. S. Verma, 2010. Invertebrate Zoology. S. Chand and Company. 2. Jordan, E. L. and P. S. Verma, 2008. Chordate Zoology. S. Chand and Company. 3. Miller, S. A. and J. P. Harley, 2009. Zoology. McGraw-Hill Professional, New York. 4. Barnes, R.D. 1978. Invertebrate Zoology. WB Saunders Co., Philadelphia, London.
Supplementary Readings	

Assessment Pattern

CIE- Continuous Internal Evaluation (40 Marks)					
Bloom's Category Marks (out of 40)	**Class test (10)**	**Assignment (05)**	**Notebook/ Presentation (05)**	**Quizzes (10)**	**Attendance (10)**
Remember				05	
Understand	02			05	
Apply	04				
Analyze	04	01			
Evaluate		02			10
Create		02	05		

SEE- Semester End Examination (60 Marks)	
Bloom's Category	**Tests**
Remember	5
Understand	5
Apply	20
Analyze	10
Evaluate	10
Create	10

Course Code: 0831 FBG 112	**Year:** First	**Semester:** First
Course Title: Fisheries Zoology Sessional		
Course Status: Core		
Credit: 1.0		
Prerequisite(s): None		
Rationale	Students will be familiar with many invertebrate and chordate groups that are significant to fisheries and aquaculture. Students will learn how to identify, characterize, and preserve animals. They will also understand the internal and external morphology of selected aquatic animals.	

	By the end of the course, the students will be able to:		**Mapping with PLOs**
Course Learning Outcomes (CLOs)	CLO1	Classify and identify different aquatic vertebrates and invertebrates.	PLO_1, PLO_2
	CLO2	Explain the external morphology of invertebrates and chordates.	PLO_1, PLO_2, PLO_3
	CLO3	Dissect and display different organs/system of selected aquatic animals.	$PLO_1, PLO_2, PLO_3, PLO_9$

Course Contents		**CLOs**
1	Collection and preservation of aquatic animals.	CLO1
2	Characterization and identification of the collected specimens.	CLO1
3	Study of external morphology of fresh and preserved specimens.	CLO2
4	Study of anatomy of different organs systems of representative invertebrates and chordates.	CLO3

Mapping CLOs with the Teaching-Learning and Assessment Strategy		
CLOs	**Teaching-Learning Strategy**	**Assessment Strategy**
CLO1	Lecturing, group discussion, demonstration, presentation, assignment, Question-Answering	Quiz, Field report, Short question
CLO2	Lecturing, demonstration, group discussion, presentation, assignment, Question-Answering	Short question and objective structured practical question (OSPE)
CLO3	Lecturing, demonstration, group discussion, presentation, assignment, Question-Answering	Quiz, Viva voce, Short question, Dissect and display

Learning Materials

Text Book	1. Barnes, R. D. 1978. Invertebrate Zoology. WB Saunders Co., Philadelphia, London. 2. Hickman Jr., C. P., S. L Keen, A. L. Larson and D. J. Eisenhour, 2007. Integrated Principles of Zoology (Fourteenth Edition).McGraw Hill Science. 3. King, M. 2007. Fisheries Biology.John Wiley and Sons. 4. Kotpal, R. L. 2009. Modern Text Book of Zoology Invertebrates.Print Asia. 5. Little, C. and J. Meyer, 2008. General Zoology Laboratory Guide.
Supplementary Readings	

Assessment Pattern

CIE- Continuous Internal Evaluation (40 Marks)					
Bloom's Category Marks (out of 40)	**Class test (10)**	**Assignment (05)**	**Notebook/ Presentation (05)**	**Quizzes (10)**	**Attendance (10)**
Remember				05	
Understand	02			05	
Apply	04				
Analyze	04	01			
Evaluate		02			10
Create		02	05		

SEE- Semester End Examination (60 Marks)	
Bloom's Category	**Tests**
Remember	5
Understand	5
Apply	20
Analyze	10
Evaluate	10
Create	10

Level-1, Semester-I		
Course Code: 0831FMN111	**Year:** First	**Semester:** First
Course Title: Aquatic Ecology		
Course Status: Core		

Credit: 2.0	
Prerequisite(s): None	
Rationale	In this course students will learn aquatic ecology through lectures and demonstrations and discussion. It briefly covers history and scope of ecology, population characteristics and their distribution pattern, community structure, process of ecological succession, laws of limiting factors, ecological classification of freshwater organisms, flood plain fisheries and its ethical management.

	By the end of the course, the students will be able to:		**Mapping with PLOs**
Course Learning Outcomes (CLOs)	CLO1	Define basic terminologies of ecology and ecosystem	PLO1
	CLO2	Explain a first insight in the structure and functioning of freshwater systems such as lakes, rivers and floodplain, and the biota inhabiting these systems	PLO1
	CLO3	Illustrate the structure and functions of different aquatic ecosystems	PLO1, PLO3
	CLO4	Ascertain limiting factors and laws of limiting factors	PLO1
	CLO5	Analyze population properties and their distribution pattern along with the interspecific relationship	PLO1, PLO6
	CLO6	Evaluate community structure and predict ecological succession	PLO1, PLO6
	CLO7	Communicate effectively individual and in groups works	PLO5, PLO9, PLO10

Course Contents		**CLOs**
1	**Introduction:** Concepts, history, scope and importance of ecology, concept of ecosystem, habitat, ecological niche, food chain, trophic structure and ecological pyramids, productivity of water, homeostasis and ecological balance.	CLO1
2	**Population Ecology:** Definition of population, population characteristics, concepts of interaction, types of interaction between two species.	CLO5
3	**Community Ecology:** Community concept, community classification, composition, structure, stratification and periodicity, ecological succession, concept of the climax, ecotone and edge effect.	CLO6
4	**Limiting Factors:** Types of limiting factors, Liebig's "Law of Minimum", Shelford's "Law of Tolerance", combined concept of limiting factors, ecological indicators.	CLO4

5	**Freshwater Ecosystem:** Types of freshwater ecosystems, ecological classification of freshwater organisms, general models of production, running water communities, sources of food, energy flow in streams.	CLO2, CLO3
6	**Flood plain Ecosystem:** Concept of flood plains, flood plain fisheries and its ethical management, modification of floodplain, recommendations for the development of floodplain ecosystem.	CLO2

Mapping CLOs with the Teaching-Learning and Assessment Strategy		
CLOs	**Teaching-Learning Strategy**	**Assessment Strategy**
CLO1	Lecturing, Question-Answering, group discussion, Assignment, Graphical presentation	Quiz, Assignment, Short and Narrative question, MCQ, Fill in the Gap
CLO2	Lecturing, Graphical presentation, Question-Answering, Assignment, Video clip	Quiz, Assignment, Short and Narrative question, MCQ, Fill in the Gap
CLO3	Lecturing, Group discussion, Assignment, Question-Answering, Graphical presentation	Quiz, Assignment, MCQ, Short and Narrative question, Fill in the Gap
CLO4	Lecturing, Group discussion, Question-Answering, Assignment, Graphical presentation	Quiz, Assignment, Short and Narrative question, MCQ, Fill in the Gap
CLO5	Lecturing, Graphical presentation, Group discussion, Question-Answering, Assignment	Quiz, Assignment, Short and Narrative question, MCQ, Fill in the Gap
CLO6	Lecturing, group discussion, assignment, Question-Answering	Quiz, Assignment, Short and Narrative question, MCQ, Fill in the Gap
CLO7	Assignment preparation and submission, and Student presentation	Class attendance, individual presentation

Learning Materials	
Text Book	1. Dobson, M. and C. Frid. 1998. Ecology of aquatic systems, Addison Wesley, Longman Limited, England. 336 pp. 2. Moss, B. 1998. Ecology of Freshwater. Blackwell Scientific Publications, Oxford.384 pp. 3. Odum, E. P. 1971. Fundamentals of Ecology. W.B. Saunders Company, London. 574 pp. 4. Odum, E. P. 1993. Ecology and our endangered life-support systems.2nd Edition. Sinauer Associates, Inc., Massachusetts, U.S.A. 301
Supplementary Readings	

Assessment Pattern

CIE- Continuous Internal Evaluation (40 Marks)					
Bloom's Category	**Class**	**Assignment**	**Presentation**	**Quizzes**	**Attendance**

Marks (out of 40)	test (10)	submission (05)	(05)	(10)	(10)
Remember				05	
Understand	02			05	
Apply	04				
Analyse	04	01			
Evaluate		02			10
Create		02	05		

SSE- Semester End Examination (60 Marks)	
Bloom's Category	**Tests**
Remember	5
Understand	10
Apply	15
Analyse	15
Evaluate	10
Create	5

Level-1, Semester-I		
Course Code: 0831FMN112	**Year:** First	**Semester:** First
Course Title: Aquatic Ecology Sessional		
Course Status: Core		
Credit: 1.0		
Prerequisite(s): None		
Rationale	In this course, students will learn aquatic ecology through lectures, demonstrations, and practical work. It covers the identification of aquatic organisms and plants along with their ecological classification for explaining the interactions within and between abiotic and biotic components of different aquatic ecosystems.	

Course Learning Outcomes (CLOs)	**By the end of the course, the students will be able to:**		**Mapping with PLOs**
	CLO1	Identify the equipment used in aquatic ecological field studies along with their operation and uses.	PLO1

	CLO2	Identify and describe the ecological classification of important freshwater fishes, mollusks and arthropods of Bangladesh.	PLO1, PLO3
	CLO3	Identify and classify different types of aquatic weeds of wetland habitat.	PLO1, PLO3
	CLO4	Analyze the structure and function of lentic and lotic habitats.	PLO6
	CLO5	Draw pictures of various aquatic organisms.	PLO10

Course Contents		CLOs
1	Acquaintance with the equipment used in ecological field study.	CLO1
2	Collection of freshwater mollusks and arthropods and their ecological classification.	CLO2
3	Collection of freshwater fishes and their ecological classification.	CLO3
4	Identification of some aquatic weeds and their types.	CLO4
5	Field visit to pond for analyzing lentic ecosystem.	CLO5
6	Field visit to river analyzing lotic ecosystem.	CLO2

Mapping CLOs with the Teaching-Learning and Assessment Strategy		
CLOs	**Teaching-Learning Strategy**	**Assessment Strategy**
CLO1	Lecture, Multi-media presentation, demonstration, Question-Answering, Short video presentation, Lab work	Quiz, Assignment, Short question, MCQ, Fill in the GapSpotting, Viva voce, Notebook
CLO2	Lecture, Multi-media Assignment and Group Discussion, Lab work and Graphical presentation	Quiz, Assignment, Short question, MCQ, Fill in the Gap Spotting, Viva voce, Notebook
CLO3	Lecture, Sample collection, Lecture, Assignment, Lab work and Demonstration	Quiz, Assignment, Short question, MCQ, Fill in the Gap Spotting, Viva voce, Notebook
CLO4	Lecture, Multi-media presentation and demonstration, Field visit	Quiz, Assignment, Short question, MCQ, Fill in the Gap Spotting, Viva voce, Notebook
CLO5	Lecture, Group Discussion, Report writing and presentation, Field visit	Quiz, Assignment, Short question, MCQ, Fill in the Gap Spotting, Viva voce, Notebook

Learning Materials	
Text Book	1. Seagrave, C. 1988. Aquatic weed control. Fishing News Books.154 pp. 2. Odum, E.P. 1971. Fundamentals of Ecology. W.B. Saunders Company, London, 574 pp.
Supplementary Readings	1. Dudley, W. D. 1992. Aquatic Insects. Wallingford: CAB International. 335 pp. 2. Gupta, O. P. 1992. Aquatic Weeds. Today and Tomorrow's Printers and Pub., New Delhi. 272 pp. 3. Rahman. A. K. A. 1989. Freshwater Fishes of Bangladesh. Zoological Society of Bangladesh.364 pp.

Assessment Pattern

CIE- Continuous Internal Evaluation (40 Marks)					
Bloom's Category Marks (out of 40)	**Class test (10)**	**Assignment (05)**	**Notebook/ Presentation (05)**	**Quizzes (10)**	**Attendance (10)**
Remember				05	
Understand	02			05	
Apply	04				
Analyse	04	01			
Evaluate		02			10
Create		02	05		

SEE- Semester End Examination (60 Marks)	
Bloom's Category	**Tests**
Remember	5
Understand	5
Apply	20
Analyse	10
Evaluate	10
Create	10

First Year First Semester		
Course Code: 0831 FST 111	**Year:** First	**Semester:** First
Course Title: Fishing Technology		
Course Status: Core		
Credit: 2.0		
Prerequisite(s): None		
Rationale	In this course, students will learn principles of fishing technologies through lectures and demonstrations and discussion. It also covers history and importance of traditional and modern fishing technologies, fishing craft, net making and mending, net preservation, commercial fishing, fishing ground and navigation in the sea.	

Course Learning Outcomes (CLOs)	**By the end of the course, the students will be able to:**		**Mapping with PLOs**
	CLO1	Define the knowledge of fishing techniques for the sustainable management in fisheries.	PLO1 & PLO2
	CLO2	Compare the various fishing gears and crafts	PLO1 & PLO2

		relating to international standardization fishing gear classification	
	CLO3	Evaluate different fishing gear materials for the management strategies in manufacturing industries.	PLO6 & PLO10
	CLO4	Distinguish between the various traditional fishing gears used in inland water bodies for the improvement of socio-economic status.	PLO4, PLO5 & PLO8
	CLO5	Deliver innovative fishing techniques knowledge in accordance with existing fishing gears used in the Bay of Bengal.	PLO2, PLO3, PLO4, PLO5 & PLO10
	CLO6	Explain knowledge on different international fishing conventions and treaties on small-scale and commercial fishing.	PLO2, PLO3, PLO4, PLO5, PLO9 & PLO10

Course Contents		CLOs
1	**Introduction:** Objectives, history of fishing. Principles of fishing, relationship between fishing and fisheries management.	CLO1
2	**Classification of fishing gears and crafts:** Different fishing gears and crafts in Bangladesh, FAO (1982) classification of fishing gear and crafts.	CLO2
3	**Fishing net and its raw materials:**Fishing gear raw materials and its preservation technology in fishing industries.	CLO3
4	**Fishing gears and methods in inland water bodies:** Fishing in inland closed and open waters bodies by traditional, non-conventional and modern fishing gears and methods, Fish Attraction Devices, Fish Aggregating Devices.	CLO4
5	**Fishing gears and methods in coastal, marine artisanal and commercial sector:** Trawling, gill netting, purse seining, long lining, trammel netting, fish trapping, light fishing, trolling, jigging, estuarine and marine set bag nets, traps, lift nets, cast nets, beach seine, set bag nets, bottom gillnet, drift gill net. Ghost fishing gears.	CLO 5
6	**Navigation in fishing:** Navigation equipment, fish location in the sea, factors concerned in locating fishing grounds, fishing grounds in the Bay of Bengal. Detection of fish; eco-sounder, Echo-ranger, SONAR (sound navigation and ranging).	CLO6
7	**International Fishing Conventions**: The Work in Fishing Convention 2007, (C.188)**;** The Cape Town Agreement, 2012; The Port State Measures Agreement;The International Convention on Standards of Training, Certification and Watch keeping for Fishing Vessel Personnel (STCW-F);Voluntary Guidelines for Securing Sustainable Small-Scale Fisheries, Occupational Safety	CLO6

Mapping CLOs with the Teaching-Learning and Assessment Strategy		
CLOs	**Teaching-Learning Strategy**	**Assessment Strategy**
CLO1	Lecture and presentation	Quizzes and short questions
CLO2	Lecture, presentation, question answering and discussion	Quizzes, short questions, poster submission and narrative questions
CLO3	Lecture, presentation, question answering and discussion	Quizzes, assignment, short questions and narrative questions
CLO4	Lecture, presentation, discussion and video clip	Short questions and narrative questions
CLO5	Lecture, presentation, questions answering and video clip	Short questions, assignment, poster submission and narrative questions
CLO6	Lecture, presentation, discussion, Simulation and case studies	Short questions and narrative questions

Learning Materials	
Text Book	1. Brandt, A. V. 1984. Fish catching methods of the world (3rd Edition). Fishing News (Books) Ltd. Surrey, England. 2. Kristijohnsson, H. 1975. (ed.). Modern fishing of the world. Fishing News (Books) Ltd. Surrey, England. 3. Sainsbury, J. C. 1975. Commercial fishing methods: an introduction to vessels and gears. Fishing News (Books) Ltd. Surrey, England. 4. Training Department, SEAFDEC. 1988. (ed.). Fishing technology outline. TD/TRB/45. October, 1988. Text Reference Book.
Supplementary Readings	1. Deep Sea Trawling and wing Trawling. 1956. (ed.). The Gourock Ropework Co. Ltd., Port Glasgow, Scotland. 2. FAO. 1980. (ed.). Echo Sounding and Sonar for Fishing. Fishing News Book Ltd., 1 Long Garden Walk, Farnham, Surrey, England. 3. Gerhard, K. 1973. Netting materials for fishing gear. FAO Fishing Manuals. Fishing News (Books) Ltd. Surrey, England. 4. Munprasit, A., Y. Theparoonrat, S. Sae-Ung, S. Soodhom, Y. Matsunaga, B. Chokesanguan and S. Siriraksophon. 1989. Fishing Gear and Methods in Southeast Asia: II. Malaysia. Training Departments, Southeast Asian Fisheries Development Centre (SEAFDEC), Thailand. 5. Nomura, M. 1978. Outline of fishing gear and method. Kanagawa International Fisheries Training Centre. Nagai, Yokoshika-ken, Japan.

Assessment Pattern

CIE- Continuous Internal Evaluation (40 Marks)					
Bloom's Category Marks (out of 40)	**Class test (10)**	**Assignment submission (05)**	**Presentation (05)**	**Quizzes (10)**	**Attendance (10)**
Remember				05	
Understand	2	01		05	
Apply	4	01			
Analyze	4	02			
Evaluate		01			10
Create			05		

SSE- Semester End Examination (60 Marks)	
Bloom's Category	**Tests**
Remember	5
Understand	10
Apply	15
Analyze	15
Evaluate	10
Create	5

First Year First Semester		
Course Code: 0831 FST 112	**Year:** First	**Semester:** First
Course Title: Fishing Technology Sessional		
Course Status: Core		
Credit: 1.0		
Prerequisite(s): None		
Rationale	In this course, students will learn principles of fishing methods through demonstrations and discussion. They also learn about fishing net making, mending and preservation techniques.	

	By the end of the course, the students will be able to:		**Mapping with PLOs**
Course Learning Outcomes (CLOs)	CLO1	Identify different types of gears, crafts and net materials used in fishing and outline their appropriate selection.	PLO1, PLO2, PLO4, PLO6 & PLO10
	CLO2	Demonstrate nets with appropriate mesh size and extend their shelf-life in order to ensure economically viable fishing.	PLO1, PLO2, PLO3, PLO6, PLO7 & PLO8
	CLO3	Evaluate traditional, artisanal and modern fishing methods practiced in the Bay of Bengal.	PLO1, PLO2, PLO4, PLO6 & PLO7

	Course Contents	**CLOs**
1	**Acquaintance with different types of traditional fishing gears in Bangladesh:** Wounding gears, fish traps and nets, their identification, description, operation and significance.	CLO1
2	**Acquaintance with different types of fishing crafts in Bangladesh:** Identification, carrying capacities, use and significance in fishing.	CLO1 CLO3
3	**Acquaintance with the modern fishing methods practiced in the Bay of Bengal:** Identification, description, operation and significance.	CLO3
4	Identification of different types of knots and demonstration of net	CLO2

	making/ mending and measurement of mesh size.	
5	Study on different techniques of net preservation.	CLO2
6	Field visit to different fishing locations (inland and marine) to gather experience on traditional and commercial fishing operations.	CLO1, CLO2 & CLO3

Mapping CLOs with the Teaching-Learning and Assessment Strategy		
CLOs	**Teaching-Learning Strategy**	**Assessment Strategy**
CLO1	Lecture, presentation, demonstration and discussion	Quizzes, spotting, practical note book (PNB), assignment, field visit and viva-voce
CLO2	Lecture, demonstration, question answering and discussion	Quizzes, spotting, practical note book (PNB), field visit and viva-voce
CLO3	Lecture, presentation, discussion and zoom class	Spotting, assignment, practical note book (PNB), field visit and viva-voce

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

Assessment Pattern

CIE- Continuous Internal Evaluation (40 Marks)					
Bloom's Category Marks (out of 40)	**Class test (10)**	**Assignment (05)**	**Notebook/ Presentation (05)**	**Quizzes (10)**	**Attendance (10)**
Remember				05	
Understand	02			05	
Apply	04	01			
Analyze	02	01			
Evaluate	02	02			10
Create		01	05		

SEE- Semester End Examination (60 Marks)	
Bloom's Category	**Tests**
Remember	5
Understand	5
Apply	15
Analyze	15
Evaluate	20
Create	

Course Code: 0831 MFO 111	**Level: 1**	**Semester: I**
Course Title: Marine Biology		
Department: Core		
Credit Hours: 2.0		
Prerequisite(s): None		
Rationale:	In this course students will learn the key features of different types of marineinvertebrates and vertebrates' organisms and importance of marine organisms, history of marine biology; fundamental concept of biology and adaptations for life in the oceans. Distribution of marine communities, environmental factors that affecting the distribution of marine organisms,bottom topography, their adaptation in the marine ecosystem and threats to them.	

	By the end of the course, the students will be able to:		**Mapping with PLOs**
Course Learning Outcomes (CLOs)	CLO 1	Identify the diversity of sea life, from the smallest plankton to the largest marine mammals.	PLO_1, PLO_2, PLO_9
	CLO 2	Learn about various phylum of marineinvertebrates, vertebrates' and shellfish animals.	PLO_1, PLO_2, PLO_3
	CLO 3	Develop knowledge on the diversity and classification of marine organisms.	PLO_1, PLO_2, PLO_3
	CLO 4	Discuss the biological processes such as: feeding, reproduction, behavior, migration etc.	PLO_1, PLO_2, PLO_3
	CLO 5	Explain a range of marine habitats, including sandy beaches, rocky shores, mudflats and estuaries, open ocean and the deep sea.	PLO_1, PLO_2, PLO_3, PLO_5
	CLO 6	Acquired knowledge on marine reptiles, seabirds and mammals.	PLO_1,PLO_2

	Course Contents	**CLOs**
1	**Introduction to marine biology**: Definition; objectives, importance of ocean and mariner organisms, history of marine biology; fundamental concept of biology and adaptations for life in the oceans	CLO1, CLO6
2	**Marine environment:** Ecology of the oceanic environment, zonation, distribution of marine communities, environmental factors that affecting the distribution of marine organisms, biosphere.	CLO1, CLO5, CLO6

3	**Marine Primary producer:** Classification of Marine plankton, multicellular algae and seaweeds in Bangladesh.	CLO1, CLO3
4	**Marine invertebrates and vertebrates:**Lower invertebrates, higher invertebrates; ecological role of marine invertebrates. Jawless fishes, cartilaginous fishes, lobefin and ray-finned fishes, bony fishes; biology of important marine fishes,	CLO1, CLO2,CLO3, CLO4
5	**Marine Shellfish:** Concept and importance of shellfish. Classification of marine mollusks and crustaceans, and their Biology.	CLO 2, CLO5
6	**Marine reptiles, seabirds and mammals**:Types, biology, adaptation, migration, threats. cetaceans - characteristics, types, behavior, adaptation, role of marine mammalian in the ecosystem.	CLO6,CLO7
7	**Intertidal communities:**Rocky shore – adaptation to life on rocky shore, rocky shore zonation, intertidal fishes, ecology of rocky shore. Sandy shore – role of wave and sediments, sandy shore zonation, ecology of sandy shore. Comparison of rocky and sandy shore. Threats to intertidal communities.	CLO5

Mapping CLOs with the Teaching-Learning and Assessment Strategy		
CLOs	**Teaching-Learning Strategy**	**Assessment Strategy**
CLO 1	Lecture using board/LCD projectors	Quiz, Assignment, Presentation, Short question
CLO 2	Group discussion, Workshop	Quiz, Class test (Short Q and MCQ)
CLO 3	Visual presentation, Case study/Tutorial	Individual presentation, Summative Assessment (SA)
CLO 4	Audio-visual teaching aids (film and documentaries, virtual classroom, etc.)	Short and Narrative question, Assignment, Presentation
CLO 5	Self-learning using reference books/research articles/case study/other online materials	MCQ, Fill in the Gap, Semester-end examination
CLO 6	Animated VDO clips, Question-Answer session Field demonstration	Class attendance, Essay type test, problem solving, Report

Learning Materials

Text Book	1. John F. Morrissey and James L. Sumich, 2018. Introduction to the Biology of Marine Life. Jones & Bartlett Publishers. 2. George Karleskint, Jr., Richard Turner, James W. Small, Jr., 2012. Introduction to Marine Biology. Cengage Learning, 2012. 3. Karleskint G., Turner R. and Small J.W. 2013. Introduction to Marine Biology. 4th edition. Thomson Brooks/Cole, Belmont CA. 4. Nybakken J.W. and Bertness M.D. 2004. Marine Biology an Ecological Approach, 6th edition. Pearson Benjamin Cummings, San Francisco CA.
Supplementary Readings	1. Imants G. Priede, Deep-Sea Fishes Biology, Diversity, Ecology and Fisheries. Cambridge University Press 2017. 2. 2. Miller, S. A. and J. P. Harley, 2009. Zoology. McGraw-Hill Professional, New York. 3. Jennings S., Kaiser M.J., Reynolds J.D. 2000. Marine Fisheries Ecology. Blackwell Science.

Assessment Pattern

CIE- Continuous Internal Evaluation (40 Marks)					
Bloom's Category Marks (out of 40)	**Class test (10)**	**Assignment submission (05)**	**Presentation (05)**	**Quizzes (10)**	**Attendance (10)**
Remember				05	
Understand	02			05	
Apply	04	01			
Analyze	04				
Evaluate		02			10
Create		01	05		

SSE- Semester End Examination (60 Marks)	
Bloom's Category	**Tests**
Remember	5
Understand	10
Apply	15
Analyse	15
Evaluate	10
Create	5

Course Code: 0831 MFO 112	**Year: 1**	**Semester:** I

Course Title: Marine Biology Sessional	
Department: Core	
Credit Hours: 1.0	
Prerequisite(s): None	
Rationale	In this course Students must be familiar with the many marine seaweed, invertebrate and vertebrate especiallymarine shellfish, fish, reptiles, seabirds and mammals that are significant to fisheries. Students will learn how to identify, characterize, preserve, key features of marine animals and their life pattern, behavior and reproduction in this subject.

	By the end of the course, the students will be able to:		**Mapping with PLOs**
Course Learning Outcomes (CLOs)	CLO 1	Collection, preservation and study of different marine species.	PLO_1, PLO_2
	CLO 2	Identify and understand the characteristics of species.	PLO_1, PLO_2
	CLO 3	Classify, key features of different marine animals.	PLO_1, PLO_2,PLO_3
	CLO 4	Explain the various marine fish, reptiles, seabirds, mammals and their reproduction, life cycle.	PLO_1, PLO_2, PLO_3, PLO_9
	CLO 5	Identify types of marine seaweed and their biology.	PLO_1, PLO_2

	Course Contents	**CLOs**
1	Collection and preservation of marine invertebrate, shellfish, fish, reptiles, seabirds and mammals.	CLO 1
2	Characterization and identification of the collected marine specimens.	CLO 2,
3	Study of marine invertebrates: Life cycle, morphology, reproduction	CLO 2,
4	Study of seaweed: Life cycle, morphology, reproduction	CLO 5
5	Study of marine finfish: Life cycle, morphology, reproduction.	CLO 3, CLO 4
6	Study of marine reptiles, seabirds and mammals.	CLO 4
7	Fieldtrip to Bay of Bengal and marine fish landing center: Collection, preservation, and study of marine invertebrates, marine vertebrates, marine algae,reptiles, seabirds, mammals, and intertidal communities.	CLO 1, CLO 2, CLO 3, CLO 4
8	Fieldtrip to coastal region for visit seaweed and shellfish culture.	CLO 5

Mapping CLOs with the Teaching-Learning and Assessment Strategy		
CLOs	**Teaching-Learning Strategy**	**Assessment Strategy**
CLO 1	Lecture, Multi-media presentation, demonstration, Question-Answering, Short video presentation, Lab work	Quiz, Assignment, Short question, MCQ, Fill in the Gap Spotting, Viva voce, Notebook
CLO 2	Lecture, Multi-media Assignment and Group Discussion, Lab work and Graphical presentation	Quiz, Assignment, Short question, MCQ, Fill in the Gap Spotting, Viva voce, Notebook
CLO 3	Lecture, Sample collection, Lecture, Assignment, Lab work and Demonstration	Quiz, Assignment, Short question, MCQ, Fill in the Gap Spotting, Viva voce, Notebook
CLO 4	Lecture, Multi-media presentation and demonstration, Field visit	Quiz, Assignment, Short question, MCQ, Fill in the Gap Spotting, Viva voce, Notebook
CLO 5	Lecture, Multi-media presentation, demonstration, Question-Answering, Short video presentation, Lab work	Quiz, Assignment, Short question, MCQ, Fill in the Gap Spotting, Viva voce, Notebook

Learning Materials	
Text Book	1. Marine Fishes of Bangladesh, BFRI and Institute of Marine Science of Chittagong University (CU). 2. George Karleskint, Jr., Richard Turner, James W. Small, Jr., 2012. Introduction to Marine Biology. Cengage Learning, 2012. 3. Practical invertebrate zoology, edited by R. P. Dales, John Wiley & Sons (1981). 4. A manual of practical zoology: Invertebrate, by P. S. Verma, S Chand (2010), ISBN:8121908299. 5. Vertebrate Life, by F. H. Pough, C. M. Janis, J. B. Heiser, Pearson (9thEdition, 2012).
Supplementary Readings	1. John F. Morrissey and James L. Sumich, 2018. Introduction to the Biology of Marine Life. Jones & Bartlett Publishers. 2. Imants G. Priede, Deep-Sea Fishes Biology, Diversity, Ecology and Fisheries. Cambridge University Press 2017. 3. Miller, S. A. and J. P. Harley, 2009. Zoology. McGraw-Hill Professional, New York. 4. Jennings S., Kaiser M.J., Reynolds J.D. 2000. Marine Fisheries Ecology. Blackwell Science.

Assessment Pattern

CIE- Continuous Internal Evaluation (40 Marks)

Bloom's Category Marks (out of 40)	Class test (10)	Assignment (05)	Notebook/ Presentation (05)	Quizzes (10)	Attendance (10)
Remember				05	
Understand	02			05	
Apply	04				
Analyze	04	01			
Evaluate		02			10
Create		02	05		

SSE- Semester End Examination (60 Marks)	
Bloom's Category	**Tests**
Remember	5
Understand	5
Apply	20
Analyze	10
Evaluate	10
Create	10

Course Code: 0831AQC 121	Level-1	Semester-II
Course Title: Coastal Aquaculture and Mariculture		
Course Status: Core		
Credit: 3.0		
Prerequisite(s): None		
Rationale	The course will provide the students with the knowledge of fry and PL production of shrimp, prawn, crab and sea bass, culture techniques of different commercial brackish and marine fish and shellfish species. It includes learning about the seaweed farming, mangrove ecosystem and its impact on aquaculture	

Course Learning Outcomes (CLOs)	**By the end of the course, the students will be able to:**		**Mapping with PLOs**
	CLO1	Justify the importance of coastal and marine resources for aquaculture and identify suitable sites for coastal and marine aquaculture.	PLO_1, PLO_2, PLO_3
	CLO2	Characterize culture techniques of different commercial brackish and marine fish and	PLO_1, PLO_2, PLO_3

		shellfish species.	
	CLO3	Produce fry and PL of shrimp, prawn, and crab.	PLO_1, PLO_2, PLO_3
	CLO4	Examine mangrove ecosystem with its impact on aquaculture and environmental Management for Aquaculture.	PLO_1, PLO_2, PLO_3

Course Contents		CLOs
1	Introduction: Definition, history and present status, global and national importance of coastal aquaculture and mariculture, and site selection	CLO1
2	Culture techniques of coastal and marine fishes: Larval rearing and culture techniques of seabass (*Latescalcarifer*), milkfish, mullets, seabream, tuna and salmon	CLO2
3	Culture of shellfishes: Culture techniques of crabs, shrimp and prawn, oysters, mussels, lobsters.	CLO2
4	Larvae rearing technique: Giant freshwater prawn, marine tiger shrimp and mud crab.	CLO3
5	Environmental management for aquaculture: Introduction, environmental policy, aquaculture wastes, waste minimization	CLO4

Mapping CLOs with the Teaching-Learning and Assessment Strategy		
CLOs	**Teaching-Learning Strategy**	**Assessment Strategy**
CLO1	Lecture, Assignment, Presentation, Question-Answering	Quiz,Assignment, Presentation,Short and Narrative question.
CLO2	Lecture, Assignment, presentation, Question-Answering	Quiz, Assignment, Presentation,Short and Narrative question
CLO3	Lecture, Assignment, presentation, Question-Answering	Assignment, Presentation, Short and Narrative question
CLO4	Lecture, Assignment, presentation, Question-Answering	Assignment, Presentation, Short and Narrative question

Learning Materials

Text Book	1. Bardach, J. E. J. H. Ryther, and Mclarney, W. O. 1972. Aquaculture. John willey&Sone. Inc. New York. 2. Imai, T. 1977. Aquaculture in shallow seas: Progress in shallow sea culture. Oxford. IBH Publishing Co. New Delhi, Bombay, Calcutta. 615 pp. 3. Anonymous. 1985. Shrimp culture in the semisaline zone of the Delta. Final Report, Technical Report No. 13, Vol. 1. Aruhem. The Hague 60 pp. 4. Islam, A. 1988. SamudraUpakulaMatsyaChash. Bangla Academy, Dhaka. 115 pp. 5. Kurian C. V. and V. O. Sehastian 1978. Prawn and Prawn Fisheries of India, Hindustan Publishing Corporation, Delhi.
Supplementary Readings	1. FAO. 2001. Planning and Management for Sustainable Coastal Aquaculture Development. FAO Publ. 2. Kurian C. V. and V. O. Sehastian 1978. Prawn and Prawn Fisheries of India, Hindustan Publishing Corporation, Delhi. 3. Lee, D. O. C. and J. F. Wichins, 1991. Crustacean Farming. Oxford, Fishing News Books/Blackwell Scient. Publ. Ltd. 4. McVey, J. 1991. (Ed): CRC Hand book of Mariculture, Vol.2, Finfish Aquaculture, CRC Press, Boca Raton. 5. McVey, J. 1991. CRC Hand book of Mariculture. Vol. II. Finfish Aquaculture.

Assessment Pattern

CIE- Continuous Internal Evaluation (40 Marks)					
Bloom's Category Marks (out of 40)	**Class test (10)**	**Assignment submission (05)**	**Presentation (05)**	**Quizzes (10)**	**Attendance (10)**
Remember				05	
Understand	2			05	
Apply	4	01			
Analyze	4				
Evaluate		02			10
Create		01	05		

SSE- Semester End Examination (60 Marks)	
Bloom's Category	**Tests**
Remember	5
Understand	10
Apply	15
Analyze	15

Evaluate	10
Create	5

Course Code: 0831 AQC 122	Level-1	Semester-II
Course Title: Coastal Aquaculture and Mariculture Sessional		
Course Status: Core		
Credit: 1.0		
Prerequisite(s): None		
Rationale	The course will provide the students a hands-on experience on coastal shrimp and fish farm and hatchery design. Collection, transportation and nursing of larvae and PL, decapsulation and hatching procedures of Artemia, prawn hatchery and shrimp farm visit.	

	By the end of the course, the students will be able to:		**Mapping with PLOs**
Course Learning Outcomes (CLOs)	CLO1	Design of a coastal shrimp and fish farm.	PLO_1
	CLO2	Implement the collection, transportation and nursing of larvae and PL.	PLO_3
	CLO3	Demonstrate the culture techniques for shrimp, oysters, mussels and clams.	PLO_3, PLO_4

	CLO4	Demonstrate thedecapsulation and hatching procedures of Artemia in laboratory condition.	PLO_3, PLO_4
	CLO5	Investigate the current scenario of coastal aquaculture by visiting prawn hatchery and shrimp farm.	PLO_3, PLO_4, PLO_{10}

Course Contents		CLOs
1	Designing of a coastal shrimp and fish farm.	CLO1
2	Collection and transportation and nursing of larvae and PL of shrimp	CLO2
3	Demonstration of culture techniques for shrimp, oysters, mussels and clams.	CLO3
4	Decapsulation and hatching of Artemia in laboratory condition.	CLO4
5	Case study: Visit to prawn hatchery and shrimp farms and preparation of case study report.	CLO4
6	Case study: Visit to hatchery and fish farms and preparation of case study report.	CLO5

Mapping CLOs with the Teaching-Learning and Assessment Strategy		
CLOs	**Teaching-Learning Strategy**	**Assessment Strategy**
CLO1	Lecture, Demonstration, group discussion, Question-Answering	Quiz, Short and Narrative question, Practical Note book, Viva voce.
CLO2	Lecture, Demonstration, Question-Answering	Quiz, Short and Narrative question, Practical Note book, Viva voce.
CLO3	Lecture, Demonstration, group discussion, Question-Answering	Short and Narrative question, Practical Note book, Viva voce.
CLO4	Lecture, Demonstration, group discussion, Question-Answering	Short and Narrative question, Practical Note book, Viva voce.
CLO5	Lecture, Field visit, Question-Answering	Report writing, Short and Narrative question, Practical Note book, Viva voce.

Learning Materials	
Text Book	1. Bardach, J. E., J. H. Ryther, and W.O. Mclarney 1972. Aquaculture. John Willey & Son. Inc. New York. 2. Imai, T. 1977. Aquaculture in shallow seas: Progress in shallow sea culture. Oxford. IBH Publishing Co. New Delhi, Bombay, Calcutta. 615 pp. 3. Iverson. E. S. 1968. Farming at the Edge of the Sea, Fishing News Books) Ltd. London. 301 pp. 4. McVey, J. 1991. (Ed): CRC Hand book of Mariculture, Vol.2, Finfish Aquaculture. CRC Press. Boca Raton
Supplementary	1. Kurian C. V. and V. O. Sehastian 1978. Prawn and Prawn Fisheries of

Readings	India, Hindustan Publishing Corporation, Delhi. 2. Landau, M. 1991. Introduction to Aquaculture John Wiley & Sons, Inc. 3. Lee, D. O. C. and J. F. Wichins, 1991. Crustacean Farming. Oxford, Fishing News Books/Blackwell Scient. Publ. Ltd. 4. Mcvey, J. and J. Moore. 1983. CRC Hand book of Mariculture. Vol. I: Crustacean Aquaculture. 5. Pillay, T. V. R. 1973. Coastal Aquaculture in the Indo-pacific region Fishing News (Books) Ltd. London. 497 pp. 6. Shigeno, K. 1978. Problems in prawn culture Amerind Publishing Co. PVJ. Ltd. New Delhi.

Assessment Pattern

CIE- Continuous Internal Evaluation (40 Marks)					
Bloom's Category Marks (out of 40)	**Class test (10)**	**Assignment (05)**	**Notebook/ Presentation (05)**	**Quizzes (10)**	**Attendance (10)**
Remember				05	
Understand	02			05	
Apply	04				
Analyze	04	01			
Evaluate		02			10
Create		02	05		

SSE- Semester End Examination (60 Marks)	
Bloom's Category	**Tests**
Remember	5
Understand	5
Apply	20
Analyze	10
Evaluate	10
Create	10

Course Code	0831FBG 121	**Year:** First	**Semester:** Second
Course Title	Ichthyology		

Course Status	Core
Credit	3.0
Prerequisite(s)	None
Rationale	Students will acquire knowledge necessary for classification and identification of major groups of fish based on their anatomical features. Moreover, students will also learn the external morphology, anatomy and functions of various organs, and integration systems (nervous system, endocrine system, receptors) of different fish groups.

	By the end of the course, the students will be able to:		**Mapping with PLOs**
Course Learning Outcomes (CLOs)	CLO1	Classify different groups of freshwater and marine fishes.	PLO1, PLO2, PLO5, PLO6, PLO9
	CLO2	Explain different external morphological features and the principle of fish coloration.	PLO1, PLO2, PLO4, PLO5, PLO9
	CLO3	Illustrate different skeletal and musculature features with their respective types and importance.	PLO1, PLO4, PLO5, PLO9, PLO10
	CLO4	Illustrate anatomy of different fish organs.	PLO1, PLO4, PLO5
	CLO5	Describe the mechanism, function and role of swim bladder in buoyancy.	PLO1, PLO2, PLO4, PLO5, PLO9
	CLO6	Explain different integration systems (nervous system, endocrine system, receptors) in fish with their corresponding types and functions.	PLO1, PLO4, PLO5, PLO8
	CLO7	Know the adaptive radiation of fishes in various environments in the world.	PLO1, PLO4, PLO5, PLO8

Course Contents		**CLOs**
1	Introduction: Definition of fish, important facts and figures about fishes, classification of major groups of fishes.	CLO1
2	External morphology: Body forms, shapes and sizes, body coverings, skins, scales, skeleton, fins and openings, derivatives of skin, coloration in fishes and its significance.	CLO2

3	Muscles and locomotion: Types and their roles in locomotion and movements of different body parts.	CLO3
4	Anatomy of different organs: Respiratory system- structure of gills, accessory air-breathing organs, digestive system - food and feeding habits, feeding adaptations, comparative study of the alimentary canal in different groups of fishes, structure of excretory, circulatory, electric and bioluminescence organs.	CLO4
5	Swim bladder: Origin and role in buoyancy, functions and mechanism of filling and emptying of gases.	CLO5
6	Integration systems in fishes: Nervous systems - brain and cranial nerves, spinal cord and nerves, receptors- types and functions, endocrine systems- types of endocrine glands, their location, secretion and function.	CLO6
7	Adaptive radiation in fish.	CLO7

Mapping CLOs with the Teaching-Learning and Assessment Strategy		
CLOs	**Teaching-Learning Strategy**	**Assessment Strategy**
CLO1	Lecture and multi-media presentation, asking questions and answers	Multiple choice questions, quiz/short answer and essay
CLO2	Lecture, multi-media presentation, assignment and group discussion	Multiple choice questions, short answer, essay and presentation
CLO3	Lecture, report writing and multi-media presentation	Short answer and essay
CLO4	Lecture, multi-media presentation, assignment and group discussion	Short answer, essay and presentation
CLO5	Lecture, multi-media presentation and group discussion	Short answer, essay and presentation
CLO6	Lecture, multi-media presentation, assignment and group discussion	Short answer, essay and presentation
CLO7	Lecture and multi-media presentation	Short answer and essay

Learning Materials

Text Books	1. Lagler, K. F., J. E. Bardach, R. R. Miller and D. R. M. Passino. 1977. Ichthyology. 2nd Edition. John Willey and Sons, Inc., New York. 528 pp. 2. Jhingran, V. G. 1988. Fish and Fisheries of India, Hindustan Publishing Corporation (India), Delhi. 3. Journal of Applied Ichthyology. http//onlinelibrary.wiley.com/ journal/10-

	1111/ (ISSN)1439-0429. 4. Moyle, P. B. and J. J. Cech. 2003. Fishes: An Introduction to Ichthyology. 5th Edition, Benjamin Cumin. 744 pp. 5. Bond, C. E. 1996. Biology of Fishes. 2nd Edition. Sunders College Publishing. 750 pp. 6. Khanna, S. S. and H. R. Singh. 2003. A Text Book of Fish Biology and Fisheries. 524 pp.
Supplementary Readings	

Assessment Pattern

CIE- Continuous Internal Evaluation (40 Marks)					
Bloom's Category Marks (out of 40)	**Class test (10)**	**Assignment (05)**	**Notebook/ Presentation (05)**	**Quizzes (10)**	**Attendance (10)**
Remember				05	
Understand	02			05	
Apply	04	01			
Analyze	02	01			
Evaluate	02	02			10
Create		01	05		

SEE- Semester End Examination (60 Marks)	
Bloom's Category	**Tests**
Remember	5
Understand	5
Apply	15
Analyze	15
Evaluate	20
Create	

Course Code	0831FBG 122	**Year:** First	**Semester:** Second
Course Title	Ichthyology Sessional		
Course Status	Core		
Credit	1.0		
Prerequisite(s)	None		

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

	By the end of the course, the students will be able to:		**Mapping with PLOs**
Course Learning Outcomes (CLOs)	CLO1	Identify important marine and freshwater fishes and different fish scales.	PLO1, PLO2, PLO3
	CLO2	Explain different external morphological features with internal anatomy of fishes.	PLO1, PLO2, PLO4, PLO5, PLO9
	CLO3	Dissect and display digestive, and circulatory blood vessels of fishes.	PLO1, PLO2, PLO3, PLO4, PLO10
	CLO4	Identify important bones of fish.	PLO1, PLO4, PLO9, PLO10
	CLO5	Prepare bone album of fish.	PLO1, PLO4, PLO9
	CLO6	Dissect the Weberian osicles of Cypriniformes fishes, occulomotor muscles, and central nervous system.	PLO1, PLO2, PLO3, PLO4, PLO9

Course Contents		**CLOs**
1	Identification of important marine and freshwater fishes.	CLO1
2	Microscopic study of the structures of fish scales.	CLO2
3	Study of external morphology and internal anatomy of fishes.	CLO2
4	Comparative study of digestive systems of fishes with different food and feeding habits.	CLO3
5	Study of major circulatory blood vessels.	CLO3
6	Identification of important bones of fish and preparation of bone album.	CLO4 &CLO5
7	Dissection of the fish brain and pituitary gland, weberianosicles of cypriniformes fishes, occulomotor muscles, central nervous system.	CLO6

Mapping CLOs with the Teaching-Learning and Assessment Strategy		
CLOs	**Teaching-Learning Strategy**	**Assessment Strategy**
CLO1	Lecture, and multi-media presentation,	Quiz, Viva voce, Short question

	demonstration, asking questions and answers	and objective structured practical question (OSPE)
CLO2	Lecture, microscopic observation and group discussion	Microscopic observation, short answer and essay
CLO3	Lecture, multi-media presentation, demonstration, group studies and discussion	Short answer, essay and presentation
CLO4	Lecture, multi-media presentation, demonstration, group studies and discussion	Prepare bone album and presentation, oral test & short answer
CLO5	Lecture, multi-media presentation, group studies and discussion	Prepare bone album and presentation, oral test & short answer
CLO6	Lecture, dissecting specimens, group studies and discussion	Dissect and display of specimens, oral test , and presentation

Learning Materials

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

Assessment Pattern

CIE- Continuous Internal Evaluation (40 Marks)					
Bloom's Category Marks (out of 40)	**Class test (10)**	**Assignment (05)**	**Notebook/ Presentation (05)**	**Quizzes (10)**	**Attendance (10)**

Remember				05	
Understand	02			05	
Apply	04	01			
Analyze	02	01			
Evaluate	02	02			10
Create		01	05		

SEE- Semester End Examination (60 Marks)	
Bloom's Category	**Tests**
Remember	5
Understand	5
Apply	15
Analyze	15
Evaluate	20
Create	

Level-1, Semester-II		
Course Code: 0831FMN121	**Year: First**	**Semester: Second**
Course Title: Limnology		
Course Status: Core		
Credit: 3.0		
Prerequisite(s): None		
Rationale	This course is specially designed primarily for fisheries students to teach them the salient features of the inland water bodies, their origin, and the different physical, chemical, and biological parameters of water that govern the biological productivity of these water bodies.	

	By the end of the course, the students will be able to:		**Mapping with PLOs**
Course Learning Outcomes (CLOs)	CLO1	Outline the different types of inland water bodies and characterize their origin.	PLO1
	CLO2	Compare the river's and lake's origins, histories, and ecosystems;	PLO1, PLO3
	CLO3	Investigate the most essential water quality parameter in inland waterbodies and recognize their importance on aquatic ecosystems.	PLO1, PLO3
	CLO4	Explain the water cycle, distribution of water and physical and chemical properties of water.	PLO1, PLO3
	CLO5	Illustrate the biogeochemical cycle, primary production and productivity.	PLO1, PLO3
	CLO6	Adopt the necessary steps to remediate the inland habitat's water quality parameters.	PLO3, PLO6
	CLO7	Communicate and work effectively in groups in developing presentations	PLO5, PLO9, PLO10

Course Contents		**CLOs**
1	**Introduction:** Concepts, causal factors, history, types of inland waters, ponds and reservoirs, estuaries, swamps and marshes.	CLO1
2	**Water:** Water distribution, water cycle, physico -chemical characteristics of water and their limnological significance.	CLO4
3	**Rivers:** Definition, significance, types, origin, sources of water, roles of rivers on human civilization, rivers of Bangladesh and the world.	CLO2
4	**Lakes:** Classification of lakes, thermal stratification, origin of lakes, lakes of Bangladesh and the world, heat budget of lake.	CLO3
5	**Physical parameters of inland waters:** Light, temperature, transparency, water movement, water depth and turbidity	CLO3, CLO6
6	**Chemical parameters of inland waters:** concept of chemical parameter, various types of dissolved gases and solids, macro- and micro nutrients, total alkalinity and total hardness, pH and its effects on aquatic organisms.	CLO3, CLO6
7	**Biogeochemical cycles:** Definition, biogeochemical cycles of nitrogen, phosphorus, calcium, carbon, silicon, sulfur, iron etc. in	CLO5

	freshwater.	
8	**Primary production:** Definition, determination of primary production, factors affecting primary production.	CLO5, CLO7

Mapping CLOs with the Teaching-Learning and Assessment Strategy		
CLOs	**Teaching-Learning Strategy**	**Assessment Strategy**
CLO1	Lecturing, Question-Answering, group discussion, Assignment, Graphical presentation	Quiz, Assignment, Short and Narrative question, MCQ, Fill in the Gap
CLO2	Lecturing, Question-Answering, group discussion, Assignment, Graphical presentation	Quiz, Assignment, Short and Narrative question, MCQ, Fill in the Gap
CLO3	Lecturing, Question-Answering, group discussion, Assignment, Graphical presentation	Quiz, Assignment, Short and Narrative question, MCQ, Fill in the Gap
CLO4	Lecturing, Question-Answering, group discussion, Assignment, Graphical presentation	Quiz, Assignment, Short and Narrative question, MCQ, Fill in the Gap
CLO5	Lecturing, Question-Answering, group discussion, Assignment, Graphical presentation	Quiz, Assignment, Short and Narrative question, MCQ, Fill in the Gap
CLO6	Lecturing, Question-Answering, group discussion, Assignment, Graphical presentation	Quiz, Assignment, Short and Narrative question, MCQ, Fill in the Gap
CLO7	Assignment preparation and submission, and Student presentation	Class attendance, individual presentation

Learning Materials	
Text Book	3. Rahman, M.S. 1992. Water quality management in aquaculture. BRAC Prokashana. Dhaka-1212. 4. Reid G. K. and Wood. 1976. Ecology of Inland waters and Estuaries. Reinhold Publishing Co., New York. 8 5. Welch, P. S. 1952. Limnology. McGraw-Hill Book Co. New York.
Supplementary Readings	4. Jorgensen, S. E. 1980. Lake Management. Pergamon Press Ltd., Oxford. 5. Kalff, J. 2002. Limnology-Inland Water Ecosystem. Prentice- Hall, Upper Saddle River, New, Jersey 07458 6. Lecren, E. D. and R. H. Low-McConnel. 1980. The Functioning of Freshwater Ecosystems. IBP 22. Cambridge University Press. Cambridge, London.

Assessment Pattern

CIE- Continuous Internal Evaluation (40 Marks)					
Bloom's Category Marks (out of 40)	**Class test (10)**	**Assignment submission (05)**	**Presentation (05)**	**Quizzes (10)**	**Attendance (10)**

Remember				05	
Understand	02			05	
Apply	04				
Analyse	04	01			
Evaluate		02			10
Create		02	05		

SEE- Semester End Examination (60 Marks)	
Bloom's Category	**Tests**
Remember	5
Understand	10
Apply	15
Analyse	15
Evaluate	10
Create	5

Level-1, Semester-II		
Course Code: 0831FMN122	**Year: First**	**Semester: Second**
Course Title: Limnology Sessional		
Course Status: Core		
Credit: 3.0		
Prerequisite(s): None		
Rationale	In this course students will learn the lentic and lotic water bodies, should identify the major inland waterbodies and the physical, chemical parameters of water that can affect the biological production of inland waters.	

	By the end of the course, the students will be able to:		**Mapping with PLOs**
Course Learning Outcomes (CLOs)	CLO1	Enlist, draw and label the major inland water bodies in Bangladesh and the world with their description	PLO1
	CLO2	Demonstrate the determination of physical and chemical parameters of inland waters	PLO3, PLO6
	CLO3	Analyze the optimum physico-chemical parameters of different waterbodies for maximum fisheries production	PLO3, PLO6
	CLO4	Measure the physical characteristics of water bodies	PLO1, PLO6
	CLO5	Calculate the area, water volume of any pond.	PLO3, PLO9

Course Contents		CLOs
1	Study of the rivers in Bangladesh: Map of Bangladesh, drawing and labeling with brief descriptions of important rivers of Bangladesh.	CLO1
2	Study of the rivers in world: Drawing and labeling with brief descriptions of important rivers of the world.	CLO1
3	Study of the lakes of Bangladesh and in the world.	CLO1
4	Determination of area, depth and water volume of experimental pond.	CLO5
5	Determination of physical factors: temperature, transparency, and turbidity.	CLO3
6	Determination of chemical factors in freshwater.	CLO3, CLO4

Mapping CLOs with the Teaching-Learning and Assessment Strategy		
CLOs	**Teaching-Learning Strategy**	**Assessment Strategy**
CLO1	Lecture, Multi-media presentation, demonstration, Question-Answering, Short video presentation, Lab work	Quiz, Assignment, Short question, MCQ, Fill in the Gap, Viva voce, Notebook
CLO2	Lecture, Multi-media presentation, demonstration, Question-Answering, Short video presentation, Lab work	Quiz, Assignment, Short question, MCQ, Fill in the Gap, Viva voce, Notebook
CLO3	Lecture, Multi-media presentation, demonstration, Question-Answering, Short video presentation, Field visit	Quiz, Assignment, Short question, MCQ, Fill in the Gap, Viva voce, Notebook
CLO4	Lecture, Multi-media presentation, demonstration, Question-Answering, Short video presentation, Field visit	Quiz, Assignment, Short question, MCQ, Fill in the Gap, Viva voce, Notebook
CLO5	Lecture, Group Discussion, Report writing and presentation, Field visit	Quiz, Assignment, Short question, MCQ, Fill in the Gap, Viva voce, Notebook

Learning Materials	
Text Book	6. Wetzel, G. W. and G. E. Likens. 1991. Limnological Analyses. 2nd Edition. Springr-Verlag, New York, Berlin, Heilberg, London, Paris, Tokyo, Hong Kong, Barcelona. 391 pp.
Supplementary Readings	7. APHA. 1980. Standard methods for the examination of water and wastewater. 15th Edition. Washington, D.C. American Public Health Association. 1134 pp. 8. Boyd, C. E. and C. S. Tucker. 1992. Water Quality and Pond Soil Analyses for Aquaculture. Agricultural Experiment Station, Auburn University, Alabama, USA. 183 pp.

Assessment Pattern

CIE- Continuous Internal Evaluation (40 Marks)

Bloom's Category Marks (out of 40)	Class test (10)	Assignment submission (05)	Notebook/ Presentation (05)	Quizzes (10)	Attendance (10)
Remember				05	
Understand	02			05	
Apply	04				
Analyse	04	01			
Evaluate		02			10
Create		02	05		

SEE- Semester End Examination (60 Marks)	
Bloom's Category	**Tests**
Remember	05
Understand	05
Apply	20
Analyse	10
Evaluate	10
Create	10

Course Code: 0831 MFO 121	**Level-1**	**Semester-II**
Course Title: Coastal and Marine Ecology		
Department: Core		
Credit Hours: 2.0		
Prerequisite(s): None		
Rationale	This course is designed to disseminate ecological knowledge of marine environmental prospect. The coastal and marine environment has particular ecological characteristics that vary throughout the world. So, it is having high demand to study ecology in context of marine science as well as Bangladesh. Through this course student will able to learn about various coastal and marine ecosystems.	

Course Learning Outcomes (CLOs)	**By the end of the course, the students will be able to:**		**Mapping with PLOs**
	CLO 1	Explain the interaction between the biotic and abiotic components of the ecosystem.	PLO_1, PLO_2, PLO_9
	CLO 2	Explore the environmental variables, affect the biological communities and ecological interactions.	PLO_1, PLO_2, PLO_3

	CLO 3	Identify different ecological parameters.	PLO_1, PLO_2, PLO_3
	CLO 4	Learn various coastal and marine ecosystems at global, regional and local level.	PLO_1, PLO_2, PLO_3
	CLO 5	Acquire a basic knowledge of interaction within various ecosystem components.	PLO_1, PLO_2, PLO_3, PLO_5
	CLO 6	Evaluate the ecological adaptation of various species to a particular ecosystem.	PLO_1,PLO_2

Course Contents		CLOs
1	**Introduction:** History and scope of coastal and marine ecology, sub-division of coastal and marine ecology, population and community of the coastal and marine environment, major ecological divisions ofmarine habitat.	CLO 1, , CLO 2,CLO 3
2	**Coastal ecosystem:** Concept of coastal zone and types, biodiversity of coastal ecosystem; ecological classification of coastal organisms, inter-tidal niche. Human modification of coastal ecosystem	CLO 1, CLO 2, CLO 3, CLO 4
3	**Estuarine ecosystem:** Definitions; types and limiting factors; life in estuaries; different estuarine organisms; natural productivity and food production potential of estuary; estuarine food waveand its major estuaries of world and Bangladesh.	CLO 1, CLO 2, CLO 3, CLO 4, CLO 5, CLO 6
4	**Mangrove ecosystem**: Definitions, types, importance and formation of mangrove environment; biodiversity in the mangrove environment; adaptations to environmental changes in mangrove flora and marine fauna; area and role of mangrove forests in Bangladesh.	CLO 1, CLO 2, CLO 3, CLO 4, CLO 5, CLO 6
5	**Coral reef ecosystem:** Definitions, types, and formation of coral reefs; distribution and environmental factors that influences corals; growth and geomorphology of reefs; zonation pattern on reef; fauna and flora of coral reef; human impact on coral reef ecosystem; threats and its conservation; St. martin's coral island and its biodiversity.	CLO 1, CLO 2, CLO 3, CLO 4, CLO 5, CLO 6
6	**Marine ecosystem**: Concept, types, ecological features and functions of marine ecosystem; controlling factors of marine ecosystem; major ecological divisions of marine habit, marine biota and their distribution, inter relationships between marine fishes withotherabioticandbioticfactors; adaptative strategies of marine organisms to different environment, ecology of the Bay of Bengal	CLO 2, CLO 3, CLO 4, CLO 5, CLO 6, CLO 7

Mapping CLOs with the Teaching-Learning and Assessment Strategy		
CLOs	**Teaching-Learning Strategy**	**Assessment Strategy**
CLO 1	Lecture using board/LCD projectors	Assignment, Presentation, Mid Term Examination
CLO 2	Lecture using board/LCD projectors, Group discussion, Workshop	Quiz, Class test (Short Q and MCQ)

CLO 3	Lecture using board/LCD projectors, Visual presentation, Case study/ Tutorial	Summative Assessment (SA), Attendance
CLO 4	Audio-visual teaching aids (film and documentaries, virtual classroom, etc.)	Short and Narrative question
CLO 5	Self-learning using reference books/research articles/case study/other online materials	Semester-end examination
CLO 6	Animated VDO clips, Question-Answer session	Essay type test, problem solving

Mapping CLOs with the Teaching-Learning and Assessment Strategy		
CLOs	**Teaching-Learning Strategy**	**Assessment Strategy**
CLO 1	Lecture using board/LCD projectors	Assignment, Presentation, Mid Term Examination
CLO 2	Lecture using board/LCD projectors, Group discussion, Workshop	Quiz, Class test (Short Q and MCQ)
CLO 3	Lecture using board/LCD projectors, Visual presentation, Case study/ Tutorial	Summative Assessment (SA), Attendance
CLO 4	Audio-visual teaching aids (film and documentaries, virtual classroom, etc.)	Short and Narrative question
CLO 5	Self-learning using reference books/research articles/case study/other online materials	Semester-end examination
CLO 6	Animated VDO clips, Question-Answer session	Essay type test, problem solving

Learning Materials	
Text Book	1. Fundamental of Ecology, by E. Odum, W. B. Gray, Cengage Learning (2004). 2. Tait.R.V.1972.ElementsofMarineEcology. Butterworths,London 3. Elements of Marine Ecology, by R. V. Tait, F. A. Dipper, Butterworth-Heinemann (4th edition, 1998). 4. An Introduction to Marine Science, by P. S. Meadows and J. I. Campbell, Springer.
Supplementary Readings	1. Odum, E.P.,1971.FundamentalsofEcology, W.BSaundersCompany, USA. 2. The Oceans: Their Physics, Chemistry, and General Biology, by H. U. Sverdrup, M. W. Johnson, R. H. Fleming, Prentice Hall (1942). 3. Chapman,J.I.andReiss,M.J.,1995.Ecology,Principles&application,CambridgeUniversityPress,Cambridge.

Assessment Pattern

CIE- Continuous Internal Evaluation (40 Marks)					
Bloom's Category Marks (out of 40)	**Class test (10)**	**Assignment (05)**	**Notebook/ Presentation (05)**	**Quizzes (10)**	**Attendance (10)**

Remember				05	
Understand	01			05	
Apply	02	01			
Analyze	03	02			
Evaluate	03	02			10
Create	01		05		

SSE- Semester End Examination (60 Marks)	
Bloom's Category	**Tests**
Remember	5
Understand	5
Apply	10
Analyze	10
Evaluate	20
Create	10

Level-1, Semester-II		
Course Code: BCM 121	**Year:** First	**Semester:** Second
Course Title: Biochemistry		
Course Status: Core		
Credit: 3.0		
Prerequisite(s): None		
Rationale	A graduate of fisheries may choose to be expert in Biochemistry. Therefore, at first he or she should have a sound knowledge and deep understanding of biomolecules and different metabolic pathway of biomolecules. This course follows up on the Biochemistry and Food Analysis subjects being introduced to the student during the second semester and comprises theoretical knowledge to build in concept of biomolecules and their metabolic process. This course covers definition, classification, function, sources, recommended dietary allowance(RDA), structure, stereochemistry and reaction of different biomolecules such as carbohydrates, protein, lipid, enzyme, nucleic acid and catabolic nature of carbohydrates, protein, lipid etc.	

Course Learning Outcomes	**By the end of the course, the students will be able to:**		**Mapping with PLOs**
	CLO1	Understand the basic concepts of	PLO1

(CLOs)		biomolecules	
	CLO2	Diagnosis inherit diseases related to metabolism.	PLO1
	CLO3	Evaluate metabolic function of macronutrients	PLO1, PLO3
	CLO4	To study the chemistry, reactions, sources and RDA of biomolecules.	PLO1
	CLO5	Explain the major catabolic and anabolic pathways in metabolism of carbohydrates, lipids, amino acids and nucleotides	PLO1, PLO6

Course Contents		**CLOs**
1	An Introduction to Biochemistry: History, Definition and Classification of Biochemistry and Biomolecules, Subject related to Biochemistry. Carbohydrate: Definition, classification, stereochemistry related to carbohydrates, Disaccharides and polysaccharide- definition and classification, occurrence, properties and structure, function, requirements of carbohydrate.	CLO1,CLO4
2	Dietary fiber: Definition, components, classification, properties, function and their fates in the body.	CLO4
3	Lipids: Definition, classification, nomenclature, sources, structure and classification of Saturated, monounsaturated, and polyunsaturated fatty acids; structure, classification and functions of phospholipid, sphingolipid.	CLO3, CLO4
4	Proteins: Amino acids, peptides and proteins, structure of standard and non-standard amino acids, non protein amino acid, peptide bond, Naming, structure and stereochemistry of protein.	CLO3 ,CLO 4
5	Enzyme: Definition, properties and classification, co-enzymes and co-factors; effect of substrate, temperature and pH on enzyme activity; Michaelis- Menten equation for enzyme kinetics.	CLO4
6	Nucleic acid: Definition and types of nucleic acid, Double helical structure of DNA,	CLO4

Topic7	Metabolism: Glycolysis:The glycolytic pathway,preparatory and pay off phase of glycolysis, net ATP count of glycolysis, aerobic and anaerobic fates of pyruvate, The Tricarbooxilicacid(TCA) cycle: An over view of TCA cycle ,amphibolic nature of TCA cycle, anaplerotic reactions of the TCA cycle. Glycogenolysis, Pentose phosphate pathway and its significance, Gluconeogenesi Glyoxylate cycle: An over view and importance of glyoxylate cycle. Relationship between glyoxylate cycle and TCA cycle, Protein metabolism(Deamination, transamination Decarboxylation, urea cycle) and Fat metabolism(Activation of fatty acid,entrance of Fatty acyl Co-A into mitochondrial matrix,beta oxidation, even and odd chain fatty acid metabolism, formation of ketonebodies)	CLO2 ,CLO 5

Mapping CLOs with the Teaching-Learning and Assessment Strategy		
CLOs	**Teaching-Learning Strategy**	**Assessment Strategy**
CLO1	Lecturing, Question-Answering, group discussion, Assignment,	Quiz, Assignment, Short and Narrative question, MCQ, Fill in the Gap
CLO2	Lecturing, Graphical presentation, Question-Answering, Assignment, Video clip	Quiz, Assignment, Short and Narrative question, MCQ, Fill in the Gap
CLO3	Lecturing, Group discussion, Assignment, Question-Answering,	Quiz, Assignment, MCQ, Short and Narrative question, Fill in the Gap
CLO4	Lecturing, Group discussion, Question-Answering, Assignment,	Quiz, Assignment, Short and Narrative question, MCQ, Fill in the Gap
CLO5	Lecturing, Graphical presentation, Group discussion, Question-Answering, Assignment	Quiz, Assignment, Short and Narrative question, MCQ, Fill in the gap

Learning Materials

Text Book	**1.** 1 Human Nutrition and Dietetics : Garrow **2.** Advanced Nutrition and Human Metabolism : Sareen S. Gropper **3.** Lehninger- Principle of Biochemistry : Nelson & M Cox **4.** Fundamentals of Biochemistry : J.LJain
Supplementary Readings	1. Biochemistry : Satyanarayan

Assessment Pattern

CIE- Continuous Internal Evaluation (40 Marks)					
Bloom's Category Marks (out of 40)	**Class test (10)**	**Assignment submission (05)**	**Presentation (05)**	**Quizzes (10)**	**Attendance (10)**
Remember				05	
Understand	02			05	
Apply	04				
Analyse	04	01			
Evaluate		02			10
Create		02	05		

SSE- Semester End Examination (60 Marks)	
Bloom's Category	**Tests**
Remember	5
Understand	10
Apply	15
Analyse	15
Evaluate	10
Create	5

Level-1, Semester-II		
Course Code: BCM 122	**Year:** First	**Semester:** Second
Course Title: Biochemistry Sessional		
Course Status: Core		
Credit: 1.0		
Prerequisite(s): None		
Rationale	In this course students will learn with the preliminary practical knowledge of chemical analysis. Students will know about some important definitions and mathematical problems of biochemistry, basic concepts of colour test (Molisch, Iodine, Benedict, Barfoed's, Sellivanoff's, Bial's, Mucic acid, Inversion, Millon's, Xanthoproteic, Ninhydrin, Bi-uret, Lead acetated test) of carbohydrates and proteins. Vitamin-C, glucose and protein estimation methods are also be discussed in this course.	

	By the end of the course, the students will be able to:		**Mapping with PLOs**
Course Learning Outcomes (CLOs)	CLO1	Understand basic methods for different carbohydrates and protein identification	PLO1
	CLO2	Work effectively as a team worker in the laboratory	PLO1
	CLO3	Use different methods to estimate protein and total nitrogen	PLO1, PLO3
	CLO4	Transmit acquired knowledge to the stakeholder	PLO1
	CLO5	Perform titrimetric method for Vitamin-C and glucose estimation	PLO1, PLO6

	Course Contents	**CLOs**
1	a. Some important definition for Biochemistry practical b. Some mathematical problem related to Biochemistry practical c. Principles of color tests of protein	CLO1
2	Basic concepts of color test of carbohydrates	CLO1,CLO 2
3	Identification of unknown carbohydrates	CLO1,CLO 2
4	Estimation of vitamin-C by redox titration method.	CLO5,CL O4

5	Estimation of glucose by Fehling's method	CLO5,CLO4
6	Estimation of total nitrogen by Kjeldhal method	CLO3

Mapping CLOs with the Teaching-Learning and Assessment Strategy		
CLOs	**Teaching-Learning Strategy**	**Assessment Strategy**
CLO1	Lecturing, Question-Answering, group discussion, Assignment,	Quiz, Assignment, Short and Narrative question, MCQ, Fill in the Gap
CLO2	Lecturing, Graphical presentation, Question-Answering, Assignment, Video clip	Quiz, Assignment, Short and Narrative question, MCQ, Fill in the Gap
CLO3	Lecturing, Group discussion, Assignment, Question-Answering,	Quiz, Assignment, MCQ, Short and Narrative question, Fill in the Gap
CLO4	Lecturing, Group discussion, Question-Answering, Assignment,	Quiz, Assignment, Short and Narrative question, MCQ, Fill in the Gap
CLO5	Lecturing, Graphical presentation, Group discussion, Question-Answering, Assignment	Quiz, Assignment, Short and Narrative question, MCQ, Fill in the gap

Learning Materials	
Text Book	1.Lab Techniques booklet (Fundamental Biochemistry) 2.Laboratory Techniques in Chemistry and Biochemistry :Diamond and derman 3.Instrumental Methods of Chemical Analysis :E. Hill 4. A Biologist guide to principles and techniques of practical Biochemistry:Willard et. al
Supplementary Readings	Manual of Biochemistry practical

Assessment Pattern

CIE- Continuous Internal Evaluation (40 Marks)					
Bloom's Category Marks (out of 40)	**Class test (10)**	**Assignment (05)**	**Notebook/ Presentation (05)**	**Quizzes (10)**	**Attendance (10)**

Remember				05	
Understand	02			05	
Apply	04				
Analyse	04	01			
Evaluate		02			10
Create		02	05		

SSE- Semester End Examination (60 Marks)	
Bloom's Category	**Tests**
Remember	5
Understand	5
Apply	20
Analyse	10
Evaluate	10
Create	10

Course Code: 0831 AQC 211	Level-2,	Semester-I
Course Title: Live Food Culture		
Course Status: Core		
Credit: 2.0		
Prerequisite(s): None		
Rationale	This course is designed to make students understand the commercial culture of different live food for hatchery operations, larval rearing of fish and shellfish, and organic aquaculture.	

	By the end of the course, the students will be able to:		**Mapping with PLOs**
Course Learning Outcomes (CLOs)	**CLO 1**	Categorize the different types of live food, its role and importance, and nutritive value.	PLO_1, PLO_2, PLO_3
	CLO 2	Construct the culture systems of freshwater and marine water algae	PLO_1, PLO_2, PLO_3
	CLO 3	Explain different culture techniques of important rotifers, cladocerans, copepods, annelids, maggot of house fly, larvae of chironomus, cluexflies larvae and brine shrimp	PLO_1, PLO_2, PLO_3
	CLO 4	Investigate the low-cost spirulina production method for various purpose	PLO_1, PLO_2, PLO_3, PLO_6

Course Contents		**CLOs**
1	Introduction: Importance, present status, and prospect of live food in aquaculture, types of live food organisms: phytoplankton, zooplankton, microcrustaceans and other food organisms; their nutritive values.	CLO 1
2	Culture of algae: Freshwater and sea water representative algae culture in sterilized media, culture techniques- batch culture, continuous culture, culture in cheap media prepared from agro-industrial wastes, techniques of instant marine algae production.	CLO 2
3	Culture techniques of important freshwater and marine rotifers, cladocerans, copepods, brine shrimp (*Artemia*).	CLO 3
4	Culture techniques of annelids (*Tubifex* and earthworms).	CLO 3
5	Culture techniques of maggot of house fly, larvae of chironomus, culexflies larvae.	CLO 3
6	Low-cost spirulina production for various purposes.	CLO 4

Mapping CLOs with the Teaching-Learning and Assessment Strategy		
CLOs	**Teaching-Learning Strategy**	**Assessment Strategy**
CLO1	Lecture, Assignment, Presentation, Question-Answering	Quiz,Assignment, Presentation,Short and Narrative questions.
CLO2	Lecture, Assignment, Presentation, Question-Answering	Quiz, Assignment, Presentation,Short and Narrative question
CLO3	Lecture, Assignment, Presentation, Question-Answering	Assignment, Presentation,Short and Narrative question
CLO4	Lecture, Demonstration, presentation, assignment, Question-Answering	Assignment, Presentation,Vivavoce,Short and Narrative question
CLO5	Lecture, Group discussion, Question-Answering	Short and Narrative question

Learning Materials	
Text Book	1. Fulks, W and Main, K.L. (eds) (1992). Rotifer and microalgae culture systems. Argent Laboratory Press. 364 pp. 2. Lavens and Sorgeloos (eds) (1996). Manual on the production and use of live food for Aquaculture. 295 pp. 3. Richmond, A. (ed.) (2008). Handbook of microalgal culture: biotechnology and applied phycology. John Wiley & Sons. 4. Stottrup (2002). Live feed for fish. 336 pp (in press)
Supplementary Readings	

Assessment Pattern

CIE- Continuous Internal Evaluation (40 Marks)					
Bloom's Category Marks (out of 40)	**Class test (10)**	**Assignment submission (05)**	**Presentation (05)**	**Quizzes (10)**	**Attendance (10)**
Remember				05	
Understand	2			05	
Apply	4	01			
Analyze	4				
Evaluate		02			10
Create		01	05		

SSE- Semester End Examination (60 Marks)	
Bloom's Category	**Tests**
Remember	5

Understand	10
Apply	15
Analyze	15
Evaluate	10
Create	5

Course Code: 0831 AQC 212	Level-2	Semester-I
Course Title: Live Food Culture Sessional		
Course Status: Core		
Credit: 1.0		
Prerequisite(s): None		
Rationale	This course is designed to provide the students hands-on experience on the culture techniques of different types of live food for fish, their management and various factors that can affect live feed production.	

Course Learning Outcomes (CLOs)	**By the end of the course, the students will be able to:**		**Mapping with PLOs**
	CLO 1	Apply hands-on experience on the culture of algae, rotifer and cladocera.	PLO_1, PLO_2, PLO_4
	CLO 2	Create the culture techniques of *Artemia*in laboratory condition.	PLO_1, PLO_2, PLO_4
	CLO 3	Develop the culture techniques of*Tubifex* in laboratory condition.	PLO_1, PLO_2, PLO_4
	CLO 4	Demonstrate the culture of maggot of house fly, larvae of ChironomusandCulexflies larvae in Laboratory conditions.	PLO_1, PLO_2, PLO_4
	CLO 5	Establish low-cost spirulina production in laboratory condition	PLO_1, PLO_2, PLO_4

	Course Contents	**CLOs**
1	Culture of algae, rotifer and cladocera in laboratory condition.	CLO1
2	Culture of *Artemia*in laboratory condition.	CLO2
3	Collection and culture of annelids such as *Tubifex*.	CLO3
4	Culture of maggot of house fly (*Luciliasericata*), larvae of *Chironomus*and*Culex*flies larvae in Laboratory.	CLO4
5	Spirulina production in Laboratory condition.	CLO5

Mapping CLOs with the Teaching-Learning and Assessment Strategy		
CLOs	**Teaching-Learning Strategy**	**Assessment Strategy**
CLO1	Lecture, Demonstration, group discussion, Question-Answering	Quiz, Short and Narrative question, Practical Note book, Viva voce.
CLO2	Lecture, Demonstration, group discussion, Question-Answering	Quiz, Short and Narrative question. Practical Note book, Viva voce
CLO3	Lecture, Demonstration, group discussion, Question-Answering	Short and Narrative question, Practical Note book, Viva voce.
CLO4	Lecture, Demonstration, group discussion, Question-Answering	Short and Narrative question, Practical Note book, Viva voce.
CLO5	Lecture, Demonstration, group discussion, Question-Answering	Report writing, Short and Narrative question, Practical Note book, Viva voce.

Learning Materials	
Text Book	1. Fulks, W and Main, K.L. (eds) (1992). Rotifer and microalgae culture systems. Argent Laboratory Press. 364 pp. 2. Armitage, P., Creanston P.S. Pinder, L.C.V. (1995). The Chironomidae - Biology and Ecology of Non-biting Midges. Chapman and Hall, London. 572 pp. 3. Falconer, I.R. (1993). Algal Toxins in Seafood and Drinking Water. Academic Press, New York, USA.224 pp. 4. Mitra, A., Banerjee, K., Gangopadhyay, A. (2004). Introduction to Marine Plankton. Daya Publishing House, Delhi 110035, India. 97 pp. 5. Phang, S.M., Chu, W.L. (1999). Catalogue of Strains. University of Malaya Algae Culture Collection. University of Malaya, Kuala Lumpur, Malaysia.77 pp. 6. Tompkins, J., DeVille, M.M., Day, J.G., Turner, M.F. (eds.) (1995). Culture Collection of Algae and Protozoa. Catalogue of Strains. National Environment Research Council. Institute of Freshwater Ecology, Windermere Laboratory, Ambleside, Cumbria, UK.203 pp. 7. Ward, H.B., Whipple, G.C. (1959). Freshwater Biology. 2nd edn.
Supplementary Readings	

Assessment Pattern

CIE- Continuous Internal Evaluation (40 Marks)

Bloom's Category Marks (out of 40)	Class test (10)	Assignment (05)	Notebook/ Presentation (05)	Quizzes (10)	Attendance (10)
Remember				05	
Understand	02			05	
Apply	04				
Analyze	04	01			
Evaluate		02			10
Create		02	05		

SSE- Semester End Examination (60 Marks)	
Bloom's Category	**Tests**
Remember	5
Understand	5
Apply	20
Analyze	10
Evaluate	10
Create	10

Course Code: 0831FBG211	**Year:** Second	**Semester:** First
Course Title: Fish Biodiversity and Systematics		
Course Status: Core		
Credit: 2.0		
Prerequisite(s): None		
Rationale	The course is centered on conserving aquatic diversity, understanding the factors contributing to its decline, and learning methods for its restoration and protection. Additionally, the course covered the systematic classification and identification of aquatic organisms, exploring both traditional and contemporary taxonomic concepts within fish biosystematics.	

	By the end of the course, the students will be able to:		Mapping with PLOs
Course Learning Outcomes (CLOs)	CLO 1	Explicate thethe concept of aquatic biodiversity and its value at global and national level	PLO_1
	CLO 2	Explain the present status of freshwater and marine biodiversity of Bangladesh pinpointing the major and minor causes responsible for biodiversity loss	PLO_1, PLO_5, PLO_{10}
	CLO 3	Apply different measure to conserve aquatic biodiversity of Bangladesh	PLO_3, PLO6, PLO10
	CLO 4	Interpret species identification, taxonomy terminology, and Linnean hierarchy.	PLO_1, PLO_2 PLO_4
	CLO 5	Explain the ideas of species, taxonomic characters, species concepts, zoological nomenclature, and zoogeography of fishes.	PLO_1, PLO_2, PLO_7

Course Contents		CLOs
1	Introduction: Course goals, objectives and outcomes	CLO1
2	Basic information on biodiversity: Definition of species, ecosystem and genetic diversity, the nature and value of biodiversity- economic and ecological.	CLO1 and CLO2
3	Aquatic biodiversity of Bangladesh: Ecosystem diversity: inland waters - rivers, beels, haors and baors, and coast and marine - Bay of Bengal, coast, off-shore and estuaries protected areas of Bangladesh, the mangrove forests and the major hotspots.	CLO1 and CLO2
4	Species biodiversity: Aquatic animals - freshwater, coastal and marine, and SIS.	CLO1 and CLO2
5	Loss of the biodiversity: Causes, natural variation in time and space, present situation, threatened aquatic species of Bangladesh and the Red List	CLO3
6	Biodiversity rules and regulations and Conservation of Biological Diversity (CBD).	CLO3
7	Systematics: An overview, taxonomy and systematics, terms and definitions, the role of taxonomy, category and taxon, classification and identification, hierarchy of categories, Linnean hierarchy.	CLO4 and CLO5
8	Taxonomic characters: Morphometric, meristic, physiological, ecological, and ethological criteria for taxonomic categorization.	CLO4 and CLO5
9	Species concepts: Typological, nominalistic and biological; difficulties in	CLO4 and

	the applications.	CLO5
10	Zoological nomenclature: The rules of zoological nomenclature, International Code of Zoological Nomenclature, validity of names, homonymy, synonymy, law of priority.	CLO4 and CLO5
11	Zoogeography of Fishes: Clues to geographical history of fishes, geography of freshwater and marine fishes, continental patterns.	CLO4 and CLO5

Mapping CLOs with the Teaching-Learning and Assessment Strategy		
CLOs	**Teaching-Learning Strategy**	**Assessment Strategy**
CLO1	Lecturing, Group discussion, presentation, assignment, Question-Answering	Quiz, Assignment, Diagnostic assessment, Short and Narrative question.
CLO2	Lecturing, Fish bowl discussion, presentation, assignment, Question-Answering	Quiz, Assignment Exit slip Short and Narrative question
CLO3	Lecturing, Problem based learning, presentation, assignment, Question-Answering	Quiz, Assignment, Observation, Short and Narrative question
CLO4	Lecturing, Socratic method, presentation, Question-Answering	Quiz, Assignment, One minute paper, Short and Narrative question
CLO5	Lecturing, Group discussion, presentation, assignment, Question-Answering	Quiz, Assignment, Exit ticket Short and Narrative question

Learning materials	
Text Book and References	Gaston, K. J. and J. I. Spicer. 1998. Biodiversity - An Introduction. Wiley-Blackwell.133 pp. 2. Helfman, G. E., B. B. Collette, D. E. Facey and B. W. Bowen. 2009. The Diversity of Fishes. Wiley-Blackwell.736 pp. 3. Mayr, E. and P. D. Ashlock. 1991. Principles of Systematic Zoology. McGraw Hill College.416 pp. 4. Patro, L. R. 2010. Aquatic Biodiversity, Discovery Publishing House Pvt. Ltd. 216 pp. **References:** 1. Day, F. 1971. The Fishes of India. Today and Tomorrows Book Agency, New Delhi. 2. Hickman, L., S. Roberts and A. Larson. 2002. Animal Diversity, McGraw-Hill Science/Engineering/ Math; 3rd edition.4 64 pp.

	3. IUCN. 1996. The Multiple Dimension of Biodiversity. The World Conservation Union, Gland, Switzerland. 4. Kapoor, D., R. Dayal and A. G. Ponniah. 2002. Fish Biodiversity in India. NBFGR. 5. Mayr, E. 1963. Animal Species and Evolution. Belknap Press. 811 pp. 6. Ponniah, A. G. and U. K. K. Sarker. 2001. Fish Biodiversity in North East India. National Bureau of Fish Genetic Resources, India. 7. Ponniah, A. G., P. Das and S. R. Verma. 1998. Fish Genetics and Biodiversity Conservation. Nature, Conservators. 500 pp
Supplementary Readings	

Assessment Pattern

CIE- Continuous Internal Evaluation (40 Marks)					
Bloom's Category Marks (out of 40)	**Class test (10)**	**Assignment (05)**	**Notebook/ Presentation (05)**	**Quizzes (10)**	**Attendance (10)**
Remember				05	
Understand	02			05	
Apply	04				
Analyze	04	01			
Evaluate		02			10
Create		02	05		

SEE- Semester End Examination (60 Marks)	
Bloom's Category	**Tests**
Remember	5
Understand	5
Apply	20
Analyze	10
Evaluate	10
Create	10

Course Code: 0831FBG212	**Year:** Second	**Semester:** First
Course Title: Fish Biodiversity and Systematics Sessional		
Course Status: Core		
Credit: 1.0		
Prerequisite(s): None		
Rationale	In the laboratory, students will gain hands-on experience with fish taxonomy core concepts such as methods of identification and morphometric and meristic analysis of fishes. Students will conduct activities and experiments in a laboratory setting where they will apply the scientific method for invention.	

	By the end of the course, the students will be able to:		**Mapping with PLOs**
Course Learning Outcomes (CLOs)	CLO1	Identify fishes and some important aquatic fauna of Bangladesh.	PLO_1, PLO_8, PLO_{10}
	CLO2	Analyze morphometric and meristic characteristics of fishes.	PLO_1, PLO_{10}
	CLO3	Create a brief report of the local fauna, their abundance, occurrence and ecological conditions.	PLO_1, PLO_6, PLO_{10}
	CLO4	Apply taxonomical concepts in laboratory and field.	PLO_1, PLO_2, PLO_3, PLO_4, PLO_5, PLO_6, PLO_7, PLO_8, PLO_9, PLO_{10}

Course Contents		CLOs
1	Preparation and study of checklist of marine and freshwater fishes of Bangladesh	CLO1
2	Study of basic fish taxonomy and keys of major group of fishes	CLO2
3	Study of morphometric and meristic characters of fishes.	CLO3
4	Preparation of phylogenic tree	CLO5
5	Ecosystem diversity study - freshwater ponds and floodplain	CLO5
6	Study of biodiversity in protected areas.	CLO4 and CLO5
7	Field visit - Evaluation of the trend of freshwater fish availability through market survey.	CLO4

Mapping CLOs with the Teaching-Learning and Assessment Strategy		
CLOs	**Teaching-Learning Strategy**	**Assessment Strategy**
CLO1	Lecturing, Mnemonic device, demonstration, presentation, assignment, Question-Answering	Quiz, Assignment, Short answer, OSPE, Essay, PNB, Individual demonstration, Viva-voce
CLO2	Lecturing, Socratic method, demonstration, presentation, assignment, Question-Answering	Quiz, Assignment, Short answer, OSPE, PNB, Individual demonstration, Viva-voce
CLO3	Lecturing, group discussion, demonstration, presentation, assignment, Question-Answering	Quiz, Assignment, Short answer, OSPE, PNB, Observation, Viva-voce.

CLO4	Lecturing, Problem based learning, demonstration, presentation, assignment, Question-Answering	Quiz, Report, OSPE, Documentary preparation, Viva-voce

Learning materials

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

Assessment Pattern

CIE- Continuous Internal Evaluation (40 Marks)					
Bloom's Category Marks (out of 40)	**Class test (10)**	**Assignment (05)**	**Notebook/ Presentation (05)**	**Quizzes (10)**	**Attendance (10)**
Remember				05	
Understand	02			05	
Apply	04				
Analyze	04	01			
Evaluate		02			10
Create		02	05		

SEE- Semester End Examination (60 Marks)	
Bloom's Category	**Tests**
Remember	5
Understand	5
Apply	20
Analyze	10
Evaluate	10
Create	10

Level 2, Semester-I		
Course Code: 0831FMN211	**Year:** Second	**Semester:** First
Course Title: Water Quality Management		
Course Status: Core		
Credit: 2.0		
Prerequisite(s): None		
Rationale	In this course students will learn water quality management in fisheries through lectures and demonstrations and discussion. It also covers various freshwater production systems, water quality requirements for cultured species, primary and secondary production of inland lentic and lotic habitats, algal management as well as unique issues in coastal aquaculture and solutions.	

	By the end of the course, the students will be able to:		Mapping with PLOs
Course Learning Outcomes (CLOs)	CLO1	Clarify various water quality parameters and their importance in fisheries and aquaculture.	PLO1
	CLO2	Explain primary and secondary production of natural waterbody and their role in fish production.	PLO1, PLO3
	CLO3	Develop knowledge on various water quality parameters with different freshwater and coastal aquaculture production systems	PLO1, PLO3, PLO6
	CLO4	Relate eutrophication and phytoplankton bloom-factors influencing phytoplankton bloom, biological effects of phytoplankton bloom.	PLO1, PLO3, PLO6
	CLO5	Describe morphology, life history, flotation, cosmopolitanism of freshwater zooplankton, benthos and periphyton, their distribution and seasonal succession.	PLO1, PLO3, PLO6
	CLO6	Suggest solutions for problems of water quality deterioration for freshwater and coastal aquaculture and management.	PLO3, PLO6, PLO9
	CLO7	Communicate effectively individual and in groups works	PLO5, PLO9, PLO10

Course Contents		CLOs
1	**Introduction:** Concept on water quality in open and closed waterbodies, goal of water quality management and importance in fisheries and aquaculture.	CLO1
2	**Water quality in open water culture systems:** Water quality characteristics in different water bodies, open water production	CLO1a nd

	systems viz cages, pens, integrated systems, and other innovative systems.	CLO3
3	**Phytoplankton and algal management:** Concept, classification of phytoplankton, seasonal succession, inputs used and carrying capacity, algal assemblages, distribution, seasonal fluctuations, phytoplankton blooms, factors influencing phytoplankton bloom,	CLO2 and CLO4
4	**Algal toxins and their effects:** Concepts, types of algal toxin, bioaccumulation of toxin, effects on aquatic organisms, effects on animal and human health, eutrophication, control measures.	
5	**Water quality and zooplankton:**Characteristics of major groups, seasonal variations in abundance, Food and feeding habits, reproduction biology, diurnal vertical migrations, cosmopolitanism, cyclomorphosis, relations with other organisms, phytoplankton-zooplankton relations.	CLO2a nd CLO5
6	**Water quality, benthos and periphyton production:** Concept, characteristics of major groups, substrates, seasonal variations in abundance and distribution in lentic and lotic habitats, importance in the ecosystems and relations with other organisms and fish production.	CLO 5

Mapping CLOs with the Teaching-Learning and Assessment Strategy		
CLOs	**Teaching-Learning Strategy**	**Assessment Strategy**
CLO1	Lecturing, Question-Answering, group discussion, Assignment, Graphical presentation	Quiz, Assignment, Short and Narrative question, MCQ, Fill in the Gap
CLO2	Lecturing, Question-Answering, group discussion, Assignment, Graphical presentation	Quiz, Assignment, Short and Narrative question, MCQ, Fill in the Gap
CLO3	Lecturing, Question-Answering, group discussion, Assignment, Graphical presentation	Quiz, Assignment, Short and Narrative question, MCQ, Fill in the Gap
CLO4	Lecturing, Question-Answering, group discussion, Assignment, Graphical presentation	Quiz, Assignment, Short and Narrative question, MCQ, Fill in the Gap
CLO5	Lecturing, Question-Answering, group discussion, Assignment, Graphical presentation	Quiz, Assignment, Short and Narrative question, MCQ, Fill in the Gap
CLO6	Lecturing, Question-Answering, group discussion, Assignment, Graphical presentation	Quiz, Assignment, Short and Narrative question, MCQ, Fill in the Gap
CLO7	Assignment preparation and submission, and Student presentation	Class attendance, individual presentation

Learning Materials	
Text Book	1. Boyd, C. E. 1982. Water Quality Management for Pond Fish Culture. Elsevier, Scientific and Publishing Company, Amsterdam, Oxford, New York.318 pp. 2. Egna, H. S. and C. E. Boyd. 1997. Dynamics of Pond Aquaculture. CRC Press. Boca Raton, New York. 437 pp. 3. Wetzel, R. G. 1983. Limnology.2nd Edition. Saunders Coll. Philadelphia.858 pp.
Supplementary Readings	

Assessment Pattern

CIE- Continuous Internal Evaluation (40 Marks)					
Bloom's Category Marks (out of 40)	**Class test (10)**	**Assignment submission (05)**	**Presentation (05)**	**Quizzes (10)**	**Attendance (10)**
Remember				05	
Understand	02			05	
Apply	04				
Analyse	04	01			
Evaluate		02			10
Create		02	05		

SEE- Semester End Examination (60 Marks)	
Bloom's Category	**Tests**
Remember	5
Understand	10
Apply	15
Analyse	15
Evaluate	10
Create	5

Level-2, Semester-I		
Course Code: 0831FMN212	**Year:** Second	**Semester:** First
Course Title: Water Quality Management Sessional		
Course Status: Core		
Credit: 1.0		
Prerequisite(s): None		
Rationale	In this course, students will learn water quality management in fisheries through lectures, demonstrations, and practical work. It covers identification of phytoplankton, zooplankton, periphyton and benthos along with their systematic classification for explaining the interactions within and between abiotic and biotic components and their role in fish production.	

	By the end of the course, the students will be able to:		Mapping with PLOs
Course Learning Outcomes (CLOs)	CLO1	Explain collection and preservation of phytoplankton, zooplankton, periphyton and benthos from different freshwater habitats	PLO1, PLO4
	CLO2	Identify and describe the systematic classification of important phytoplankton, zooplankton, periphyton and benthos	PLO1, PLO4
	CLO3	Estimate primary productivity of freshwater habitats and plankton standing crop through determination of Chlorophyll-*a*	PLO1, PLO3
	CLO4	Evaluate farm effluents and sludge characterization	PLO1, PLO3, PLO8
	CLO5	Organize field trips to public and private fish farms for practical exposure.	PLO6, PLO9, PLO10

Course Contents		CLOs
1	Water quality parameters of different culture systems.	CLO1
2	Collection of plankton sample using plankton net and its counting methods	CLO1
3	Study on phytoplankton	CLO2 and CLO3
4	Study on zooplankton	CLO2
5	Quantitative study of benthos	CLO2
6	Quantitative study on periphyton	CLO2
7	Determination of chlorophyll-*a*.	CLO3
8	Field visit of farm effluents and sludge characterization.	CLO4 and CLO5

Mapping CLOs with the Teaching-Learning and Assessment Strategy

CLOs	Teaching-Learning Strategy	Assessment Strategy
CLO1	Lecture, Multi-media presentation, demonstration, Question-Answering, Short video presentation, Field visit, Data collection	Quiz, Assignment, Short question, MCQ, Fill in the Gap, Viva voce, Notebook
CLO2	Lecture, Multi-media presentation, demonstration, Question-Answering, Short video presentation, Field visit	Quiz, Assignment, Short question, MCQ, Fill in the Gap, Viva voce, Notebook
CLO3	Lecture, Multi-media presentation, demonstration, Question-Answering, Short video presentation, Field visit	Quiz, Assignment, Short question, MCQ, Fill in the Gap, Viva voce, Notebook
CLO4	Lecture, Multi-media presentation, demonstration, Question-Answering, Short video presentation, Field visit	Quiz, Assignment, Short question, MCQ, Fill in the Gap, Viva voce, Notebook
CLO5	Lecture, Multi-media presentation, demonstration, Question-Answering, Short video presentation, Field visit, Data collection and management	Quiz, Assignment, Short question, MCQ, Fill in the Gap, Viva voce, Notebook

Learning Materials

Text Book	1. Boyd, C. E. 1982. Water Quality Management for Pond Fish Culture. Elsivier, Scientific and Publishing Company, Amsterdam, Oxford, New York.318 pp. 2. Egna, H. S. and C. E. Boyd. 1997. Dynamics of Pond Aquaculture. CRC Press. Boca Raton, New York. 437 pp. 3. Kaff, J. 2002. Limnology.Prentice Hall, New Jersey, USA.591 pp. 4. Stirling, H. P. 1985 (ed.). Chemical and Biological Methods of Water Analysis for Aquaculturists.Institute of Aquaculture, University of Stirling, Scotland, UK.119 pp. 5. Wetzel, G. W. and G. E. Likens. 1991. Limnological Analyses. 2nd Edition.Springr-Verlag, New York, Berlin, Heilberg, London, Paris, Tokyo, Hong Kong, Barcelona.391 pp.
Supplementary Readings	

Assessment Pattern

CIE- Continuous Internal Evaluation (40 Marks)					
Bloom's Category Marks (out of 40)	**Class test (10)**	**Assignment submission (05)**	**Notebook/ Presentation (05)**	**Quizzes (10)**	**Attendance (10)**
Remember				05	

Understand	02			05	
Apply	04				
Analyse	04	01			
Evaluate		02			10
Create		02	05		

SSE- Semester End Examination (60 Marks)	
Bloom's Category	**Tests**
Remember	05
Understand	05
Apply	20
Analyse	10
Evaluate	10
Create	10

Second Year First Semester		
Course Code: 0831 FST 211	**Year:** Second	**Semester:** First
Course Title: Fisheries Microbiology		
Course Status: Core		
Credit: 3.0		
Prerequisite(s): None		
Rationale	In this course, student will be learnt about history and importance of microbiology in fisheries. It also covers the important mold, yeast, bacteria, virus that attack in fishes and fishery products, spoilage and chemical spoilage and immunity. The students will also be equipped with knowledge on the morphology, structure, physiology and reproductive characteristics of microorganism, microbial growth patterns, contamination and spoilage of fish, food borne illness caused by seafood and the role of microorganism in food spoilage through this course so that they can enhance immunity and ensure safety of fish and fishery products.	

	By the end of the course, the students will be able to:		**Mapping with PLOs**
Course Learning Outcomes (CLOs)	CLO1	Describe the scope, historical development and classification of microorganisms.	PLO1 & PLO4
	CLO2	Illustrate the classification, structure, morphology, growth, reproduction, cultural and physiological characteristics of different microorganisms.	PLO1 & PLO4
	CLO3	Analyze the knowledge of Fisheries Microbiology in ensuring the safety and quality of fish and fish products, thus to stop the food borne illness caused by seafood.	PLO2, PLO4, PLO6 & PLO8
	CLO4	Evaluate hygiene and sanitation in every step of processing to maintain quality of fish and fishery products.	PLO3 & PLO6
	CLO5	Develop in policy making in setting-up of different national and international microbial safe limit for the fish and fishery products and quality products development of the country.	PLO10

Course Contents		CLOs
1	**Introduction:** Scope, historical development and taxonomic classification of microorganisms- mold, yeast, bacteria, mycoplasma, chlamydia, virus and rickettsia, general characteristics of prokaryotes	CLO1

	and eukaryotes, microorganisms of freshwater and marine environment.	
2	**Bacteria and viruses:** Morphology, structure and reproduction, cultural and physiological characteristics of bacteria, characteristics of genera important in food bacteriology.	CLO2, CLO3 & CLO5
3	**Molds and yeasts:** General morphology, structural, reproductive, cultural and physiological characteristics, distinguishing characters of important genera, industrial importance.	CLO2, CLO3 & CLO5
4	**Microbial growth and nutrition:** Growth curve, factors affecting microbial growth- water activity aw, pH, temperature, redox-potential, nutrient, microbial interactions, antimicrobial agents.	CLO2
5	**Contamination and spoilage of fresh fish:** Microorganisms of cold, temperate and tropical regions, sources of contamination, causes of spoilage, factors affecting kinds and rates of spoilage, evidence of spoilage, chemical changes caused by microorganisms in fish.	CLO3, CLO4 & CLO5
6	**Food borne illness:** Food Infection and food intoxication, bacterial food poisoning and infection, botulism, staphylococcal intoxication, salmonellosis, shigellosis, *Clostridium perfringens* infection.	CLO3 & CLO4
7	**Control of micro-organisms:** Decontamination process of microorganisms, Immunity, antigen, antibody, antigen-antibody reactions, agglutination, precipitation, complement fixation, cytolysis, phagocytosis, hypersensitivity, immunological methods-FAT, ELISA.	CLO2, CLO3 & CLO4

Mapping CLOs with the Teaching-Learning and Assessment Strategy		
CLOs	**Teaching-Learning Strategy**	**Assessment Strategy**
CLO1	Lecture and presentation	Quizzes and short questions
CLO2	Lecture, presentation, discussion and video clip	Short questions, assignment and poster submission
CLO3	Lecture, presentation, question answering and discussion	Short questions, assignment and narrative questions
CLO4	Lecture, presentation, discussion, simulation and video clips	Short questions, assignment and narrative questions
CLO5	Lecture, presentation, question answering, discussion and project	Short questions, assignment and narrative questions

Learning Materials	
Text Book	1. Alcamo, I. E. 1984. Fundamentals of Microbiology. Addison-Wesley Publishing Company. USA. 834 pp. 2. Burrows, W. 1985. Textbook of Microbiology. 22nd Edition. W. B. Saunders Co., Philadelphia and London. 1038 pp. 3. Frazier, W. C. and Westhoff. D. C. 1990. Food Microbiology. 3rd Edition. McGraw Hill Book Co., New York, London. 502 pp.

	4. Ward, D. R. and C. Hackney. 1991. Microbiology of Marine Food Products. Van Nostrand Reinhold, New York. 438 pp. 5. Adam, M. R. and N. O. Moss. 2008. Food Microbiology. 3rd Edition. RSC Publishing Co., Cambridge, U.K.
Supplementary Readings	1. Chichester, C. O. and H. D. Graham. 1973 (eds.). Microbiological Safety of Fishery Products. Academic Press, NY, London. 2. Franklin, T. J. and G. A. Snow. 1971. Biochemistry of Antimicrobial Action. Chapman and Hall, London. 3. Mansur, M. A. 2010. Microbiology In "Fisheries Studies": Part-I. Botomul (Publisher), Dhaka. 234-312 pp. 4. Michel, P. D. and R. B. Larry. 2007. Food Microbiology: fundamentals and frontiers. ASM Press, Washington, D.C. 5. Nickerson, J. T. and A. J. Sinskey. 1993. Microbiology of Food and Food Processing. Elsevier, New York, Oxford, Amsterdam.

Assessment Pattern

CIE- Continuous Internal Evaluation (40 Marks)					
Bloom's Category Marks (out of 40)	**Class test (10)**	**Assignment (05)**	**Notebook/ Presentation (05)**	**Quizzes (10)**	**Attendance (10)**
Remember				05	
Understand	01			05	
Apply	02	01			
Analyze	03	02			
Evaluate	03	02			10
Create	01		05		

SEE- Semester End Examination (60 Marks)	
Bloom's Category	**Tests**
Remember	5
Understand	5
Apply	10
Analyze	15
Evaluate	20
Create	5

Second Year First Semester		
Course Code: 0831 FST 212	**Year:** Second	**Semester:** First
Course Title: Fisheries Microbiology Sessional		
Course Status: Core		
Credit: 1.0		
Prerequisite(s): None		
Rationale	In order to ensure safety of fish and fishery products, students shall acquire knowledge on the morphology, structure, physiology and reproductive characteristics of microorganisms, microbial growth patterns and the role of microorganism in food spoilage be studied at laboratory and field levels.	

	By the end of the course, the students will be able to:		**Mapping with PLOs**
Course Learning Outcomes (CLOs)	CLO1	Identify different microorganisms from fish, fish products and aquatic environments.	PLO1 & PLO4
	CLO2	Describe the qualitative and quantitative properties of microorganisms related to fish/sea-foods spoilage, safety and quality.	PLO1 & PLO4
	CLO3	Demonstrate the knowledge of fisheries microbiology in different culture media and techniques, and to ensuring the limit of microbial safety and quality in fish and fish products.	PLO2, PLO4, PLO6 & PLO8
	CLO4	Assess good handling practices and good manufacturing practices in harvesting, marketing and processing of fish and fish products to avoid microbial contamination.	PLO2, PLO4, PLO5, PLO6, PLO7 & PLO8

	Course Contents	**CLOs**
1	Important terminology and guideline for exercises in the practical classroom.	CLO1
2	Study of different types of microscopes- principles and operation.	CLO2
3	Study of different sterilization techniques: Autoclaving, dry heat sterilization, tyndallization, gaseous sterilization and filtration.	CLO2, CLO3 & CLO4
4	Study of culture media: Ingredients, types, and preparation of culture media.	CLO2, CLO3 & CLO4
5	Culture of microorganisms: Broth culture, pour plate culture, spread plate culture, streak plate culture, stab culture and shake culture.	CLO2, CLO3 & CLO4
6	Microscopic observation of bacteria:Gram's stain, spore stain, flagella	CLO2

	stain, Ziehl-Neelsen's stain, Hiss's methods and Albert's staining.	
7	Isolation and identification of bacteria**:** Morphological, biochemical, physiological and serological study.	CLO1,CLO2 & CLO5
8	Quantitative estimation of bacteria: Consecutive decimal dilution method and most probable number method [Standard plate count (SPC), aerobic plate count (APC), total plate count (TPC)].	CLO1,CLO2 & CLO5
9	Field visit for sample collection from selected fish landing centers, fish markets and processing plants- bacteriological analysis and preparation of report.	CLO1,CLO2, CLO4 & CLO5

Mapping CLOs with the Teaching-Learning and Assessment Strategy		
CLOs	**Teaching-Learning Strategy**	**Assessment Strategy**
CLO1	Lecture and presentation	Quizzes, short questions and practical note book (PNB)
CLO2	Lecture, presentation, demonstration and question answering	Spotting, assignment, practical note book (PNB) and viva-voce
CLO3	Lecture, presentation, demonstration and discussion	Spotting, assignment, practical note book(PNB) and viva-voce
CLO4	Lecture, presentation, demonstration, question answering and discussion	Quizzes, spotting, practical note book (PNB) and viva-voce

Learning Materials	
Text Book	1. American Public Health Association. 1998. Standard Methods for the Examination of Water and Wastewater, 20th Edition. APHA, Washington, D. C. 2. Barrow, G. L. and R. K. A. Feltham. 1993 (ed.). Cown and Steel's Manual for the Identification of Medical Bacteria, Cambridge University Press. 3. Burrows, W. 1985. Textbook of Microbiology. 22nd Edition. W. B. Saunders Co., Philadelphia and London. 4. Collins, C. H. and P. M. Lyne. 1976. Microbiological Methods. 4th
Supplementary Readings	1. Frazier, W. C. and D. C. Westhoff. 1990. Food Microbiology. 3rd Edition. McGraw Hill Book Co., New York, London. 2. Holt, G. J. 1986. Bergey's Manual of Systematic Bacteriology, Williams and Wilkins, Baltimore. 3. Miwa, K. and S. J. Low. 1992. Laboratory Manual on Analytical Methods and Procedures for Fish and Fish Products. 2nd Edition. Marine Fisheries Research Department, SEAFDEC, Singapore.

Assessment Pattern

CIE- Continuous Internal Evaluation (40 Marks)					
Bloom's Category Marks (out of 40)	**Class test (10)**	**Assignment (05)**	**Notebook/ Presentation (05)**	**Quizzes (10)**	**Attendance (10)**
Remember				05	
Understand				05	
Apply	02	01			
Analyze	03	02			
Evaluate	03	02			10
Create	02		05		

SEE- Semester End Examination (60 Marks)	
Bloom's Category	**Tests**
Remember	5
Understand	5
Apply	15
Analyze	20
Evaluate	10
Create	5

Course Code: 0831 MFO 211	**Level: 2**	**Semester: 1**
Course Title: Physical and Geological Oceanography		
Department: Core		
Credit Hours: 3.0		
Prerequisite(s): None		
Rationale	Physical and geological oceanography is one of the most vital branches of oceanography which deals with the physics and geology of the ocean. The course is designed aiming to basic building blocks for the students to understand ocean dynamic processes and the various aspects of geology which are related to ocean and its phenomenon. This course help students to develop the knowledge of air-sea interaction and another physical phenomenon like El Niño, La Niña, IOD, NAO etc. Besides these it provides an understanding on the physical processes that control the distribution of water properties and the dynamics of those properties in the ocean as well as marine geological processes, ocean basin structure and tectonics movement, sea floor spreading and deep-sea sediment, origin, structure, formation of sea floor and evolution of the ocean basins and their margins.	

Course Learning	**By the end of the course, the students will be able to:**	**Mapping with PLOs**

Outcomes (CLOs)	CLO 1	Define the physical and geological properties of the ocean.	PLO_1, PLO_2,
	CLO 2	Analyze the physical and geological aspects of ocean, ocean dynamics processes and geological features of ocean.	PLO_1, PLO_2, PLO_3
	CLO 3	Explain how and why physical parameters changes vertically and horizontally in the world ocean as well as the ocean basin and margin changes.	PLO_1, PLO_2, PLO_9
	CLO 4	Evaluate the various physical and geological process which controls the ocean environment, ocean dynamics and ocean characteristics.	PLO_1, PLO_2, PLO_5
	CLO 5	Distinguish between the various physical process and geological process of the world ocean.	PLO_1, PLO_2, PLO_5
	CLO 6	Analyze different ocean color and it's causes.	PLO_9, PLO5
	CLO 7	Apply knowledge of physical and geological oceanography	PLO_1,PLO_2

	Course Contents	**CLOs**
1	**Introduction to physical oceanography:** Concept of physical oceanography, historical review of oceanography; current and future oceanographic research; global atmospheric circulation, latitude and longitude and its role on the ocean, intertropical convergence zone (ITCZ), geology of the ocean.	CLO 1
2	**Physical properties of sea water:** Horizontal and vertical distribution of temperature,mixed layer depth, barrier layer depth, and salinity in ocean: surface distribution, vertical distribution; Sound and light propagations in the sea water; sea ice: freezing point and temperature of maximum density, effect of salinity.	CLO 3
3	**Ocean Wave & Tide:** Concept of wave and tides, classification and importance of waves and tides, wave theories, planetary waves and their impact, causes of tide, centrifugal force and gravitational attraction, effects of sun-moon system on tide: distance, declination and nutation, diurnal inequality, tidal datums.	CLO 2
4	**Ocean circulation:** Concept, Types, causes, oceanic gyre, meso-scale eddies; wind driven surface circulation, wind stress, coriolis force, ekman spiral and ekman transport, upwelling and downwelling, thermohaline circulation and water mass; circulation of Bay of Bengal.	CLO 4, CLO 5
5	**Seasonal cycle:** Seasonal cycle of wind, sea surface temperature, sea surface salinity, sea surface current, chl-a, MLD, BLD and surface processes, circulation, eddies and thermal inversion in the Bay of Bengal and Indian ocean.	CLO 5, CLO 7, CLO 8
6	**Air-sea interaction:** Physical phenomenon El Niño, La Niña, ENSO, IOD, PDO, NAO etc.	CLO 6, CLO 7

7	**Geology of ocean:** Concept and historical development of geological oceanography; voyage of the Beagle, challenger expedition; origin of earth, atmosphere and oceans; geological time scale; the interior of the earth, convection currents; continental drift and sea-floor spreading, plate tectonics, evidences; rings of fire in ocean, volcanic island and sea mountain building; evolution of the Indian ocean and Bay of Bengal floor.	CLO 2, CLO 4
8	**Bathymetry of Ocean:** Techniques of determining bathymetry, the sea floor features: the continental margins, the deep-water basins/abyssal plain; the continental shelf, the continental slope and the continental rise, submarine canyons, turbidity currents, fan system; abyssal plains features,ridge, rift zone, trench, fracture zone, fault, sea mount, island arc, abyssal hill, guyot, abyssal plain and others; near shore and other features (e.g., reef, coral island, atoll, sedimentary formations and others).	CLO 4, CLO 5, CLO 7, CLO 8
9	**Oceanic sedimentsand deep-sea deposits:** Importance, sources and classification. transportation and distribution of sediments. factors influencing marine sedimentation; deep sea deposits: oozes, calcium carbonate and foraminifera deposition in the sea; topography and sediments of the Bay of Bengal floor and deep-sea deposits.	CLO 7, CLO 8

Mapping CLOs with the Teaching-Learning and Assessment Strategy		
CLOs	**Teaching-Learning Strategy**	**Assessment Strategy**
CLO 1	Lecture using board/LCD projectors	Assignment, Presentation, Mid Term Examination
CLO 2	Lecture using board/LCD projectors, Group discussion, Workshop	Quiz, Class test (Short Q and MCQ),Assignment, Presentation,
CLO 3	Lecture using board/LCD projectors, Visual presentation, Case study/Tutorial	MCQ, Assignment, Presentation, Summative Assessment (SA)
CLO 4	Audio-visual teaching aids (film and documentaries, virtual classroom, etc.)	Short and Narrative question, Quiz
CLO 5	Self-learning using reference books/research articles/case study/other online materials	assignment and Semester-end examination
CLO 6	Animated VDO clips, Question-Answer session	Essay type test, problem solving
CLO 7	Case study	Presentation, Summative Assessment (SA)

Learning Materials	
Text Book	1. General Oceanography: An Introduction by Dietrich, Kalle, Krauss and Siedler, John Wiley & Sons (1980, Second Edition). 2. Descriptive Physical Oceanography, by G. L Pickard, Elsevier Science Ltd, ISBN: 0080379524. 4. Introduction to Physical Oceanography, by RH Stewart, University Press of Florida (2009), ISBN: 1616100451. 5. Principles of Physical Oceanography, by G. Neumann, Prentice-Hall, ISBN: 0137097417. 6. Marine Geology, by H. Kuenen, Read Books (2008), ISBN: 1443725102. 7. The Sea Floor - An Introduction to Marine Geology, by E. Seibold and W. ll. Berger, Springer, ISBN: 3540601910. 8. Geological Oceanography: evolution of coasts, continental margins and the deep-sea floor, by Francis P. Shepard, Harper & Row, ISBN: 0060460911.
Supplementary Readings	1. Stephen pond, George L. Pickard, Introductory Dynamical Oceanography, Butterworth-Heinemann ISBN: 9780750624961. 2. The Ocean Basins: Their Structure and Evolution, ISBN: 9780080537931 3. The Oceans: Their Physics, Chemistry, and General Biology, by H. U. Sverdrup, M. W. Johnson, R. H. Fleming, Prentice Hall (1942), ISBN: 0136303501. 4. Elements of Physical Oceanography, by John Steele, Academic Press, ISBN: 0080964850. 5. Physical oceanography of coastal and shelf seas, by B Johns, Cambridge University Press, ISBN: 0521701481. 6. Submarine Geology, by F. P. Shepard, Harper & Row, 1973, ISBN: 0060460911. 7. Marine Geology, by J. P. Kennett, Prentice Hall, ISBN: 0135569362.

Assessment Pattern

CIE- Continuous Internal Evaluation (40 Marks)					
Bloom's Category Marks (out of 40)	**Class test (10)**	**Assignment (05)**	**Notebook/ Presentation (05)**	**Quizzes (10)**	**Attendance (10)**
Remember				05	
Understand	01			05	
Apply	02	01			
Analyze	03	02			
Evaluate	03	02			10
Create	01		05		

SSE- Semester End Examination (60 Marks)	
Bloom's Category	**Tests**
Remember	5
Understand	5
Apply	10
Analyze	10
Evaluate	20
Create	10

Course Code: 0831 MFO 212	**Level: 2**	**Semester: 1**
Course Title: Physical and Geological Oceanography Sessional		
Department: Core		
Credit Hours: 1.0		
Prerequisite(s): None		
Rationale	The course is designed to develop the field work, computation and measurement capability of the students. The purpose of this course is to provide experience in the data collection process using various instruments to measure the physical and geological properties of seawater, calculate different parameters, and prepare and analyze graphs. The students also able to prepare different types of maps, charts and analysis the sea sediment samples from this practical course.	

	By the end of the course, the students will be able to:		**Mapping with PLOs**
Course Learning Outcomes (CLOs)	CLO 1	Know about instruments those are used in physical and geological oceanography	PLO_1, PLO_2,
	CLO 2	Demonstrate the features of major world ocean, sea and straits.	PLO1, PLO2, PLO3
	CLO 3	Understand the data collection and analysis process in physical and geological oceanography.	PLO_1, PLO_2, PLO_3
	CLO 4	Measure the physical properties of sea water.	PLO_1, PLO_2, PLO_9
	CLO 5	Demonstrate the marine geological processes, coastal and ocean bathymetry and marine tectonics.	PLO_1, PLO_2, PLO_5
	CLO 6	Collect, identify and analyze marine sediment.	PLO_1, PLO_2, PLO_5

Course Contents		CLOs
1	Acquaintance and practice in fieldwithbasicoceanographicequipment.	CLO 1
2	Major oceans, sea and straits of the world.	CLO
3	Measurementofseawaterproperties:Temperature, salinity,electrical conductivity, density, transparency; use of TS diagram to (i) derive salinity, density and temperature, (ii) to examine water masses and their mixing.	CLO 3, CLO 4
4	Field trip to Bay of Bengal and Swatch of No ground for calculation and making profile: Temperature, salinity, density, Electrical Conductivity etc.	CLO 4, CLO 5
5	Collection,identification and analysis of grain size of different marine sediment.	CLO 6

Learning Materials	
Text Book	1. Descriptive Physical Oceanography, by G. L Pickard, Elsevier Science Ltd, ISBN: 0080379524. 2. Introduction to Physical Oceanography, by RH Stewart, University Press of Florida (2009), ISBN: 1616100451. 3. Marine Geology, by H. Kuenen, Read Books (2008), ISBN: 1443725102. 4. The Sea Floor - An Introduction to Marine Geology, by E. Seibold and W. ll. Berger, Springer, ISBN: 3540601910. 5. Geological Oceanography: evolution of coasts, continental margins and the deep-sea floor, by Francis P. Shepard, Harper & Row, ISBN: 0060460911.
Supplementary Readings	1. The Oceans: Their Physics, Chemistry, and General Biology, by H. U. Sverdrup, M. W. Johnson, R. H. Fleming, Prentice Hall (1942), ISBN: 0136303501. 2. Elements of Physical Oceanography, by John Steele, Academic Press, ISBN: 0080964850. 3. Physical oceanography of coastal and shelf seas, by B Johns, Cambridge University Press, ISBN: 0521701481. 4. Submarine Geology, by F. P. Shepard, Harper & Row, 1973, ISBN: 0060460911. 5. Marine Geology, by J. P. Kennett, Prentice Hall, ISBN: 0135569362.

Assessment Pattern

CIE- Continuous Internal Evaluation (40 Marks)					
Bloom's Category Marks (out of 40)	**Class test (10)**	**Assignment (05)**	**Notebook/ Presentation (05)**	**Quizzes (10)**	**Attendance (10)**
Remember				05	
Understand				05	
Apply	02	01			
Analyze	03	02			
Evaluate	03	02			10
Create	02		05		

SSE- Semester End Examination (60 Marks)	
Bloom's Category	**Tests**
Remember	5
Understand	5
Apply	15
Analyze	20
Evaluate	10
Create	5

Course Title	Introduction to Sociology	Level 2	Semester-I
Course Code	ECO211		
Department	Economics and Sociology		
Faculty/Program	Fisheries		
Credit Hours	3.00		
Level			
Course Description	This course will provide the basic information of sociology such as the culture, social group, family, marriage, society, social change, social process, social mobility and social stratification. It will helpful for his personal life and professional life.		
Course Objectives	➢ Students will use the theories and methods of sociology. ➢ Students will analyze the culture, family, marriage and apply in the personal life. ➢ They will understand the society, social change, social process, social mobility and social stratification. ➢ Students will evaluate the impact of folkways, customs and mores for their personal activities.		

Course Learning Outcomes

By the end of the course, the students will be able to:

No	Description
CLO 1	Explain the concepts of sociology, relation between sociology and other social sciences.
CLO 2	Interpret macro and micro sociology.
CLO 3	Analyze the origin and development of society, Social Interaction and Everyday Life.
CLO 4	Assess the different Social Groups and Social Organizations.
CLO5	Describe the characteristics, types, elements of culture, culture and civilization.
CLO6	Realize the different types of Socialization and Social Process,Theories of socialization.
CLO 7	Narrate the types, functions and features of family and marriage.
CLO 8	Interpret the Family and Marriage.
CLO 9	Narrate the Social Groups and Social Organizations.
CLO 10	Illustrate the Designing Your Life and Science of Happiness.

Mapping of CLO with PLO

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

CLO4		√					√		√	
CLO5		√						√		√
CLO6		√			√					
CLO 7					√					√
CLO 8					√		√			
CLO 9					√				√	√
CLO 10						√				

Summary of course content

Sl. No.	Topic/Course content	Teaching Strategy	Assessment Strategy
1	**Introduction to Sociology: Nature and scope** Definition of sociology -Concepts and variables,Perspective of Sociology, Macro and micro Sociology, Elements of Sociology, Sociology is a Science. "August Comte"-Father of Sociology,Different social sciences: a glimpse on other disciplines, the beginning of sociology-origin of sociology, sociology and fisheries, importance of social science.	Lecture, Reading, Assignment	True- False Item, Multiple Choice, Short answer, Easy type, Observation
2	**Social interaction and social capital** Social Interaction: Process and forms of social interaction, social and cultural reproduction. Social capital: Definition, types and perspective, measurement and importance. the Goffman's social contraction of reality, Dimension of digital transformation of modern life	Lecture, Reading, Assignment	True- False Item, Multiple Choice, Short answer, Easy type, Observation
3	**Theory of socialization and Social Process** Process of the socialization, types of socialization, importance of socialization, social norms, cooperation competition conflict, assimilation, accommodation. **The agencies of socialization:** traditional and modern. **Theories of socialization:** i. Colley's theory of looking glass self ii. Mead's theory of role playing iii. Freud: concept of human mind	Lecture, Reading, Assignment	Short answer, Easy type, Observation, True- False Item, Multiple Choice,

	iv. Thomas: theory of situation v. Durkheim: theory of collective representation **Socialization and the life cycle:** Erikson's eight stages of man		
4	**Social stratification and mobility** Definition, characteristics and types of stratification, slavery system, estate system in middle age, caste system, social class and status, difference between caste and social class, social stratification in Bangladeshi society in rural and urban society, social mobility and its types, importance and theory of social mobility.		
5	**Culture** Elements/major concepts of culture: Symbols, language, values, beliefs, sanctions, norms Key feature of culture, the functions of culture Interdependence and interrelationship between culture and civilization, folkways, mores, and customs.	Lecture, Reading	True- False Item, Multiple Choice, Short answer, Easy type
6	**Family and Marriage** Theories and concepts, types and structure of the family, functions of the family, factors affecting family patterns. Transition and problems in family life-changes in family patterns. **Twenty first century:** Future of the family and marriage.	Lecture, Reading Assignment	True- False Item, Multiple Choice, Short answer, Easy type
7	**Social Groups and Social Organizations** Social bonds-the factors of group life, importance of social groups. **Types of social groups-**in groups-out groups, primary groups-secondary groups, peer groups–reference groups, small groups-large groups, horizontal groups-vertical groups, open groups-Closed groups, involuntary groups- voluntary groups and their differences. **Formal organization:** importance and goals of formal organizations, interrelationship between the formal and informal organizations, bureaucracy.	Lecture, Reading Assignment	True- False Item, Multiple Choice, Short answer, Easy type

8	**Community and Society** Definition, characteristics and theories about community, Definition, characteristics and theories about the origin and development of society, differentiate between community and society	Lecture, Reading Assignment	True- False Item, Multiple Choice, Short answer, Easy type
9	**Theory of Social change and development** Definition, types and characteristics and causes of social change, theory of social change, Tele theory of social change, social development and progress, Rowtow's theory of development, structural change theory, new growth model	Lecture, Reading Assignment	True- False Item, Multiple Choice, Short answer, Easy type
10	**Designing Your Life and Science of Happiness** Mind-body interaction, stress management techniques Positive emotion, relationships, optimism, gratitude, mindfulness,practical habits for every day, cognitive behavioral therapy,Career pathway and its implications, happiness index.	Lecture, Reading Assignment	True- False Item, Multiple Choice, Short answer, Easy type

Part C: Learning Resources

Texts and References Books:

1. Giddens, A. (2009). Sociology (6th ed.). Cambridge: The Polity Press.
2. Macionis, JJ.(2008) Sociology: A Global Introduction (4th ed.) London: Pearson Education
3. J. Ross Eshleman and Barbarag Cashion, Sociology: An Introduction.
4. Richard T. Schaefer, Sociology: A Brief Introduction.
5. Michael Hughes, Carolyn J. Kroehler, and James A. Van Demark, Sociology: The Core
6. Joan Ferrante, Sociology: A Global Perspective
7. David M. Newman, Sociology: Exploring the Architecture of Everyday Life.
8. Michael Haralambos and Martin Holborn, Sociology: Themes and Perspectives.
9. George Ritzer, Essentials of Sociology.
10. John J. Macionis and Ken Plummer, Sociology: A Global Introduction.
11. Steve Bruce, Sociology: A Very Short Introduction.

Assessment Pattern

CIE- Continuous Internal Evaluation (40 Marks)					
Bloom's Category Marks (out of 40)	**Class test (10)**	**Assignment submission (05)**	**Presentation (05)**	**Quizzes (10)**	**Attendance (10)**
Remember				05	
Understand	2			05	
Apply	4	01			
Analyse	4				
Evaluate		02			10
Create		01	05		

SSE- Semester End Examination (60 Marks)	
Bloom's Category	**Tests**
Remember	5
Understand	10
Apply	15
Analyse	15
Evaluate	10
Create	5

Course Code: 0831 AQC 221	Level-2	Semester-II
Course Title: Fish Parasitology		
Course Status: Core		
Credit: 2.0		
Prerequisite(s): None		
Rationale	This course is designed to provide the knowledge and skill necessary for classification and identification of major groups of fish parasites and to understand their relationship, mode of replication, their reproduction with the host, and prevention and control measures of parasitic diseases.	

	By the end of the course, the students will be able to:		**Mapping with PLOs**
Course Learning Outcomes (CLOs)	CLO1	Evaluate the basic concepts of fish parasites that are found in nature.	PLO_1, PLO_2, PLO_3
	CLO2	Categorize the different groups of pathogenic fish parasites.	PLO_1, PLO_2, PLO_3
	CLO3	Analyze the life history pattern of some important parasites in fish.	PLO_1, PLO_2, PLO_3
	CLO4	Explain the concept of various parasitic diseases that are found in fish and also in human.	PLO_1, PLO_2, PLO_3
	CLO5	Execute the knowledge gained for sustainable fish production.	PLO_1, PLO_2, PLO_3

	Course Contents	**CLOs**
1	Introduction and host-parasite relationship: Definition related to fish parasitology, role of parasitology in fisheries and aquaculture. Symbiosis, parasitism, host specificity, infestation, and infection.	CLO1 and CLO 5
2	Parasitic fauna of freshwater and marine fish and shellfish: Major groups of parasites and their characteristics, classification of protozoan, helminths, copepod and annelid parasites of fishes.	CLO2 and CLO 5
3	Life history: Life cycle of some protozoan, digenean, cestode, nematode acanthocepahan and crustacean parasites of fish and shell fish.	CLO3 and CLO 5
4	Common parasitic diseases of fishes: causative agents, symptoms and pathological signs, prevention and control measures.	CLO4 and CLO 5

5	Host parasite interaction: Mechanical and toxic effects on the host, influence on host's foods, growth, condition and size of population; host cell and tissue reactions, humoral reactions, immunity.	CLO3 and CLO4
6	Physiological factors of parasitic diseases: Stress and susceptibility of fish parasitic diseases, stress mediated diseases, mechanism of infection into diseases. Host-parasite-environment relationship.	CLO3 and CLO4
7	Public health and fish consumption: Fish borne human parasitic diseases (zoonotic disease), control of aquatic vector and zoonotic diseases.	CLO4 and CLO 5

Mapping CLOs with the Teaching-Learning and Assessment Strategy		
CLOs	**Teaching-Learning Strategy**	**Assessment Strategy**
CLO1	Lecture, Group discussion, Question-Answering	Quiz, Short and Narrative question.
CLO2	Lecture, Assignment, Presentation, Question-Answering	Quiz,Assignment, Presentation, Short and Narrative question.
CLO3	Lecture, Assignment, Presentation, Question-Answering	Quiz, Assignment, Presentation, Short and Narrative question.
CLO4	Lecture, Assignment, Presentation, Question-Answering	Quiz, Assignment, Presentation, Short and Narrative question.
CLO5	Lecture, Assignment, Presentation, Question-Answering	Quiz, Assignment, Presentation, Short and Narrative question.

Learning Materials	
Text Book	5. Chandra, K.J. 2009. Fish Parasitology (2nd Edition) (pp.183). Chaudhury Printing and Publication. 6. Dogiel, V.A. 1962. General Parasitology (pp.516). Oliver and Boyd, Edinburgh, U.K. 7. Woo, P.T.K. (ed.) 1995. Fish Diseases and Disorders. Vol. I. Protozoa and Metazoa infections (pp.808). CAB, International
Supplementary Readings	1. Cheng, T. C. 1982. General Parasitology. Academic Press Inc. N.Y. pp.102. 2. Kabata, Z. 1985. Parasites and Diseases of fish cultured in the tropics. Taylor and Francis, London.pp.202. 3. Kenndy, C. R. 1975. Ecological Animal Parasitology. Blacwell Scientific Publications, Oxford, London, Edinburgh and Melbourne.pp.65. 4. Roberts, R. J. 1989. Fish Pathology 2nd Edition. Baillere Tindal, London, U.K. pp.256.

Assessment Pattern

CIE- Continuous Internal Evaluation (40 Marks)					
Bloom's Category Marks (out of 40)	**Class test (10)**	**Assignment submission (05)**	**Presentation (05)**	**Quizzes (10)**	**Attendance (10)**

Remember				05	
Understand	2			05	
Apply	4	01			
Analyze	4				
Evaluate		02			10
Create		01	05		

SSE- Semester End Examination (60 Marks)	
Bloom's Category	**Tests**
Remember	5
Understand	10
Apply	15
Analyze	15
Evaluate	10
Create	5

Course Code: 0831 AQC 222	Level-2	Semester-II
Course Title: Fish Parasitology Sessional		
Course Status: Core		
Credit: 1.0		
Prerequisite(s): None		
Rationale	This course is designed to provide the students with the practical knowledge and skills necessary to understand the various parasites that are available in the country.	

Course Learning Outcomes (CLOs)	**By the end of the course, the students will be able to:**		**Mapping with PLOs**
	CLO1	Isolate various parasites from various organ samples of fishes.	PLO_1, PLO_2, PLO_3
	CLO2	Characterize and identify the major groups of parasites	PLO_1, PLO_2, PLO_3
	CLO3	Organize field trips to public and private fish farms for practical exposure.	PLO_6

	Course Contents	**CLOs**
1	Study of museum specimens of fish parasites.	CLO1 and CLO 2
2	Calibration of the microscope for measurements	CLO2 and CLO 2

3	Technique of investigation of fish host for parasitological study	CLO1 and CLO 2
4	Collection, fixation, and preservation of fish parasites	CLO2 and CLO 2
5	Permanent preservation of parasites-staining, dehydration, clearing and mounting.	CLO1 and CLO 2
6	Key out, the identification and description of collected parasites.	CLO2 and CLO 2
7	Field trip to a fish farm and preparation of report on the parasitological investigation.	CLO3

Mapping CLOs with the Teaching-Learning and Assessment Strategy		
CLOs	**Teaching-Learning Strategy**	**Assessment Strategy**
CLO1	Lecture, Dissection, Identification, Question-Answering	Quiz, Identification, Short and Narrative question, Practical Note Book, Viva voce.
CLO2	Lecture, Microscopic Demonstration, Identification, Question-Answering	Short and Narrative question, Practical Note Book, Viva voce.
CLO3	Lecture, Field visit, Question-Answering	Report writing,Short and Narrative question, Practical Note Book, Viva voce.

Learning Materials	
Text Book	8. Chandra, K.J. 2008. A Practical Text book of Fish Parasitology and Health Management. Published by the Bangladesh University Grants Commission, Dhaka.
Supplementary Readings	1. Bykhovskaya-Pavloskaya, I. E., S. V. Gussev, M.N. Dubinina, N.A. Izymova, T.S. Smiruova, I.L. Sokolovskaya, G.A. Shtein, S.S. Shul'man and V.M. Epshtein. 1964. Key to Parasites of Freshwater fishes of the U.S.S.R. pp.97. 2. Cable, R.M. 1943. Illustrated Laboratory Manual of Parasitology. Burgess Publ. Co. Minneapolis, New York, San Francisco, London.ranslation, Jerusalem. pp.55. 3. Tonguthai, K., S. Chinabut, T. Somsiri, P. Chandratchakool and S. Kanchanakhan. 1999. DiasnosticProceddures for Fin fish Diseases. AAHRI, Department of Fisheries, pp.43. 4. Yamaguti, S. 1958, 1959, 1961, 1962, 1963. SystemaHelminthum. Vol. I-V. Interscience Publishers Inc. pp.43.

Assessment Pattern

CIE- Continuous Internal Evaluation (40 Marks)					
Bloom's Category Marks (out of 40)	**Class test (10)**	**Assignment (05)**	**Notebook/ Presentation (05)**	**Quizzes (10)**	**Attendance (10)**
Remember				05	
Understand	02			05	
Apply	04				
Analyze	04	01			
Evaluate		02			10
Crea te		02	05		

SSE- Semester End Examination (60 Marks)	
Bloom's Category	**Tests**
Remember	5
Understand	5
Apply	20
Analyze	10
Evaluate	10
Create	10

Course Code: 0831FBG221	**Year:** Second	**Semester:** Second
Course Title: Fish Physiology		
Course Status: Core		
Credit: 2.0		
Prerequisite(s): None		
Rationale	This course will provide a detailed overview of the physiology of fishes and generate students with an outstanding knowledge in physiological characteristics and adaptations that allow fish to survive and thrive in an aquatic environment.	

	By the end of the course, the students will be able to:		Mapping with PLOs
Course Learning Outcomes (CLOs)	CLO1	Describe major concepts of fish physiology (e.g. thermal regulation system, digestive system, metabolism, respiratory system, circulatory system, excretory system, osmoregulatory system and reproductive system).	PLO_1, PLO_2, PLO_{10}
	CLO2	Illustrate the relationships between different systems of fish body (e.g. digestive system, metabolism, respiratory system, circulatory system, osmoregulatory system, reproductive system etc.).	PLO_1, PLO_2, PLO_4, PLO_{10}
	CLO3	Assess various environmental changes and conditions that affect fish and their responses.	PLO_1, PLO_2, PLO_5, PLO_6, PLO_7, PLO_8, PLO_{10}
	CLO4	Utilize this knowledge in fish culture and breeding program.	PLO_1, PLO_2, PLO_3, PLO_4, PLO_7, PLO_{10}

Course Contents		CLOs
1	**Introduction:** Introduction to fish Physiology.	CLO1
2	**Temperature regulation:** Classification of fish based on thermal regulation, low and high thermal effect, temperature regulation in homeotherms, fish as poikilotherms, endothermic fishes.	CLO1 and CLO2
3	**Digestion:** Digestion mechanism of different classes of food, role of HCl, bile, enzymes and hormones, gastric evacuation, parameters to study efficiency of digestion, absorption of digested food.	CLO1 and CLO2
4	**Metabolism:** Metabolism and its phases, classification of metabolic rate based on activity levels, factors controlling metabolism in fish.	CLO1, CLO2, and CLO3
5	**Blood circulation:** Mechanism of blood circulation, components of circulatory system, cardiovascular parameters and controlling factors.	CLO3
6	**Respiration:** External and internal respiration, mechanism of gas transport and exchange, factors affecting O2 and hemoglobin affinity, respiratory volume.	CLO1 and CLO2
7	**Excretion and osmoregulation:**	CLO1 and

	Excretory products in different groups of fishes, mechanism of excretion, osmoregulatory mechanisms in hagfish, lamprey, elasmobranches, marine and freshwater teleosts and migratory fishes.	CLO2
8	**Reproductiion:** Reproductive cycle, gonadal maturation environmental and hormonal interplay in controlling reproduction, hypothalamic-pituitary-gonadal axis in fishes, viviparity in fishes, reproductive behavior.	CLO4

Mapping CLOs with the Teaching-Learning and Assessment Strategy		
CLOs	**Teaching-Learning Strategy**	**Assessment Strategy**
CLO1	Lecture, video clips, question and answers	Short answer, Assignment, and one minute paper
CLO2	Lecture, Group Discussion, info graphics, interactive learning	Multiple choice questions, Short answer, Essay, and Presentation
CLO3	Lecture, fish bowl discussion	Quiz, Making posters, Essay, and Presentation
CLO4	Lecture, video clips, Demonstration of artificial breeding techniques	Quiz, Essay, Assignment, and Presentation,

Learning materials

Text Book	1. Evans, D. H. and J. B. Claiborne. 2006. The Physiology of Fishes, 3rd Edition CRC Press: Boca Ration, Florida. 616 pp. 2. Hoar, W. S. and D. J. Randall. 1969-1997 (eds.). Fish physiology. Academic Press Inc. 559 pp. 3. Hoar, W. S. 1983. General and Comparative Physiology. 3rd Edition. New Jersey Prentice-Hall Inc., Eaglewood Cliffs. 4. Ayala, A. G., J. M. Penalver and E. C. Pozo. 2011. Recent Advances in Fish Reproductive Biology. Research Signpost. 200 pp. 5. Bond, C. E. 1996. Biology of Fishes. 2nd Edition. Sunders College Publishing. 750 pp. 6. Brown, M. E. 1957 (ed.). The Physiology of Fishes. Vol. I and II. Academic Press New York and London. 7. Moyle, P. B. and J. J. Cech, Jr. 2000. Fishes: An Introduction to Ichthyology, 4th Edition. Prentice Hall Inc. 744 pp. 8. Wootton, R. J. 2002. Reproductive Biology of Fishes. Iowa State Press. 368 pp.
Supplementary Readings	

Assessment Pattern

CIE- Continuous Internal Evaluation (40 Marks)					
Bloom's Category Marks (out of 40)	**Class test (10)**	**Assignment (05)**	**Notebook/ Presentation (05)**	**Quizzes (10)**	**Attendance (10)**
Remember				05	
Understand	02			05	
Apply	04				
Analyze	04	01			
Evaluate		02			10
Crea te		02	05		

SEE- Semester End Examination (60 Marks)	
Bloom's Category	**Tests**
Remember	5
Understand	5
Apply	20
Analyze	10
Evaluate	10
Create	10

Course Code: 0831FBG222	**Year:** Second	**Semester:** Second
Course Title: Fish Physiology Sessional		
Course Status: Core		
Credit: 1.0		
Prerequisite(s): None		
Rationale	Students will have the opportunity to practice fundamental ideas in fish physiology in the lab, including the histology of several organs, hematology, bioenergetics, and reproductive physiology. In a closely supervised laboratory setting, students will carry out tasks and experiments in which they will use the scientific method to make discoveries.	

	By the end of the course, the students will be able to:		Mapping with PLOs
Course Learning Outcomes (CLOs)	CLO1	Dissect and display the different organs/systems of selected fish.	PLO_6, PLO_7, PLO_{10}
	CLO2	Investigate how various organs and systems interact to carry out a physiological function.	PLO_1, PLO_2, PLO_3, PLO_4, PLO_5, PLO_8, PLO_{10}
	CLO3	Histological observation of fish gills, kidney, liver, intestine and gonad	PLO_2, PLO_3, PLO_4
	CLO4	Assessment of fish physiological adaptation against stress (temperature, salinity,)	PLO_3, PLO_4, PLO_5, PLO_8
	CLO5	Apply physiological concepts in laboratory and field.	PLO_{10}

Course Contents		CLOs
1	Studies of food habit of fishes by gut content analysis	CLO2
2	Test of pepsin enzyme in the stomach	CLO3
3	Study of oxygen consumption under different metabolic levels	CLO3
4	Preparation of blood smear and study on different types of blood cells.	CLO2
5	Counting of RBC and WBC by haemacytometer	CLO4
6	Histological study of fish gills, kidney, liver, intestine, and gonad	CLO1 and CLO3
7	Studies on fish physiological adaptation against stress (temperature, salinity)	CLO4
8	**Class test**	

Mapping CLOs with the Teaching-Learning and Assessment Strategy		
CLOs	**Teaching-Learning Strategy**	**Assessment Strategy**
CLO1	Lecture, Multi-media, Demonstration, Group Work, Presentation	Short answer, Essay, Preparing PNB, Individual demonstration, Poster making, Viva-voce
CLO2	Lecture, Multi-media, Demonstration, Group	Short answer, Essay, Preparing

	Work, Presentation	PNB, Individual demonstration, Poster making, Viva-voce
CLO3	Lecture, Multi-media, Demonstration, Group Work, Presentation	Short answer, Essay, Preparing PNB, Individual demonstration, Poster making, Viva-voce
CLO4	Lecture, Multi-media, Demonstration, Group Work, Presentation	Short answer, Essay, Preparing PNB, Individual demonstration, Poster making, Viva-voce

Learning materials

Text Book	6. Bond, C. E. 1996. Biology of Fishes. 2nd Edition. Sunders College Publishing. 750 pp. 7. Moyle, P. B. and J. J. Cech, Jr. 2000. Fishes: An Introduction to Ichthyology, 4th Edition. Prentice Hall Inc. 744 pp. 8. Schreck, C. B. and P. B. Moyle. 1990 (eds.). Methods for Fish Biology. American Fisheries Society bathesda, Maryland, USA. 684
Supplementary Readings	

Assessment Pattern

CIE- Continuous Internal Evaluation (40 Marks)

Bloom's Category Marks (out of 40)	Class test (10)	Assignment (05)	Notebook/ Presentation (05)	Quizzes (10)	Attendance (10)
Remember				05	
Understand	02			05	
Apply	04				
Analyze	04	01			
Evaluate		02			10
Create		02	05		

SEE- Semester End Examination (60 Marks)

Bloom's Category	Tests
Remember	5
Understand	5
Apply	20
Analyze	10
Evaluate	10
Create	10

Level-2, Semester-II		
Course Code: 0831FMN221	**Year:** Second	**Semester:** Second
Course Title: Inland Fisheries Management		
Course Status: Core		
Credit: 3.0		
Prerequisite(s): None		
Rationale	In this course students will learn the updated knowledge on principles and practices of inland fisheries management for conservation and sustainable exploitation of fisheries resources through lectures and discussion.It covers history and importance of fisheries management, different policies and acts, and latest approach for fisheries management.	

	By the end of the course, the students will be able to:		**Mapping with PLOs**
Course Learning Outcomes (CLOs)	CLO1	Explain various concepts of inland open and close waters in Bangladesh.	PLO1
	CLO2	Describe different types of devices to improve lentic and lotic water environment.	PLO1
	CLO3	Relate various fisheries management policies and regulations for sustainable management of inland fisheries sector.	PLO1, PLO3
	CLO4	Suggest solution for management problems of inland water bodies in Bangladesh.	PLO1, PLO3, PLO8
	CLO5	Adopt appropriate fisheries management approach for sustainable production	PLO1, PLO3
	CLO6	Communicate and work effectively in groups in developing presentations.	PLO5, PLO9, PLO10

Course Contents		CLOs
1	**Introduction:** Concept and history of fisheries management, definition of fisheries management and its branches, importance of life history data in fisheries management.	CLO1
2	**Habitat Restoration:** Fish pass, screens and racks, operation and maintenance, habitat improvement devices for lentic and lotic water environment, management of 'flood control, drainage and irrigation' (FCDI), necessities and development of new fishing water.	CLO2

3	**Fisheries Management Policy of Bangladesh:** Policies and acts of open water fisheries management, management problems of inland water bodies in Bangladesh, mitigation measures.	CLO3
4	**Fisheries Cooperative:** Roles, objectives, general principles, activities and problems of fisheries cooperative, mitigation measures.	CLO5
5	**Community Based Fisheries Management:** Concept, scope and importance, overview, models of community based fisheries management, community based organizations (CBOs), constraints and mitigation measures for community based fisheries management.	CLO5
6	**Haor Fisheries Management:** Concept, overview, reasons for depletion of haor fisheries, social structures in haor regions, approaches to haor fisheries management and their strategies.	CLO4 and CLO5
7	**Sustainable Fisheries Management:** Concept, framework, sustainable management factors (social, economic, environmental and technological aspects).	CLO5
8	**Ecosystem approach of Fisheries management (EAFM):**Definition, components, benefits of EAFM, features of an EAFM, threats and issues in fisheries, fisheries management and the ecosystem approach, comparison of typical existing fisheries management and an EAFM, principles of EAFM, management cycle of EAFM, EAFM process	CLO4 and CLO5

Mapping CLOs with the Teaching-Learning and Assessment Strategy		
CLOs	**Teaching-Learning Strategy**	**Assessment Strategy**
CLO1	Lecturing, Question-Answering, group discussion, Assignment, Graphical presentation	Quiz, Assignment, Short and Narrative question, MCQ, Fill in the Gap
CLO2	Lecturing, Question-Answering, group discussion, Assignment, Graphical presentation	Quiz, Assignment, Short and Narrative question, MCQ, Fill in the Gap
CLO3	Lecturing, Question-Answering, group discussion, Assignment, Graphical presentation	Quiz, Assignment, Short and Narrative question, MCQ, Fill in the Gap
CLO4	Lecturing, Question-Answering, group discussion, Assignment, Graphical presentation	Quiz, Assignment, Short and Narrative question, MCQ, Fill in the Gap
CLO5	Lecturing, Question-Answering, group discussion, Assignment, Graphical presentation	Quiz, Assignment, Short and Narrative question, MCQ, Fill in the Gap
CLO6	Assignment preparation and submission, and Student presentation	Class attendance, individual presentation
Learning Materials		

Text Book	1. Cowx, I. G. 2000. Management and Ecology of River Fisheries. Fishing News Books, Blackwell Science Limited, Oxford OX2 0EL, UK. 2. Templeton, R. G. 1995. Freshwater Fisheries Management. Fishing News Books, Farnham, Surey, UK. 3. Tsai, C. and M. Y. Ali. 1997. Openwater Fisheries of Bangladesh. The University Press Limited, Dhaka 1000, Bangladesh. 4. Welcomme, R. L. 2001. Inland Fisheries: Ecology and Management. Fishing News Books, Farnham, Surrey, UK.
Supplementary Readings	

Assessment Pattern

CIE- Continuous Internal Evaluation (40 Marks)					
Bloom's Category Marks (out of 40)	**Class test (10)**	**Assignment submission (05)**	**Presentation (05)**	**Quizzes (10)**	**Attendance (10)**
Remember				05	
Understand	02			05	
Apply	04				
Analyse	04	01			
Evaluate		02			10
Create		02	05		

SSE- Semester End Examination (60 Marks)	
Bloom's Category	**Tests**
Remember	5
Understand	10
Apply	15
Analyse	15
Evaluate	10
Create	5

Level-2, Semester-II		
Course Code: 0831FMN222	**Year:** Second	**Semester:** Second
Course Title: Inland Fisheries Management Sessional		
Course Status: Core		
Credit: 1.0		
Prerequisite(s): None		
Rationale	In this course students will learn the tools and techniques for field visits and data collection in fisheries, observe fish markets, fishing practices of Paira river and livelihoods of fishermen and also adopt ecosystem approach to fisheries management.	

	By the end of the course, the students will be able to:		Mapping with PLOs
Course Learning Outcomes (CLOs)	CLO1	Explain various tools and techniques for field visits and data collection in fisheries	PLO1, PLO4
	CLO2	Discover the problems of existing fish market, fisheries cooperative society, and community-based fisheries management implemented areas in Bangladesh	PLO 2, PLO6
	CLO3	Observe different fishing practices and livelihood analysis of open water fishers	PLO 5, PLO8
	CLO4	Summarize and assessment of existing fisheries management programs	PLO 2, PLO4

Course Contents		CLOs
1	Acquaintance with Participatory Rural/ Rapid Appraisal (PRA) tools and techniques for field visits and data collection on fisheries.	CLO1
2	Visit to fish markets for observation of marketing systems with its constraints and mitigation measures.	CLO2
3	Survey to observe fishing practices in the Payra river to identify management constraints and mitigation measures.	CLO3
4	Visit to fishing villages on the bank of the Payra river for livelihood analysis of fishers.	CLO3
5	Visit to a fisheries cooperative society to understand how fisheries regulations are being implemented.	CLO2
6	Visit to a place where community based fisheries management are being implemented.	CLO2
7	Field trip to study haor, baor and beel ecosystem of Bangladesh.	

Mapping CLOs with the Teaching-Learning and Assessment Strategy		
CLOs	Teaching-Learning Strategy	Assessment Strategy

CLO1	Lecture, Multi-media presentation, demonstration, Question-Answering, Short video presentation, Lab work, Data collection and management	Quiz, Assignment, Short question, MCQ, Fill in the Gap, Viva voce, Notebook
CLO2	Lecture, Multi-media presentation, demonstration, Question-Answering, Short video presentation, Field visit, Data collection and management	Quiz, Assignment, Short question, MCQ, Fill in the Gap, Viva voce, Notebook
CLO3	Lecture, Multi-media presentation, demonstration, Question-Answering, Short video presentation, Field visit, Data collection and management	Quiz, Assignment, Short question, MCQ, Fill in the Gap, Viva voce, Notebook
CLO4	Lecture, Multi-media presentation, demonstration, Question-Answering, Short video presentation, Field visit, Data collection and management	Quiz, Assignment, Short question, MCQ, Fill in the Gap, Viva voce, Notebook

Learning Materials	
Text Book	Conroy, C. 2002. PRA Tools used for Research into Common Pool Resources. Socio-economic Methodologies for Natural Resources Research. Best Practice Guidelines. Chatham, UK: Natural Resources Institute. DFID (Department for International Development). 1999. Sustainable Livelihoods Guidance Sheets. Department for International Development, London, UK. Engle, C. R. and K. Quagrainie. 2006. Aquaculture Marketing Handbook. Blackwell Publishing Ltd, Oxford OX4 2DQ, UK. Hoggarth, D. D., V. J. Cowan, A. S. Halls, M. Aeron-Thomas, A.J. McGregor, C. A. Garaway, A. I. Payne and R. L Welcomme. 1999. Management Guidelines for Asian Floodplain River Fisheries. FAO
Supplementary Readings	

Assessment Pattern

CIE- Continuous Internal Evaluation (40 Marks)					
Bloom's Category Marks (out of 40)	**Class test (10)**	**Assignment submission (05)**	**Notebook/ Presentation (05)**	**Quizzes (10)**	**Attendance (10)**
Remember				05	

Understand	02			05	
Apply	04				
Analyse	04	01			
Evaluate		02			10
Create		02	05		

SSE- Semester End Examination (60 Marks)	
Bloom's Category	**Tests**
Remember	05
Understand	05
Apply	20
Analyse	10
Evaluate	10
Create	10

Second Year Second Semester		
Course Code: 0831 FST 221	**Year:** Second	**Semester:** Second
Course Title: FishFood Properties, Losses and Wastes		
Course Status: Core		
Credit: 2.0		
Prerequisite(s): None		
Rationale	The course provides a wide coverage of most fundamental and advanced aspects on food products including the chemical compositions, nutritive value, nature and characteristics of different chemical components of food products especially fish and shellfish which ultimately determine the food quality, processability and shelf life of food products. This course covers the losses and mitigations of fishery resources and also utilization of these products through recycling management.	

	By the end of the course, the students will be able to:		**Mapping with PLOs**
Course Learning Outcomes (CLOs)	CLO1	Describe the major classification of food on their nutritional aspect.	PLO1 & PLO4
	CLO2	Analyze the nutritive value, their function and mechanisms in production of different types of fish and shellfish products.	PLO1
	CLO3	Evaluate the post-harvest fishery loss through different techniques and practices of loss	PLO2

		mitigation measures through policy recommendations.	
	CLO4	Compare different fishery waste at different level of marketing and utilization and management of wastes used as renewable energy sources by recycling technology.	PLO6 & PLO7

Course Contents		CLOs
1	**Major groups of fish food:** Scope and importance of fish food products and aquatic organisms: Fish, crustaceans, mollusks and marine algae.	CLO1
2	**Protein in fish foods:** Definition, classification and structure of protein and amino acids, structural components and their characteristics in fish muscle protein, stability and gelation properties of fish muscle proteins, changes of protein during processing and preservation of fish and shellfish.	CLO2, CLO4 & CLO5
3	**Lipid in fish foods:** Definition,types, structure of lipid, fatty acid,and their variations. Saturated and (poly)unsaturated fatty acids, fatty acids in hilsa and other seafood, denaturation and rancidity of seafood lipid.	CLO2, CLO3, CLO4, CLO5
4	**Vitamins and minerals in fish foods:**Definition,types of vitamins (fat- and water-soluble) in fish; inorganic matter in fish and shellfish. Effect of processing and preservation on vitamins and mineral composition.	CLO2, CLO3 & CLO4
5	**Flavor compounds and bio-toxins in fish foods:** Nitrogenous and volatile compounds in fish food. Toxins in marine vertebrates, invertebrates, seaweed and plankton.	CLO2, CLO3, CLO4 & CLO5
6	**Fish food loss and mitigations:** Scopes and types of fish food losses; assessments of post-harvest losses in fish; market loss, quantitative loss and qualitative loss (sensory, chemical and bacteriological) of fish, loss reduction measures, policy recommendations to minimize post-harvest loss.	CLO3, CLO4 & CLO5
7	**Fish food wastes and utilizations:** Types and nature of fishery waste (farmed wastes, market wastes and industry wastes), solid and liquid waste, waste management in factory and their recycling and utilization.	CLO2, CLO3, CLO4 & CLO5

Mapping CLOs with the Teaching-Learning and Assessment Strategy		
CLOs	**Teaching-Learning Strategy**	**Assessment Strategy**
CLO1	Lecture and presentation	Quizzes and short questions
CLO2	Lecture, presentation and discussion	Quizzes, short questions,

		assignment and poster submission
CLO3	Lecture, presentation, question answering, discussion and video clip	Short questions and assignment, narrative questions
CLO4	Lecture, presentation, discussion, simulation and video clips	Short questions, assignment and narrative questions
CLO5	Lecture, presentation, question answering, discussion and project	Assignment, short questions and narrative questions

Learning Materials	
Text Book	1. Hall, G. M. 1997. Fish processing technology. Blakie Academic & Professional, London, Weinheim, New York, Melbourne, Madras. 2. Huss, H. H., M. Jakobsen, and J. Liston. 1992. Quality assurance in fish industry. In Development in Food Science, Elsevier, Amsterdam, London, New York, Tokyo. 3. Ruiter, A. 1995. Fish and Fishery Products: composition, nutritive properties and stability, Cab International. 4. Balachandran, K. K. 2001. Post-harvest Technology of Fish and Fish Products. Daya Publishing House, Delhi – 110035. India. 440 pp.
Supplementary Readings	1. Nowsad, A. K. M. A. 2007. Participatory Training of Trainers: A New Approach Applied in Fish Processing. Bangladesh Fisheries Research Forum. Bangladesh. 326 pp. 2. Stansby, M.E. 1963. Industrial Fishery Technology. Krieger Publ. Co., Hunligton, New York. 3. Nowsad, A. K. M. A. 2007, Post-harvest Fishery Losses and Mitigation Measures, Fish Processing and Quality Control, Department of Fisheries Technology, BAU.

Assessment Pattern

CIE- Continuous Internal Evaluation (40 Marks)					
Bloom's Category Marks (out of 40)	**Class test (10)**	**Assignment (05)**	**Notebook/ Presentation (05)**	**Quizzes (10)**	**Attendance (10)**
Remember				05	
Understand				05	
Apply	02	01			
Analyze	03	02			
Evaluate	04	02			10
Create	01		05		

SEE- Semester End Examination (60 Marks)	
Bloom's Category	**Tests**
Remember	5
Understand	5
Apply	10
Analyze	10
Evaluate	20
Create	10

Course Code: 0831 MFO 221	**Level: 2**	**Semester: II**
Course Title: Biological and Chemical Oceanography		
Department: Core		
Credit Hours: 3.0		
Prerequisite(s): None		
Rationale	The course is designed to know about the factors responsible of productivity, population dynamics, abundance and distribution of organisms in ecosystems of marine environment. This course also will give knowledge on marine chemistry as composition and elements of seawater, seawater chemistry and marine biogeochemical cycles.	

	By the end of the course, the students will be able to:		**Mapping with PLOs**
Course Learning Outcomes (CLOs)	CLO 1	Describe different flora and fauna of the ocean including plankton, fishes and benthos.	PLO_1, PLO_2,
	CLO 2	Learn about the distribution, migration, its relationship with seasonality and life cycle pattern of marine organisms.	PLO_1, PLO_2, PLO_3
	CLO 3	Describe the generaldistributionofthechemicalpropertiesoftheocean and the biogeochemical cycleswhichprocessesinfluencesthecycling.	PLO_1, PLO_2, PLO_9
	CLO 4	Explain the effect of organic matter, nutrient on water chemistry and marine life.	PLO_1, PLO_2, PLO_5
	CLO 5	Analyze differentissuesof biological and chemical oceanography.	PLO_1, PLO_2, PLO_5

Course Contents	**CL O**

1	**Introduction:** Scope and history of biological and chemical oceanography, major biological and chemical features of the ocean, biological and chemical properties of sea water, properties affecting life in the sea, classifications of marine environments and marine biological organisms.	CLO 1
2	**Phytoplankton and zooplankton:** Phytoplankton: concept,taxonomy of marine phytoplankton,description, distributionandimportanceofphytoplankton; neritic and oceanic plankton, photosynthesis and primary production, compensation depth, physical controls of primary production, global phytoplankton productivity, productivitymeasurementof phytoplankton. Zooplankton: concept,taxonomy of major marinezooplankton, classifications, distribution, migration in the oceans; factorsaffectingthegrowthandabundanceofphytoplanktonandzooplanktoninthecoastalandopenwater.	CLO 1, CLO 2
3	**Abiotic environment:** Solar radiation, temperature, biological significance of sea temperature, salinity, biological significance of salinity, density, biological significance of density, sea surface current, biological significance of sea surface current, energy flow and mineral cycling (open ocean, continental shelf, upwelling regions). marine food webs, food chain, microbial loop.	CLO 1, CLO 2, CLO 4
4	**Benthos:** Concept,taxonomy of major marine benthic communities,classificationofbenthosintheocean, distributionofseafloor, benthicfloraandfaunaandtheirverticalstratification,aerobicandanaerobic organisms; kelp forests; hydrothermal vents and cold seeps communities.	CLO 1, CLO 2, CLO 4
5	**Seawater:** Salinity, chlorinity, and conductivity,solubility of salts, constancy of composition, variations in salinity, chemical and physical methods for salinity measurement, relationships between chlorinity and salinity, the vapor phase, comparison of seawater with other natural waters, freezing point and boiling point of sea water.	CLO 3, CLO 4
6	**Major and Minor Constituents of Seawater:** Major constituents of seawater, solutes of seawater, sources of seawater components, classifications, residence times of major constituents, trace and minor elements, various patterns of distribution of minor elements, principle of constant proportion.	CLO 3, CLO 5
7	**Gases and Nutrients:** Concept, solubility of major gases in water, sources of dissolved gases, atmospheric exchange, dissolved gases as tracers, air-sea interaction, dissolved gasses and dissolved organic material in seawater, nutrients in the sea,redfield ratio, biological roles of nutrients; carbon, nitrogen, phosphorous and silicon; its forms of occurrence in seawater, oceanic distribution of those and its cycle; eutrophication, red-tide, ocean acidification, bio-geo-chemistry of the Bay of Bengal.	CLO 3, CLO 4, CLO 5

Mapping CLOs with the Teaching-Learning and Assessment Strategy		
CLOs	**Teaching-Learning Strategy**	**Assessment Strategy**
CLO 1	Lecture using board/LCD projectors	Assignment, Presentation, Mid Term Examination
CLO 2	Lecture using board/LCD projectors, Group discussion, Workshop	Quiz, Class test (Short Q and MCQ)
CLO 3	Lecture using board/LCD projectors, Visual presentation, Case study/Tutorial	Summative Assessment (SA)
CLO 4	Audio-visual teaching aids (film and documentaries, virtual classroom, etc.)	Short and Narrative question
CLO 5	Self-learning using reference books/research articles/case study/other online materials	Semester-end examination
CLO 6	Animated VDO clips, Question-Answer session	Essay type test, problem solving
CLO 7	Case study	Presentation, Summative Assessment (SA)

Learning Materials	
Text Book	1. Biological Oceanography an Introduction, Carol M. Lalli & Timothy R. Parsons. 2. BiologicalOceanography,Miller,C.B.andWheeler,P.A.2012.2ndEdition. WileyBlackwell. 3. BiologicalOceanographicProcesses,T.R.Parsons,M.Takahashi andB.Hargrave. 4. Riley, J.P. and Skirrow, 1975-1984. Chemical Oceanography Vols. 1 to 8. Academic Press,London. 5. MilleroF.J 2002.ChemicalOceanographyCRCpress. Hill,M.N.1963.TheSeaVols.1to3.Inter sciencePublishers,NewYork. 6. An Introduction to the Chemistry of the Sea, Michael E. Q. Pilson, 2nd Edition, Cambridge University Press, 2013.
Supplementary Readings	1. Pilson,M.E.Q.,1998.An IntroductiontotheChemistryoftheSea PrenticeHall NewJersey. 2. Plankton and Productivity in the Oceans, by J. E. G. Raymount, Pergamon, ISBN: 0080215513.

Assessment Pattern

CIE- Continuous Internal Evaluation (40 Marks)					
Bloom's Category Marks (out of 40)	**Class test (10)**	**Assignment (05)**	**Notebook/ Presentation (05)**	**Quizzes (10)**	**Attendance (10)**
Remember				05	

Understand	02			05	
Apply	04				
Analyze	04	01			
Evaluate		02			10
Create		02	05		

SEE- Semester End Examination (60 Marks)	
Bloom's Category	**Tests**
Remember	5
Understand	5
Apply	20
Analyze	10
Evaluate	10
Create	10

Course Code: 0831 MFO 222	**Level: 2**	**Semester: II**
Course Title: Biological and Chemical Oceanography Sessional		
Department: Core		
Credit Hours: 1.0		
Prerequisite(s): None		
Rationale	The aim of this course that student willacquire practical knowledge about marine biology and chemistry of ocean science. It helps student to learn practical knowledge of marine biology and practical quantitative and analytical process in marine chemistry.	

	By the end of the course, the students will be able to:		**Mapping with PLOs**
Course Learning Outcomes (CLOs)	CLO 1	Identify, collect and preserve marine organisms.	PLO_1, PLO_2
	CLO 2	Biology of different important marine organisms of Bangladesh.	PLO_1, PLO_2
	CLO 3	Estimate productivity the marine organisms.	PLO_1, PLO_2, PLO_3
	CLO 4	Analyze the composition of seawater and determine various biological parameters in seawater.	PLO_1, PLO_2, PLO_9
	CLO 5	Understand practical knowledge on the influence of different chemical parameters on the oceanic system.	PLO_1, PLO_2, PLO_5

	CLO 6	Analyze, present, and discuss different issues of chemical oceanography.	PLO_1, PLO_2, PLO_5

Course Contents		CLOs
1	Collection, preservation and identification of marineplankton, benthic organisms, crustaceans, mollusk and fishes of the Bay of Bengal.	CLO 1
2	Biologyof different important marineorganisms.	CLO 2
3	Measurementofthebiologicalproductivityofmarine waters.	CLO 3
4	Determinationof salinity, pH,DO, BOD, COD, alkalinity, hardness andmajor elementsofsea water.	CLO 4, CLO 5
5	Fieldtripforstudyingthecoastal& mangrove floraand faunaof Bangladesh.	CLO 1
6	Fieldtrip to Bay of Bengal forstudyingthemarine phytoplankton, zooplankton, floraand fauna.	CLO 1, CLO 2
7	Fieldtrip to Bay of Bengal for determinationof salinity, pH,DO, BOD, COD, chlorophyll-a concentration, alkalinity and hardness.	CLO 4, CLO 5, CLO 6

Learning Materials	
Text Book	1. Biological Oceanography an Introduction, Carol M. Lalli & Timothy R. Parsons. 2. Ecologyof Plankton,A.Kumar. 3. MilleroF.J 2002.ChemicalOceanographyCRCpress. Hill,M.N.1963.TheSeaVols.1to3.Inter sciencePublishers,NewYork.
Supplementary Readings	1. Pilson,M.E.Q.,1998.An IntroductiontotheChemistryoftheSea PrenticeHall NewJersey. 2. Strickland J.D.H and T.R Parson 1972. A Practical handbooks of seawater analysis. Fisheries Research Board of Canada,Ottawa,Bulletin 167. 3. Plankton and Productivity in the Oceans, by J. E. G. Raymount, Pergamon, ISBN: 0080215513. 4. MarineChemistry,byMartin.

Assessment Pattern

CIE- Continuous Internal Evaluation (40 Marks)					
Bloom's Category Marks (out of 40)	**Class test (10)**	**Assignment (05)**	**Notebook/ Presentation (05)**	**Quizzes (10)**	**Attendance (10)**
Remember				05	
Understand				05	
Apply	02	01			
Analyze	03	02			
Evaluate	04	02			10
Create	01		05		

SEE- Semester End Examination (60 Marks)

Bloom's Category	Tests
Remember	5
Understand	5
Apply	10
Analyze	10
Evaluate	20
Create	10

B.Sc. Fisheries (Hons) 4th Semester (L-2,S-2)

Course Code: STT 221 Course Title: Statistics

Credit hour: 03

Rationale

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

Course Learning Outcomes (CLO)

1. Identify different types of variable and draw appropriate diagram.
2. Discuss the measure of location, dispersion and shape characteristics of a frequency distribution.
3. Illustrate basic terminology, laws and distributions of probability.
4. Estimate the linear relationship between two variables and execute the testing procedure of hypotheses regarding parameters of the population.
5. Explain appropriate experimental data and conduct analysis of variance

Mapping CLO with PLO

CLO/PLO	PLO1	PLO2	PLO3	PLO4	PLO5
CLO 1					
CLO 2					
CLO 3					
CLO 4					
CLO 5					

Summary of course content

Course Content	Aligned CLO
Introduction: Definition, scope and limitations of Statistics. Define variable and different types of variables.	1
Frequency distribution: Construction of frequency distribution. Graphical representation.	1&2
Measures of location and dispersion: Measures of location, variation and shape characteristics of frequency distribution.	2
Probability and probability distribution: Random experiment, outcome, sample space, events, mutually exclusive, equally likely, independent and dependent events, mathematical and statistical definitions of probability, compound and conditional probability, laws of probability, random variable, probability function, probability distribution, Binomial distribution, Poisson distribution and Normal distribution.	3
Define various types of correlation with scatter diagram, Correlation and regression: Methods of studying correlation, Simple correlation and regression, Pearson's correlation coefficient with its properties, concept of regression and estimation procedure of regression model.	4

Test of hypothesis: Population and sample, hypothesis, null and alternative hypotheses, type I error, type II error, level of significance, basic steps for testing hypothesis, Statistical tests: a population mean is equal to a specified value, equality of two population means (independent & correlated), significance of correlation and regression coefficients, independence of attributes.	4
Experimental design: Basic concepts and principles of experimental design, purposes of experimental design, completely randomized design (CRD) and randomized block design (RBD), Latin square design, split plot design & Multiple comparison test.	5
Total No. of Lectures	**48**

Teaching Strategy

- Lectures
- Problem-based learning
- Interactive learning
- Group studies and discussion.

Assessment Strategy

- MCQ test
- Written test
- Oral test and
- Assignments.

Books recommended

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

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

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

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

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

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

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

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

Assessment Pattern

CIE- Continuous Internal Evaluation (40 Marks)					
Bloom's Category Marks (out of 40)	**Class test (10)**	**Assignment submission (05)**	**Presentation (05)**	**Quizzes (10)**	**Attendance (10)**
Remember				05	
Understand	2			05	
Apply	4	01			
Analyze	4				
Evaluate		02			10
Create		01	05		

SSE- Semester End Examination (60 Marks)	
Bloom's Category	**Tests**
Remember	5
Understand	10
Apply	15
Analyze	15
Evaluate	10
Create	5

B.Sc. Fisheries (Hons) 4th Semester (L-2, S-2)

Course Code: STT 222 Course Title: Statistics

Credit hour: 01

Rationale

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

Course Learning Outcomes (CLO)

1. Identify different types of variable and draw appropriate diagram.
2. Compute the measure of location, dispersion and shape characteristics of a frequency distribution.
3. Measure the linear relationship between two variables and interpret the coefficients.
4. Perform the testing procedure of hypotheses regarding parameters of the population.
5. Conduct analysis of variance (ANOVA) and perform multiple comparison tests.

Mapping CLO with PLO

CLO/PLO	PLO1	PLO2	PLO3	PLO4	PLO5
CLO 1					
CLO 2					
CLO 3					
CLO 4					
CLO 5					

Summary of course content

Course Content	Aligned CLO
Frequency distribution: Construction of frequency distribution tables and their graphical representation.	1
Measures of location and dispersion: Measures of location and variation, measures of moments, skewness and kurtosis.	2
Correlation and regression analysis: Pearson's correlation coefficient, fitting linear regression to observed data by the method of least squares.	3
Test of hypothesis: A population mean is equal to a specified value, equality of two population means (for both independent & correlated samples), a population proportion is equal to a specified value, equality of two population proportions, independence of attributes, significance of correlation and regression coefficients.	4
Experimental design: Analysis of variance for completely randomized design (CRD) and randomized block design (RBD),), Latin square design, split plot design & Multiple comparison test.	5
Total No. of Lectures	**16**

Teaching Strategy

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

Assessment Strategy

 MCQ test
 written test
 oral test and
 assignments.

Books recommended

Ahmed A. R., M. A. A. Bhuiyan, Z. A. Reza and M. Z. Hossain (2007). *Methods of Statistics*. 6th edition, S. Ahmed & Associates, Manikgonj.
Gomez, A. K. and A. A. Gomez (2010). *Statistical Procedures for Agricultural Research.* 2nd edition. Wiley-India.
Gupta, S. C. and V. K. Kapur (2007). *Fundamentals of Mathematical Statistics*. 12th edition, Sultan Chand & Sons, New Delhi.
Islam, M. N. (2011). *An Introduction to Statistics and Probability*, 3rd edition, Mullick & Brothers, Dhaka.
Montogomery, D. C. (2012). *Design and Analysis of Experiments*, 8th Edition, John Wiley & Sons.
Mood, A. M., Graybill, F. A. and D. C. Boes (1974). *Introduction to the Theory of Statistics*, 3rd edition. McGraw-Hill.
Rangaswamy, R. (2013). *A Textbook of Agricultural Statistics*, 2nd edition, New Age International (P) Limited, Publishers, India.
Steel, R. G. D. and J. H. Torrie (1980). *Principles and Procedures of Statistics*, McGraw-Hill International Book Company, New York.
Zaman, S. M. H., K. Rahim and M. Howlader (1982). Simple Lessons from Biometry. Joydebpur, Dhaka, Bangladesh.

Assessment Pattern

CIE- Continuous Internal Evaluation (40 Marks)					
Bloom's Category Marks (out of 40)	**Class test (10)**	**Assignment (05)**	**Notebook/ Presentation (05)**	**Quizzes (10)**	**Attendance (10)**
Remember				05	
Understand				05	
Apply	02	01			
Analyze	03	02			
Evaluate	04	02			10
Create	01		05		

SEE- Semester End Examination (60 Marks)	
Bloom's Category	**Tests**
Remember	5
Understand	5
Apply	10
Analyze	10
Evaluate	20
Create	10

Course Code: 0831 AQC 311	Level-3	Semester-I
Course Title: Fish Pathology		
Course Status: Core		
Credit: 2.0		
Prerequisite(s): None		
Rationale	This course is designed to provide a broad theoretical knowledge on disease producing factors, signs & symptoms of diseases, epizootiology of pathogens, diagnosis methods of pathogens and distribution of pathogens.	

Course Learning Outcomes (CLOs)	**By the end of the course, the students will be able to:**		**Mapping with PLOs**
	CLO1	Classify fish pathogens	PLO_1, PLO_2, PLO_3
	CLO2	Categorize infectious and non-infectious diseases of fish and shellfish	PLO_1, PLO_2, PLO_3
	CLO3	Explain systemic pathologies of diseased fish and shellfish	PLO_1, PLO_2, PLO_3
	CLO4	Evaluate different diagnosis methods for identification of pathogens	PLO_1, PLO_2, PLO_3

	Course Contents	**CLOs**
1	Introduction: Pathological terminology, significance of fish pathology, factors producing diseases in fishes, degrees of infection.	CLO1 and CLO2
2	Systemic pathology of diseased fish: Circulatory,respiratory, musculo-integumental, gill, digestive and renal pathologies.	CLO2 and CLO3
3	Viral fish diseases: Viral diseases with their etiology, epizootiology, symptoms, pathology, diagnosis and distribution.	CLO4
4	Bacterial fish diseases: Bacterial diseases with their etiology, epizootiology, symptoms, pathology, diagnosis and distribution	CLO4
5	Fungal fish diseases: Fungal diseases with their etiology, epizootiology, symptoms, pathology, diagnosis and distribution.	CLO4

6	Shellfish disease: Bacterial, viral, and fungal diseases.	CLO4
7	Non-infectious fish diseases: Environmental, nutritional and hereditary diseases of fishes.	CLO4

Mapping CLOs with the Teaching-Learning and Assessment Strategy		
CLOs	**Teaching-Learning Strategy**	**Assessment Strategy**
CLO1	Lecture, Assignment,Presentation, Question-Answering	Quiz, Assignment, Presentation Short and Narrative question.
CLO2	Lecture, Group discussion, Presentation, Question-Answering	Quiz, Presentation, Short and Narrative question.
CLO3	Lecture, Assignment, Presentation, Question-Answering	Assignment, Presentation Short and Narrative question.
CLO4	Lecture, Assignment, Presentation, Question-Answering	Assignment, Presentation Short and Narrative question.

Learning Materials	
Text Book	1. Inglis, V., R. J. Roberts and N. R. Bromage. 1993. Bacterial Diseases of fish. Blackwell Science. 320 pp. 2. Roberts, R. J. 1989 (ed.). Fish Pathology 2nd Edition.Bailliers and Tindall.London. 467 pp. 3. Wolf, K. 1988. Fish viruses and fish vrral diseases. Comstock publishing associates, Cornell University.Press, London.476 pp. 4. Plumb, J. A. 1999. Health Maintenance of Cultured Fishes: Principal Microbial Diseases. Iowa State University Press.254 pp.
Supplementary Readings	1. Austin, B and D. A. Austin. 1999. Bacterial fish pathogens: Disease of farmed and wild fish. Ellis Horwood, England. 2. Egusa, S. 1992. Infectious diseases of fish. Oxonian Press Ltd. New Delhi. 3. Ferguson, H. W. 1989. Systemic Pathology of Fish. Iowa State University Press. 4. McMillan, T. 2000. Fish histology. Chapman & Hall. 5. Noga E. J. 2000. Fish disease: diagnosis and treatment. Iowa State University Press. 6. Post, G. 1987. Textbook of fish health. T.F. H. Publications, Inc. USA. 7. Roberts. R. J. 1982 (ed.). Microbial diseases of fish. Academic Press.

Assessment Pattern

CIE- Continuous Internal Evaluation (40 Marks)					
Bloom's Category Marks (out of 40)	**Class test (10)**	**Assignment submission (05)**	**Presentation (05)**	**Quizzes (10)**	**Attendance (10)**
Remember				05	
Understand	2			05	
Apply	4	01			
Analyze	4				
Evaluate		02			10
Create		01	05		

SSE- Semester End Examination (60 Marks)	
Bloom's Category	**Tests**
Remember	5
Understand	10
Apply	15
Analyze	15
Evaluate	10
Create	5

Course Code: 0831 AQC 312	Level-3	Semester-I
Course Title: Fish Pathology Sessional		
Course Status: Core		
Credit: 1.0		
Prerequisite(s): None		

Rationale	The course will provide the students with practical knowledge and skills on various fish microbial pathogens and associated diseases with their diagnosis to reduce the impacts of various infections in the aquaculture systems.

	By the end of the course, the students will be able to:		**Mapping with PLOs**
Course Learning Outcomes (CLOs)	CLO1	Isolate and identify pathogenic virus, bacteria and fungus from diseased fish	PLO3, PLO4
	CLO2	Detect fish and shellfish diseases under laboratory and field condition	PLO3, PLO4

	CLO3	Analyze histopathological changes of different tissues and organs of diseased fish	PLO3, PLO4
	CLO4	Organize field trips to public and private fish farms for practical exposure	PLO5, PLO6

Course Contents		CLOs
1	Laboratory and field level fish disease diagnosis techniques for pathogenic viral, bacterial and fungal identification.	CLO1
2	Study on pathological signs of diseased fish under laboratory and field condition.	CLO2
3	Histopathological techniques: Sampling, tissue processing, microtomy, staining, mounting and microscopic observation.	CLO3
4	Observation of histopathological changes of different tissues and organs of diseased fish.	CLO3
5	Field trips to public and private fish farms for practical exposure	CLO4

Mapping CLOs with the Teaching-Learning and Assessment Strategy		
CLOs	**Teaching-Learning Strategy**	**Assessment Strategy**
CLO1	Lecture, Microscopic demonstration, Question-Answering	Quiz, Identification, Short and Narrative question, Practical Note Book, Viva voce.
CLO2	Lecture, Demonstration, Group discussion, Question-Answering	Quiz, Observation, Short and Narrative question, Practical Note Book, Viva voce.
CLO3	Lecture, Demonstration, Group discussion, Question-Answering	Short and Narrative question, Practical Note Book, Viva voce.
CLO4	Lecture, Field visit, Question-Answering	Report writing, Short and Narrative question, Practical Note Book, Viva voce.

Learning Materials	
Text Book	1. Bullock, G. L. 1980. Identification of fish pathogenic bacteria. TFH publication. 2. Chainabut, S. and R. J. Roberts. 1999. Pathology and histopathology of epizootic ulcerativesyndrome (EUS), AAHRI, Department of Fisheries, Bangkok, Thailand. 3. Frerichs, N. G. and S. D. Millar. 1993. Manual for the isolation and identification of fish bacterial pathogens. Pisces Press, Starling. 4. Noga E. J. 2000. Fish disease: diagnosis and treatment. Iowa State University Press. 5. Tonguthai, K. S. Chainabut, T. Somsiri, Chanracchkakool and S. Kanchanakhan. 1999. Diagnostic procedure for finfish diseases. Aquatic Animal Health Research Institute, Department of Fisheries, Bangkok, Thailand.
Supplementary Readings	

Assessment Pattern

CIE- Continuous Internal Evaluation (40 Marks)					
Bloom's Category Marks (out of 40)	**Class test (10)**	**Assignment (05)**	**Notebook/ Presentation (05)**	**Quizzes (10)**	**Attendance (10)**
Remember				05	
Understand	02			05	
Apply	04				
Analyze	04	01			
Evaluate		02			10
Create		02	05		

SSE- Semester End Examination (60 Marks)	
Bloom's Category	**Tests**
Remember	5
Understand	5
Apply	20
Analyze	10
Evaluate	10
Create	10

Course Code: 0831 GED 311	**Year-**Third	**Semester-**One
Course Title: Principles of Genetics		
Course Status: Core		
Credit: 3.0		
Prerequisite(s): None		
Rationale	Students will learn the basics of genetics, including the nature and structure of genetic materials, heredity principles, gene interactions and alterations, sex determination mechanisms, and phenotypic expression of genes, in order to apply their knowledge of genetics to improving fish populations.	

	By the end of the course, the students will be able to:		**Mapping with PLOs**
Course Learning Outcomes (CLOs)	CLO 1	Explain different terms of genetics, genetic material, Mendel's Life, laws of Mendel.	$PLO_{1,}$ PLO_2 PLO_4
	CLO 2	Outline the cell, cell cycle and its significance, cell division and gametogenesis.	$PLO_{1,}$ PLO_2 PLO_3
	CLO 3	Illustrate the sex determination system of fishes and sex related traits.	$PLO_{1,}$ $PLO_{2,}$ PLO_9
	CLO 4	Discuss the regulatory mechanism of gene expression.	$PLO_{1,}$ $PLO_{2,}$ PLO_{10}
	CLO 5	Experiment with mutation, and its effects on gene expression.	PLO5
	CLO 6	Communicate scientific concepts both verbally and in writing	$PLO_{1,}$ PLO_2 PLO_4

Course Contents		**CLOs**
1	**Introduction:** Milestones, branches, scope and significance of genetics.	CLO1
2	**Cell mechanics:**Introduction to prokaryotic and eukaryotic cells, constituents of eukaryotic cells and their functions, cell division and gametogenesis.	CLO2
3	**Genetic material:** Composition of eukaryotic chromosomes, packaging DNA molecule into chromosomes, variation in chromosome number, organization of a eukaryotic gene, DNA and RNA structure, DNA replication.	CLO4
4	**Mendelian genetics:** Mendel and his works, Mendel's laws of inheritance, interaction of genes, complete and incomplete dominant gene action, additive gene action, epistasis, epistatic and non-epistatic interaction, multiple allelism, lethal genes, pleiotropy; penetrance and	CLO1 and CLO6

	expressivity, linkage and crossingover.	
5	**Sex determination and sex chromosome:** Different sex determining systems, sex-linked inheritance, sex-linked, sex-influenced and sex-limited traits.	CLO 3
6	**Phenotypic expression of genes:** Transcription and translation, the genetic code and its properties; regulation of gene expression.	CLO 4
7	**Mutation:** Types of mutation and chromosomal aberration, practical application of mutations.	CLO 5

Mapping CLOs with the Teaching-Learning and Assessment Strategy		
CLOs	**Teaching-Learning Strategy**	**Assessment Strategy**
CLO1	Lecturing, Group discussion, Interactive learning, Question-Answering	Quiz, Assignment, observation, Short and Narrative question.
CLO2	Lecturing, group discussion, presentation, Visualization, Socratic method, Question-Answering	Quiz, Artefacts Short and Narrative question
CLO3	Lecturing, group discussion, presentation, assignment, Question-Answering	Quiz, one minute paper, Short and Narrative question
CLO4	Lecturing, group discussion, presentation, visualization, Socratic method, Question-Answering	Quiz, Infographics, Short and Narrative question
CLO5	Lecturing, group discussion, presentation, assignment, Question-Answering	Quiz, Open book exam, Short and Narrative question

Learning Materials	
Text Book	1. Gardner, E. J, Simmons, M. J. and Snustad, D. P. 1991. Principles of Genetics (8th Edition), John Willey and Sons, Inc. 736 pp. 2. Strickberger, M. W. 1990. Genetics (3rd Edition), Macmillan Publishing Co, NY. 3. Tave, D. 1993. Genetics for Fish Hatchery Managers, 2nd Edition. Van Nostrand Reinhold, New York. 415 pp. 4. Verma, P. S. and V. K. Agarwal. 1989. Genetics. S. Chand and Company Ltd. Ram Nagar, New Delhi-110055. 5. Alberts, B., A. L. Johnson, J. Raff, M. Roberts and P. Walter. 2008. Molecular Biology of the Cell. 5th Edition. Garland Science (Taylor and Francis Group).
Supplementary Readings	

Assessment Pattern

CIE- Continuous Internal Evaluation (40 Marks)					
Bloom's Category Marks (out of 40)	**Class test (10)**	**Assignment (05)**	**Notebook/ Presentation (05)**	**Quizzes (10)**	**Attendance (10)**
Remember				05	
Understand	02			05	
Apply	04				
Analyze	04	01			
Evaluate		02			10
Create		02	05		

SEE- Semester End Examination (60 Marks)	
Bloom's Category	**Tests**
Remember	5
Understand	5
Apply	20
Analyze	10
Evaluate	10
Create	10

Course Code: 0831 GED 312	**Year-**Third	**Semester-**One
Course Title: Principles of Genetics Sessional		
Course Status: Core		
Credit: 1.0		
Prerequisite(s): None		
Rationale	Students will achieve skills in studying cell division, chromosome preparation and DNA extraction, mathematical interpretation of Mendelian inheritance, and sex ratio analysis in order to apply their understanding of genetics for genetic improvement of fish.	

	By the end of the course, the students will be able to:		**Mapping with PLOs**
Course Learning Outcomes (CLOs)	CLO 1	Prepare and demonstrate chromosomes from fish larvae.	PLO_1, PLO_2, PLO_9
	CLO 2	Resolve problems in Mendelian crossing experiments to analyze phenotypic classes.	PLO_1, PLO_2 PLO_3, PLO_9, PLO_{10}
	CLO 3	Isolate genomic DNA from fish tissues.	PLO_1, PLO_9, PLO_{10}
	CLO 4	Communicate scientific concepts both verbally and in writing	PLO_1, PLO_2 PLO_4

Course Contents		**CLOs**
1	Study of cell division, chromosome preparation from tissue or embryo	CLO1
2	Exercise on inheritance of qualitative phenotypes; pedigree analysis and chi-square test.	CLO2
3	Lab work on genomic DNA isolation from fish tissue or embryos.	CLO3

Mapping CLOs with the Teaching-Learning and Assessment Strategy		
CLOs	**Teaching-Learning Strategy**	**Assessment Strategy**
CLO1	Lecturing, demonstration, group discussion, presentation, assignment, Question-Answering	Quiz, Assignment, Viva voce, Short and Narrative question.
CLO2	Lecturing, demonstration, group discussion, presentation, assignment, Question-Answering	Quiz, Assignment, Viva voce, Short and Narrative question, problem solving.
CLO3	Lecturing, demonstration, group discussion, presentation, assignment, Question-	Quiz, Assignment, Viva voce, Short and Narrative question,

	Answering	identification of laboratory equipment and materials.
CLO4	Lecturing, demonstration, group discussion, presentation, Question-Answering	Quiz, Assignment, Viva voce, Short and Narrative question

Learning Materials	
Text Book	1. Krauter, K. and M. Winey. 2012. Practical Genetics for the 21st Century. Flat world Knowledge. 2. Tave, D. 1993. Genetics for Fish Hatchery Managers, 2nd Edition. Van Nostrand Reinhold, New York. 3. Gardner, E. J, Simmons, M. J. and Snustad, D. P. 1991. Principles of Genetics (8th Edition), John Willey and Sons, Inc. 736 pp.
Supplementary Readings	

Assessment Pattern

CIE- Continuous Internal Evaluation (40 Marks)					
Bloom's Category Marks (out of 40)	**Class test (10)**	**Assignment (05)**	**Notebook/ Presentation (05)**	**Quizzes (10)**	**Attendance (10)**
Remember				05	
Understand	02			05	
Apply	04				
Analyze	04	01			
Evaluate		02			10
Create		02	05		

SEE- Semester End Examination (60 Marks)	
Bloom's Category	**Tests**
Remember	5
Understand	5
Apply	20
Analyze	10
Evaluate	10
Create	10

Level-3, Semester-I		
Course Code: 0831 FMN 311	**Year:** Third	**Semester:** First
Course Title: Hilsa Fisheries Management and Conservation		
Course Status: Core		
Credit: 2.0		
Prerequisite(s): None		
Rationale	This course is design to provide B.Sc. Fisheries (Hons.) students an opportunity regarding fisheries resources of Bangladesh, conservations and management techniques and future strategies focusing on distribution, mitigation, protection and sustainable management of these resources.	

	By the end of the course, the students will be able to:		**Mapping with PLOs**
Course Learning Outcomes (CLOs)	CLO1	Concept of fisheries resources of Bangladesh, different water bodies and their production, involvement in various organizations.	PLO1
	CLO2	Concept of hilsa fishery resource, importance of hilsa fishery, species of hilsa fishery, production scenario of hilsa fishery, economic importance.	PLO1, PLO2
	CLO3	Biology of hilsa, the spawning grounds, migration and distribution pattern, stock assessment and abundance of hilsa fisheries.	PLO1,PLO2
	CLO4	Aquatic conservation, evaluate the impacts of hilsa conservation and establishment of hilsa sanctuary Illustrate aquatic conservation and it impacts on fisheries biodiversity in Bangladesh.	PLO1,PLO3,PLO4
	CLO5	Jhatka protection and implementation authority, Govt. policies and livelihood of hilsa fishermen, impacts of management interventions, and needs for regional cooperation.	PLO3, PLO4
	CLO6	Evaluate fishing laws and legislation, fishing rules, acts and ordinance.	PLO1, PLO8
	CLO7	Communicate effectively individual and in groups works	PLO5,PLO9,PLO10

Course Contents		CLOs
1	**Introduction:** Concept of fisheries resources of Bangladesh, different water resources and its production, involvement of various organizations.	CLO1

2	**Hilsha fishery:** Concept of hilsa fishery, importance of hilsa fishery, species of hilsa fishery, production scenario of hilsa fishery, economic importance.	CLO2
3	**Distribution and migration:** Biology of hilsa fishery, the spawning grounds, migration and distribution pattern, stock assessment and abundance of hilsa fisheries.	CLO3
4	**Threats to Hilsha fishery:** Ecological and human induced threats to hilsha and their habitats.	CLO4
5	**Fishing rules and regulation:** concept of fishing rules and regulation, evaluate fishing laws and legislation, fishing rules, acts and ordinance.	CLO6
6	**Conservation and sustainable management:** Action plan, jhatka protection, declaration of sanctuaries, ban on spawning hilsa catch, implementation authority, economic incentives for hilsa conservation, govt. subsidies and livelihood of hilsa fishermen, impacts of management interventions, and needs for regional cooperation.	CLO5

Mapping CLOs with the Teaching-Learning and Assessment Strategy		
CLOs	**Teaching-Learning Strategy**	**Assessment Strategy**
CLO1	Lecturing, Question-Answering, group discussion, Assignment, Graphical presentation	Quiz, Assignment, Short and Narrative question, MCQ, Fill in the Gap
CLO2	Lecturing, multi-media power point presentation, Graphical and video show, assignment and group discussion.	Quiz, Assignment, Short and Narrative question, MCQ, Fill in the Gap
CLO3	Lecturing, Question-Answering, group discussion, Assignment, Graphical presentation	Quiz, Assignment, Short and Narrative question, MCQ, Fill in the Gap
CLO4	Lecturing, multi-media power point presentation, picture and video show, assignment and group discussion.	Quiz, Assignment, Short and Narrative question, MCQ, Fill in the Gap
CLO5	Lecturing, Question-Answering, group discussion, Assignment, Graphical presentation	Quiz, Assignment, Short and Narrative question, MCQ, Fill in the Gap
CLO6	Lecturing, Question-Answering, group discussion, Assignment, Graphical presentation	Quiz, Assignment, Short and Narrative question, MCQ, Fill in the Gap
CLO7	Assignment preparation and submission, and Student presentation	Class attendance, individual presentation

Learning Materials	
Text Book	1. King, M. 1995. Fisheries Biology, Assessment and Management. Fishing News Books. 342pp. 2. Ricker, W. E. 1975. Computation and interpretation of biological statistics of fish populations. Bull. Fish. Res. Board Can. 191: 382 pp. 3. Sparre, P., E. Ursin, and S. C. Venema. 1989. Introduction to tropical fish stock assessment. Part 1&2. FAO Fisheries Technical Papers. No. 306.1&2. Rome, FAO. 1. Alam, M.S. 2012. 'Hilsa fisheries management in Bangladesh: A paradigm in natural resource conservation', 224-238 pages. In Anon. (ed.) Hilsa: Status of fishery and potential of aquaculture, Proceedings of the Regional Workshop held in Dhaka, 16-17 September 2012. The World Fish, Bangladesh and South Asia Office, Dhaka, p 238. 2. Mazid, M.A. and S.J.M. Blaber 1998. Proceedings of BFRI/ACIAR/CSIRO workshop on hilsa fisheries research in Bangladesh held on 3-4 March at Bangladesh Agricultural Research Council, Dhaka, Bangladesh. 3. Mohammed, E.Y. 2014. Economic incentives for marine and coastal conservation: prospects, challenges and management implications. pp 270. 4. Mome MA 2007: The potential of the artisanal hilsa fishery in Bangladesh: an economically efficient fisheries policy. Fisheries Training Programme Final Project Report, United Nations University, Iceland. pp. 57.
Supplementary Readings	1. Alam, M.S. 2012. 'Hilsa fisheries management in Bangladesh: A paradigm in natural resource conservation', 224-238 pages. In Anon. (ed.) Hilsa: Status of fishery and potential of aquaculture, Proceedings of the Regional Workshop held in Dhaka, 16-17 September 2012. The World Fish, Bangladesh and South Asia Office, Dhaka, p 238. 2. Mohammed, E.Y. 2014. Economic incentives for marine and coastal conservation: prospects, challenges and management implications. pp 270. 3. Mome MA 2007: The potential of the artisanal hilsa fishery in Bangladesh: an economically efficient fisheries policy. Fisheries Training Programme Final Project Report, United Nations University, Iceland. pp. 57.

Assessment Pattern

CIE- Continuous Internal Evaluation (40 Marks)					
Bloom's Category Marks (out of 40)	**Class test (10)**	**Assignment submission (05)**	**Presentation (05)**	**Quizzes (10)**	**Attendance (10)**
Remember				05	
Understand	02			05	
Apply	04				
Analyse	04	01			
Evaluate		02			10
Create		02	05		

SSE- Semester End Examination (60 Marks)	
Bloom's Category	**Tests**
Remember	5
Understand	10
Apply	15
Analyse	15
Evaluate	10
Create	5

Third Year First Semester		
Course Code: 0831 FST 311	**Year:** Third	**Semester:** First
Course Title: Fish Processing Technology		
Course Status: Core		
Credit: 3.0		
Prerequisite(s): None		
Rationale	Fish processing covers principles and applications of post-harvest handling and processing of fish in the form of all sorts of pre-treatment, reprocessing, packaging and quality control. Access to fish as food complies food security but the fish food safety through appropriate processing is the key to build up a healthy nation, while the students of this course will be dealt with.	

	By the end of the course, the students will be able to:		Mapping with PLOs
Course Learning Outcomes (CLOs)	CLO1	Summarize the principles of different fish processing techniques	PLO1 & PLO4
	CLO2	Illustrate the traditional and improved methods of different methods of fish processing	PLO2 & PLO5
	CLO3	Distinguish different knowledge in the preparation of different techniques; identify the problems in traditional processing.	PLO2, PLO5, PLO6 & PLO10
	CLO4	Evaluate to extend the shelf-life of fish and fishery products through improved techniques of processing, packaging and storage fishery products.	PLO1 & PLO10
	CLO5	Collaborate in policy making in setting-up of different national and international stakeholders for the processed fish and fishery products and quality products development of the country.	PLO2, PLO5, PLO6, PLO8 & PLO10

	Course Contents	CLOs
1	**Introduction to fish processing:** Definition, scope and importance, principles of fish preservation/processing, production and marketing of fish and fishery products in Bangladesh; structural characteristics, biochemical composition and role of biochemical compositions in fish quality and processability.	CLO1
2	**Postmortem changes in fish:** Definition, types and mechanism of rigor mortis, changes in fish during rigor mortis, impact of rigor mortis on processing and keeping quality of fish.	CLO1
3	**Low temperature processing of fish (Chilling and Freezing):**General principles and methods of fish preservation, chilling, icing. Good handling practices of fish onboard, onshore and in plant, transportation for domestic and export. Freezing: Mechanisms of freezing of fish muscle tissue, freezing methods and equipment; Freezing of shrimp/prawn in Bangladesh- exportable shrimp/prawn products, commercial freezing of prawn, semi IQF of whitefish, quality requirements of frozen shrimp; storage of frozen products.	CLO2, CLO3 & CLO4
4	**Drying and dehydration of fish**: Concept of curing, basic principles of fish drying, species, site, season of fish drying in Bangladesh. Methods and constraints of traditional sun drying and dehydration. Different improved methods of fish drying.	CLO2, CLO3 & CLO4
5	**Salting of fish:** Basic principle of salting, types of salting, methods of fish salting, Spoilage, storage and marketing of salted products.	CLO2, CLO3 & CLO4

6	**Fermentation and smoking of fish:** Basic principle of fermentation and smoking of fish. Types, methods, storage and marketing of fermented and smoked fishery products. Chemistry of wood smoking in smoked fish quality.	CLO2, CLO3 & CLO4
7	**Canning and Marinating of Fish:** Definition, principles and steps of canning and marinating. Canning and marinating of small freshwater and marine fish and shellfish. Tuna and sardine canning. Packaging, storage and marketing of canned and marinated products.	CLO2, CLO3 & CLO4
8	**Packaging of processed fish and fishery products:** Functions of packaging, selection of appropriate packaging materials, packaging regulations; Modern approaches in fish packaging- irradiation, hurdle technology and *sous-vide* technology, modified atmospheric packaging, controlled atmospheric packaging and vacuum packaging.	CLO2, CLO3 & CLO4

Mapping CLOs with the Teaching-Learning and Assessment Strategy		
CLOs	**Teaching-Learning Strategy**	**Assessment Strategy**
CLO1	Lecture, presentation, question answering and discussion	Quizzes, short questions and assignment
CLO2	Lecture, presentation, question answering, discussion, demonstration and video clip	Short questions, assignment, spotting, poster submission and narrative questions
CLO3	Lecture, presentation, question answering, discussion and video clip	Assignment, narrative questions and field reports
CLO4	Lecture, presentation, discussion, simulation and video clip	Assignment, short questions and narrative questions
CLO5	Lecture, presentation, question answering, discussion and project	Assignment, narrative questions and field reports

Learning Materials	
Text Book	1. Clucas, I. J. and A. R. Ward. 1996. Post-harvest Fisheries Development: A guide to handling, preservation, processing and quality. Natural Resource Institute, UK. 2. Hall, G. M. 1997. Fish Processing Technology. Blakie Academic & Professional, London, Weinheim, New York, Melbourne, Madras. 3. Nowsad, A. K. M. A. 2007. Participatory Training of Trainers: A New Approach Applied in Fish Processing. Bangladesh Fisheries Research Forum. Bangladesh.
Supplementary Readings	1. Donald. 1968. (ed.). The Freezing Preservation of Foods. The Avi Publishing Company, INC. 2. Govindan, T. K. 1985. Fish Processing Technology. Oxford & IBH publishing Co., New Delhi. 3. Howgate, P., A. Johnston and Whittle, K. L. 1992. Multilingual

	Guide to EC freshness grades for fishery products (Torry Research Station, Food Safety Directorate, Ministry of Agriculture, Fisheries and Food; Aberden. Scotland, UK.

Assessment Pattern

CIE- Continuous Internal Evaluation (40 Marks)					
Bloom's Category Marks (out of 40)	**Class test (10)**	**Assignment (05)**	**Notebook/ Presentation (05)**	**Quizzes (10)**	**Attendance (10)**
Remember				05	
Understand				05	
Apply	02	01			
Analyze	02	01			
Evaluate	04	03			10
Create	02		05		

SEE- Semester End Examination (60 Marks)	
Bloom's Category	**Tests**
Remember	5
Understand	5
Apply	10
Analyze	10
Evaluate	20
Create	10

Third Year First Semester		
Course Code: 0831 FST 312	**Year:** Third	**Semester:** First
Course Title: Fish Processing Technology Sessional		
Course Status: Core		
Credit: 1.0		
Prerequisite(s): None		
Rationale	Students shall maintain a record of everything done in the practical and field sessions in a practical notebook to be signed and checked by teachers (s) concerned. Viva voce test will form an essential part of the practical examinations.	

	By the end of the course, the students will be able to:		Mapping with PLOs
Course Learning Outcomes (CLOs)	CLO1	Describe fish processing laboratory and safety use of lab equipment, glassware and chemicals and also will know the procedure of standard chemical solutions and reagents.	PLO1 & PLO4
	CLO2	Analyze the proximate composition (Protein, lipid, moisture and ash) of fish and fish products.	PLO2 & PLO5
	CLO3	Compare of post-harvest quality loss of wet fish through sensory method.	PLO2, PLO5, PLO6 & PLO10
	CLO4	Measure the rigor index of fish, non-protein nitrogen (NPN) of fish, and extraction procedure of actomyosin from fish muscle.	PLO2, PLO4, PLO5, PLO6 & PLO10

Course Contents		CLOs
1	Acquaintance with fish processing laboratory and safety use of lab equipment, glassware and chemicals.	CLO1
2	Preparation of standard chemical solutions and reagents.	CLO1, CLO2 & CLO4
3	Estimation of moisture content of fish by oven drying method	CLO1, CLO2 & CLO4
4	Estimation of ash content of fish by using Muffle Furnace.	CLO1, CLO2 & CLO4
5	Estimation of crude protein contents of fish by Kjeldahl method.	CLO1, CLO2 & CLO4
6	Estimation of crude lipid contents of fish by using Soxhlet Apparatus.	CLO1, CLO2 & CLO4
7	Assessment of post-harvest quality loss of wet fish through sensory method.	CLO1 & CLO3
8	Determination of rigor index of fish.	CLO4
9	Determination of non-protein nitrogen (NPN) and extraction of actomyosin from fish muscle of fish.	CLO4

Mapping CLOs with the Teaching-Learning and Assessment Strategy		
CLOs	**Teaching-Learning Strategy**	**Assessment Strategy**
CLO1	Lecture, presentation and demonstration	Quizzes, short questions, spotting and practical note book (PNB)
CLO2	Lecture, presentation, demonstration and discussion	Short questions, spotting, practical note book (PNB) and viva-voce

CLO3	Lecture, questions answering, demonstration and discussion	Short questions, spotting, practical note book (PNB) and viva-voce
CLO4	Lecture, demonstration, discussion and simulation	Spotting, practical note book (PNB) and viva-voce

Learning Materials	
Text Book	1. Hall, G. M. 1997. Fish processing technology. Blakie Academic & Professional, London, Weinheim, New York, Melbourne, Madras 2. Clucas, I. J. and A. R. Ward. 1996. Post-harvest Fisheries Development: A guide to handling, preservation, processing and quality. Natural Resource Institute, UK. 3. Govindan, T. K. 1985. Fish Processing Technology, Oxford & IBH publishing Co., New Delhi. 4. AOAC. 1980. Official methods of analysis. Association of Official Analytical Chemists. Washington, D. C.
Supplementary Readings	1. Botta, J. R. 1995. Evaluation of Seafood Freshness Quality. VCH Publishers, Inc. New York. 2. Hasegawa, H. 1987. Laboratory Manual on Analytical Methods and procedures for Fish and Fishery Products. Marine Fisheries Research Department, Southeast Asian Fisheries Development Center, Singapore. 3. Howgate, P., A. Johnston and K. L. Whittle. 1992. Multilingual Guide to EC freshness grades for fishery products (Torry Research Station, Food Safety Directorate, Ministry of Agriculture, Fisheries and Food; Aberden. Scotland, UK.

Assessment Pattern

CIE- Continuous Internal Evaluation (40 Marks)					
Bloom's Category Marks (out of 40)	**Class test (10)**	**Assignment (05)**	**Notebook/ Presentation (05)**	**Quizzes (10)**	**Attendance (10)**
Remember				05	
Understand				05	
Apply	02	01			
Analyze	03	02			
Evaluate	04	02			10
Create	01		05		

SEE- Semester End Examination (60 Marks)	
Bloom's Category	**Tests**
Remember	5
Understand	5
Apply	15
Analyze	15
Evaluate	15
Create	5

Course Code: 0831 MFO 311	**Level: 3**	**Semester: I**
Course Title: Blue economy and Sustainable Development		
Department: Core		
Credit Hours: 3.0		
Prerequisite(s): None		
Rationale	In This course students will learn about various marine resources. There are living and non-living resources in ocean. In order to maintain a sustainable use of resources the understanding of marine resource is important. To know about the blue economy, sustainable development goal and delta plan 2100 for marine resource and its future prospects.	

	By the end of the course, the students will be able to:		**Mapping with PLOs**
Course Learning Outcomes (CLOs)	CLO 1	Apply knowledge of blue economy, different marine resources, SDG and Delta plan 2100.	PLO_1, PLO_2
	CLO 2	Analyze various living, non-living and others marine resources.	PLO_1, PLO_2, PLO_3
	CLO 3	Explain how to extract the Gas and Oils, gas hydrate, manganese nodules, placer deposits.	PLO_2, PLO_6, PLO_9
	CLO 4	Evaluate diversity of marine resources around the world.	PLO_2, PLO_6, PLO_9
	CLO 5	Distinguish among various resource potentiality.	PLO_2, PLO_6, PLO_9
	CLO 6	Analyze the sustainable use of marine resource and its future prospects.	PLO_1, PLO_2, PLO_5
	CLO 7	Communicate and work effectively in groups in developing presentations	PLO_2, PLO_6,

			PLO_9

	Course Contents	CLOs
1	**Introduction:** Concept of blue economy; principles of blue economy; blue economy framework for sustainable development on fisheries context.	CLO 1, CLO 7
2	**Blue Economy of Bangladesh**: Shipping and port facilities, BIG-B, fisheries, mariculture, energy, biotechnology, submarine mining, marine and coastal tourism of Bangladesh.	CLO 1, CLO 5
3	**Concepts of Sustainable development goal and Bangladesh Delta Plan 2100:** History of sustainability, sustainability measurement, ecological footprint; sustainable development goals (SDGs), goal 14 of SDGs, intersect oral linkage, Bangladesh and sustainable development goals. sustainable use of biodiversity; food security; Bangladesh Delta Plan 2100.	CLO 1, CLO 6
4	**Marine fishes and others living resources:** Marine invertebrates (mollusk, crustacean, arthropoda, echinodermata, sponges, coral etc.); marine vertebrates: (marine fishes, marine reptiles, maire mammals, sea birds etc.). plant resources: seaweed, sea grass, salt marsh and mangroves economic importance and uses.	CLO 2, CLO 4, CLO 5
5	**Mariculture**: Present status in national economy, feasibility and prospects of mariculture, economic value of mariculture in Bangladesh.	CLO 2, CLO 4, CLO 7
6	**Tourism:** Present status and future prospects of coastal and marine tourism, coastal and marine tourism scope and facilities in Bangladesh (Cox's Bazar, Chattagram, Kuakata and Khulna region).	CLO 5, CLO 6
7	**Sea port, Ship building and breaking:** Geographical position of Chattagram sea port and Mongla sea port, Payra sea port, commercial importance, facilities and problems, ship building and breaking and its economic importance of Bangladesh, environmental issues and social effect.	CLO 4, CLO 5, CLO 6, CLO 7
8	**Energy resource:** Marine renewable energy resource – wave, tide, wind & current energy, osmotic power (blue energy); marine non-renewable energy resource: gas and oils, gas hydrate, manganese nodules.	CLO 2, CLO 3, CLO 4, CLO 6
9	**Heavy minerals and Evaporites:** Concept, distribution and importance of heavy minerals, placer deposits (types, formation, exploration etc.), distribution; salt production, solar salt production processes and it's uses in Bangladesh.	CLO 2, CLO 3, CLO 4, CLO 6
10	**Marine Biotechnology and therapeutics:** Marine organisms as sources of biofuel; marine microbial enzymes in the food and pharmaceutical industries; marine biotechnology applications in new functional foods; nutritional and digestive health benefits of seaweed;industrial applications of marine carbohydrates; marine algae biomass for removal of heavy metal ions.	CLO 4, CLO 5, CLO 6, CLO 7

Mapping CLOs with the Teaching-Learning and Assessment Strategy		
CLOs	**Teaching-Learning Strategy**	**Assessment Strategy**
CLO1	Lecturing, Question-Answering, group discussion, Assignment, Graphical presentation	Quiz, Assignment, Short and Narrative question, MCQ, Fill in the Gap
CLO2	Lecturing, multi-media power point presentation, Graphical and video show, assignment and group discussion.	Quiz, Assignment, Short and Narrative question, MCQ, Fill in the Gap
CLO3	Lecturing, Question-Answering, group discussion, Assignment, Graphical presentation	Quiz, Assignment, Short and Narrative question, MCQ, Fill in the Gap
CLO4	Lecturing, multi-media power point presentation, picture and video show, assignment and group discussion.	Quiz, Assignment, Short and Narrative question, MCQ, Fill in the Gap
CLO5	Lecturing, Question-Answering, group discussion, Assignment, Graphical presentation	Quiz, Assignment, Short and Narrative question, MCQ, Fill in the Gap
CLO6	Lecturing, Question-Answering, group discussion, Assignment, Graphical presentation	Quiz, Assignment, Short and Narrative question, MCQ, Fill in the Gap
CLO7	Assignment preparation and submission, and Student presentation	Class attendance, individual presentation

Learning Materials	
Text Book	1. The Blue Economy by Gunter Pauli 2. Introduction to the blue economy by Mrs. Kelly Hoareau 3. Energy resources of Bangladesh, Badrul Imam.
Supplementary Readings	1. Sustainable Development Goals by UNDP. 2. Seaweed Culture in Bangladesh (manual 1&2), M. Zafar.

Assessment Pattern

CIE- Continuous Internal Evaluation (40 Marks)					
Bloom's Category Marks (out of 40)	**Class test (10)**	**Assignment submission (05)**	**Presentation (05)**	**Quizzes (10)**	**Attendance (10)**
Remember				05	
Understand	2			05	
Apply	4	01			
Analyse	4				
Evaluate		02			10
Create		01	05		

SEE- Semester End Examination (60 Marks)	
Bloom's Category	**Tests**
Remember	**5**
Understand	**10**
Apply	**15**
Analyse	**15**
Evaluate	**10**
Create	**5**

Course Title	Fundamentals of Economics	Level 3	Semester-1
Course Code	ECO 313		
Department	Economics and Sociology		
Faculty/Program	Fisheries		
Credit Hours	3.0		
Course Description	This course will provide information about basic concepts of economics,theory of consumer's behaviour decision making, demand, supply, and elasticity. This course will helpful to the students to be competent of using economic concepts applying in various fields of fish production and fish distribution decisions as well as fish marketing.		
Objectives	1. Students will understand the basic concepts, ideasand issues of economicsand its connections to fisheries. 2. To know the consumer's behavior, utility and firm's choice. 3. Students will apply the economic theories in the field of fisheries. 4. Students will explain demand, supply and elasticity and application of the related theories in the market. 5. To gain knowledge about national income and inflation for better understanding a country's economy and prices level. 6. Student will understand macro policy for better understanding a country's economic policy for economic development		

Course Learning Outcomes **By the end of the course, the students will be able to:**	
No	**Description**
CLO 1	Interpret the basic concepts and issues of economics and fisheries economics.
CLO 2	Discuss about consumer's behavior analysis and how the consumer can achieve maximum satisfaction and reach to the equilibrium through indifference curve technique.
CLO 3	Explain the relative importance of factors of production and stages of production, rational zone of production.labor efficiency and capital formation.
CLO 4	Narrate the concepts of demand, demand schedule, demand curve and causes of shifting or shapes of curve.
CLO 5	Derive the supply curve with the hypothetical supply schedule, discuss the factor

	affecting supply and explain the elasticity of supply.
CLO 6	Explain about national income and inflation for better understanding a country's economy and prices level.
CLO 7	Narrate macro policy for better understanding of a country's economic policy
CLO 8	Analyze sustainable aquaculture and apply the economic theory to the fisheries sub-sector in the economy.

Mapping matrices		
CLO	**PLO**	**Assessment tools**
CLO_1	PLO_1	Short answer and Essay
CLO_2	PLO_2	Short answer and Essay
CLO_3	PLO_3	Short answer and Essay
CLO_4	PLO_4	Multiple Choice, Short answer, Easy type
CLO_5	PLO_1	Multiple Choice, Short answer, Easy type
CLO_5	PLO_6	Multiple Choice, Short answer, Easy type
CLO_6	PLO_7	Multiple Choice, Short answer, Easy type
CLO_7	PLO_8	Multiple Choice, Short answer, Easy type
CLO_7	PLO_9	Multiple Choice, Short answer, Easy type
CLO_8	PLO_{10}	

Mapping ofCLO with PLO										
CLO	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8	PLO9	PLO10
CLO1	√	√	√							
CLO2	√	√								
CLO3				√						
CLO4								√		
CLO5				√						
CLO6				√		√				
CLO 7								√		
CLO 8						√				

Course Contents and Aligned with CLO:

Sl. No.	Topic/Course content	Teaching Strategy	Assessment Strategy	Aligned CLO
1	**Basic concepts and issues of economics**: Definition and basic concepts related to economics and fisherieseconomics, micro and macroeconomics, relationship of economics with other social sciences, rationale of studying economics for the students of fisheries	Lecture and Multi-media presentation, asking questions and answers	Short answer and Essay	CLO 1
2	**Theory of Consumer's Behaviour:** Utility, Total utility and marginal utility, Relationship between total utility and marginal utility. Basic assumptions of Marshallian utility analysis, Law of diminishing marginal utility: Tabular and graphical representations. Exceptions/ limitation of the law. Marginal utility and price: Consumer's equilibrium through utility analysis considering single commodity purchase. ***Indifferent curve technique****:* Definition of Indifference curve, Indifference map, Marginal rate of substitution (MRS), Properties of Indifference curve. Budget line, Shifting of budget line, Consumer's equilibrium through Indifference curve.	Lecture and Multi-media presentation, asking questions and answers	Short answer and Essay	CLO 2
3	**Theory of Demand and Elasticity** Demand and Law of demand, Demand schedule and demand curve and market demand curve. Causes of changes or shifting demand curve, Causes of downward slopping to the right of a demand curve, Elasticityof demand: Definition and types, Inferior goods, superior and normal goods, Giften goods.	Lecture, Reading, Demonstration, Assignment	True- False Item, Multiple Choice, Short answer, Easy type, Report, Observation	CLO 3
4	**Theory of Production and Cost** Factors of production,land, peculiarities of land, efficiency of labour, theory of population, capital and capital formation, importance of capital, steps of capital formation. Three regions/ stages of production. Rational zone of production,	Lecture, Assignment, Group Discussion	True- False Item, Multiple Choice, Short answer, Easy type, Observation	CLO 4

	Law diminishing returns- three aspects of this law, special applicability to fisheries, Cost of production [Fixed cost, variable cost, marginal cost, opportunity cost], relationship between MC and AC curves, Short run and long run cost concepts and Economies of scale, Equilibrium of firm.			
5	**Theory of Supply** Supply and Stock, law of supply, Supply schedule and supply curve, Causes of changes or shifting supply curve, Elasticity of supply. Market equilibrium through demand and supply equations and its graphical explanations.	Lecture, Demonstration, Assignment	True- False Item, Multiple Choice, Short answer, Easy type, Observation	CLO 5
6	**National Income and macroeconomic variables:** Definition of National income (NI) and Concepts of NI -GNP, GDP, NNP, NI, PI, GDP-GNP difference, GDP growth, 15 sectors of GDP, Methods of NI Measurement: Income Approach, Expenditure Approach, Production Approach, Problems of computing National Income in Bangladesh.	Lecture, Demonstration, Assignment	True-False Item, Multiple Choice, Short answer, Easy type, Observation	CLO6
7	**Keynesian Two, Three and Four sector model** Theory of two sector model, Explanation of three sector model, export and import factor of an economy, Mathematics of two sector economy, three sector economy and four sector economy.	Lecture, Demonstration, Assignment	True-False Item, Multiple Choice, Short answer, Easy type, Observation	CLO6
8	**Inflation** Definition of inflation and deflation, types of inflation, causes of inflation, effects of inflation, control of inflation, some related terms of inflation, consumer price index (CPI), measurement of CPI and inflation.	Lecture, Assignment	True-False Item, Multiple Choice, Short answer, Easy type, Observation	CLO6
9	**Macro economic policy:** Meaning, Tools and objectives of monetary policy, Importance of monetary policy as an	Lecture, Assignment	True-False Item, Multiple	CLO7

	instrument of economic management, Monetary policy during inflation, deflation and stagflation in the economy. Meaning, Objectives and Instrument of Fiscal Policy, Fiscal Policy as an Instrument of Economic Growth, Fiscal policy during inflation and deflation, public finance and budget		Choice, Short answer, Easy type, Observation	
10	**Economics of Aquaculture and sustainable aquaculture**: Fish production and its economic importance, contribution of fisheries sub-sector in the economy of Bangladesh, small-scale, subsistence and commercial fisheries, risks of aquaculture, capture and culture fisheries, economic and bio-economic models of fisheries management.	Lecture, Demonstration, Assignment	True- False Item, Multiple Choice, Short answer, Easy type, Observation	CLO 8
11	**Agribusiness and marketing** Definition, Objectives, Scope, Importance, Agribusiness in Bangladesh- its challenge or risk, Development of agribusiness enterprises, different types of agribusiness, Concept of enterprise, entrepreneurship and entrepreneur, general characteristics of an entrepreneur, aqua-entrepreneurship, small and medium enterprise (SME), marketing channel and function, fish marketing channel in Bangladesh	Lecture, Demonstration, Assignment	True- False Item, Multiple Choice, Short answer, Easy type, Observation	CLO 8

Books Recommended:

1. Dewett, K. K. and A. Chand. 2001. Modern Economic Theory. S. Chand & Company Ltd., New Delhi.

3. Samuelson, P. A. 2005. Economics. 18th Edition. McGraw Hill, New York.

4. Mankiw, N. G. (2004). Principles of economics (3rd ed., Mason OH: Thomson / South-Western,). ISBN: 0-324-20309-8.

Book Reference:

1. Bjorndal, T., D. V. Gordon, R. Arnason, U. R. Sumaila. 2007. Advances in Fisheries Economics. Blackwell Publishing Limited.

2. Dillon, J. L. and J. B. Hardaker. 1993. Farm Management Research for Small Farmer Development, 2nd Edition, Farm Systems Management Series, FAO, Rome.

3. Gittinger, J. P. 1996. Economic Analysis of Agricultural Projects. 2nd Edition. John Hopkins University press, Baltimore.

4. Jolly, C. M. and H. A. Clonts. 1993. Economics of Aquaculture. Food Products Press, New York.

5. Shang, Y. C. 1981. Aquaculture Economics: Basic Concepts and Methods of Analysis. Westview Press, London.

Assessment Pattern

CIE- Continuous Internal Evaluation (40 Marks)					
Bloom's Category Marks (out of 40)	**Class test (10)**	**Assignment submission (05)**	**Presentation (05)**	**Quizzes (10)**	**Attendance (10)**
Remember				05	
Understand	2			05	
Apply	4	01			
Analyse	4				
Evaluate		02			10
Create		01	05		

SSE- Semester End Examination (60 Marks)	
Bloom's Category	**Tests**
Remember	5
Understand	10
Apply	15
Analyse	15
Evaluate	10
Create	5

Course Code: 0831 AQC 321	Level-3	Semester-II
Course Title: Aquatic Animal Health Management		
Course Status: Core		
Credit: 2.0		
Prerequisite(s): None		
Rationale	The course will provide the students with holistic knowledge of health management and immune defense of aquatic animalstoprevent and control diseases in the aquaculture systems.	

	By the end of the course, the students will be able to:		**Mapping with PLOs**
Course Learning Outcomes (CLOs)	CLO1	Describe the overview and impacts of aquatic animal diseases	PLO_1, PLO_5
	CLO2	Prevent and control infectious and non-infectious diseases of aquatic animals	PLO_1, PLO_3, PLO_5
	CLO3	Explain the overall immune responses of aquatic animals	PLO_1, PLO_2, PLO_3
	CLO4	Illustrate the antibody probes and vaccination strategies in aquaculture	PLO_1, PLO_2, PLO_3
	CLO5	Categorize trans-boundary aquatic animal diseases and their impacts	PLO_1, PLO_5, PLO6

	Course Contents	**CLOs**
1	Introduction: Concept of fish disease and health; causes of diseases outbreak in aquatic animals; host, pathogen and environmentalinteraction; general idea about prevention and control of diseases in aquatic animals; disease surveillance, quarantine, health certification, biosecurity and emergency disease response capacity.	CLO1 and CLO2
2	Disease diagnosis: Clinical and laboratory diagnosis.	CLO1 and CLO2
3	Immune response of aquatic animal: Components,characteristics and immune functions of fish blood; types andcharacteristics of immune responses; organs and cells associatednon-specific immunity and specific immunity; Antigen and antibody; immunoglobulin,mechanisms of immunoglobulin formation, structure, class andfunctions of Ig, primary and secondary antibody response.	CLO3
4	Antibody probes: Polyclonal and monoclonal antibodies-characteristics, preparation and use, antigen-antibody reaction, antibody titre.	CLO4 and CLO5

5	Prevention and control of viral, bacterial and fungal diseases of aquatic animals. Use of immunostimulants, prebiotics, probiotics and synbiotics.	CLO2
6	Prevention and control of fish diseases caused by environmental, dietary and hereditary factors.	CLO2
7	Quarantine and trans-boundary aquatic diseases: International trade and movement of live aquatic species, movement of pathogens, trans-boundary aquatic diseases and its impact, quarantine procedure,	CLO5
8	Fish vaccines and vaccination: Definition, types, purpose,commercially available fish vaccines, vaccine development,methods of vaccine delivery, vaccination vs chemotherapy.	CLO4

Mapping CLOs with the Teaching-Learning and Assessment Strategy

CLOs	Teaching-Learning Strategy	Assessment Strategy
CLO1	Lecture, Group discussion, Presentation, Question-Answering	Quiz, Presentation, Short and Narrative question.
CLO2	Lecture, Assignment, Presentation, Question-Answering	Quiz, Assignment, Presentation Short and Narrative question.
CLO3	Lecture, Assignment, Presentation, Question-Answering	Assignment, Presentation Short and Narrative question.
CLO4	Lecture, Assignment, Presentation, Question-Answering	Assignment, Presentation Short and Narrative question.
CLO5	Lecture, Group discussion, Presentation, Question-Answering	Presentation, short and Narrative question

Learning Materials

Text Book	1. Austin, B. and D. A. Austin. 1999. Bacterial Fish Pathogens: Diseases in Farmed and Wild Fish. 3rd ed. Ellis Horwood, England. 552 pp. 2. Iwame, G. and T. Nakanishi. 1996. (eds.). The Fish Immune System. Academic press. 378 pp. 3. Woo, P. T. K. and D. W. Bruno. 1999. Fish Diseases and Disorders Vol. 3. CABI Publishing. 874 pp.
Supplementary Readings	1. Anderson, D. P. 2010. Text Book of Fish Immunology. Narendra Publishing House. 2. Charnatchkool. P., J. F Turnbul and C. Limsuween 1996. Health Management in Shrimp Ponds AAHRI, Kasetsurt University Campus, Bangkok. 3rd Edition. 3. Gudding, R., A. Lillenaug, P. J. Midtlyng and F. Brown 1997. Fish Vaccinology. Development of Biological Standardization, Karger. 4. Kapoor, B. G., G. Zaccone, J. Meseguer, M. J. Manning and Y. Suzuki 2009. Fish Defenses: Immunology v 1. Science Publishers, U.S.

5. Plumb. J. A. 1994. Health Maintenance of Cultured Fishes: Principal Microbial Diseases. Argent: BHEAL- MCF.
6. Roberts, R. J. 1989. Fish Pathology. BaillereTindall, London, 2nd Edition.

Assessment Pattern

CIE- Continuous Internal Evaluation (40 Marks)					
Bloom's Category Marks (out of 40)	**Class test (10)**	**Assignment submission (05)**	**Presentation (05)**	**Quizzes (10)**	**Attendance (10)**
Remember				05	
Understand	2			05	
Apply	4	01			
Analyze	4				
Evaluate		02			10
Create		01	05		

SSE- Semester End Examination (60 Marks)	
Bloom's Category	**Tests**
Remember	5
Understand	10
Apply	15
Analyze	15
Evaluate	10
Create	5

Course Code: 0831 AQC 322	Level-3	Semester-II
Course Title: Aquatic Animal Health Management Sessional		
Course Status: Core		
Credit: 1.0		
Prerequisite(s): None		
Rationale	The course will provide the students with practical knowledge and skills on various aspects of health management and immune defense of aquatic animals to prevent and control aquatic animal diseases in the aquaculture systems.	

Course	**By the end of the course, the students will be**	**Mapping with**

Learning Outcomes (CLOs)	able to:		PLOs
	CLO1	Demonstrate clinical diagnosis of aquatic animal diseases by field level investigation	PLO2, PLO3
	CLO2	Arrange disease monitoring and surveillance facilities in fish farms	PLO5
	CLO3	Isolate and identify of aquatic pathogens followed by laboratory diagnosis	PLO3, PLO5
	CLO4	Prepare rabbit anti-serum, demonstrate immunodiagnostic techniques andclassify various health management techniques in aquaculture	PLO3, PLO5
	CLO5	Organize field trip to fish farms or culture facilities for practical exposure	PLO5, PLO6

	Course Contents	CLOs
1	Clinical diagnosis of aquatic animal diseases by field level investigation	CLO1
2	Disease monitoring and surveillance in fish farms	CLO2
3	Isolation, identification and characterization of fish pathogenic bacteria and fungus.	CLO3
4	Health management of aquatic animals by husbandry method.	CLO3
5	Preparation of rabbit anti-serum and study of immunodiagnostic techniques.	CLO4
6	Case study for particular disease problem on any fish farm or culture facilities.	CLO5

Mapping CLOs with the Teaching-Learning and Assessment Strategy		
CLOs	**Teaching-Learning Strategy**	**Assessment Strategy**
CLO1	Lecture, Field Demonstration, Group discussion, Question-Answering	Quiz, Observation, Short and Narrative question, Practical Note Book, Viva voce.
CLO2	Lecture, Demonstration, Group discussion, Question-Answering	Quiz, Observation, Short and Narrative question, Practical Note Book, Viva voce.
CLO3	Lecture, Demonstration, Group discussion, Question-Answering	Short and Narrative question, Practical Note Book, Viva voce.
CLO4	Lecture, Demonstration, Group discussion, Question-Answering	Short and Narrative question, Practical Note Book, Viva voce.
CLO5	Lecture, Field visit, Question-Answering	Report writing, Short and Narrative question, Practical Note Book, Viva voce.

Learning Materials	
Text Book	1. Bonded-Reantaso, M. G., S. E. McGladdery, I. East, and R. E. Subsinghe. 2001 (eds.). Asia Diagnostic Guide to Aquatic Animal Diseases. FAO Fisheries Technical Paper No 402, Supplement. 2. Frerichs, N. G and S. D. Millar 1993. Manual for the Isolation and Identification of Fish Bacterial Pathogens, Pisces Press, Stirling. 3. Stolen, J. S., T. C. Fletcher, D. P. Anderson, B. S. Robertson and W. B. UanMuiswinkel. 1993 (eds.) Techniques in Fish Immunology, FITC-1. 4. Thoesen, J. C. 1994 (ed.). Bluebook: Suggested Procedures for the Detection and Identification of Certain Finfish and Shellfish Pathogens, AFS, Fish Health Section. 4th ed. Argent. B- BLUE-SPD.
Supplementary Readings	

Assessment Pattern

CIE- Continuous Internal Evaluation (40 Marks)					
Bloom's Category Marks (out of 40)	**Class test (10)**	**Assignment (05)**	**Notebook/ Presentation (05)**	**Quizzes (10)**	**Attendance (10)**
Remember				05	
Understand	02			05	
Apply	04				
Analyze	04	01			
Evaluate		02			10
Create		02	05		

SSE- Semester End Examination (60 Marks)	
Bloom's Category	**Tests**
Remember	5
Understand	5
Apply	20
Analyze	10
Evaluate	10
Create	10

Course Code: 0831GED 321	Level-3	Semester-II
Course Title: Farm Design and Construction		
Course Status: Core		
Credit: 3.0		
Prerequisite(s): None		
Rationale	This course is designed to provide the students with the knowledge of the basic principles of aquaculture engineering for fish farm design and construction. They will gain knowledge on different aquaculture systems, site selection process as per system characteristics, farm planning, design, construction, and project management aspects.	

	By the end of the course, the students will be able to:		**Mapping with PLOs**
Course Learning Outcomes (CLOs)	CLO1	Design various aquaculture systems based on the principles of aquaculture engineering.	PLO_1,PLO_3,PLO_7
	CLO2	Construct variousprocesses of aquaculture systems.	PLO_1, PLO_3
	CLO3	Explain/demonstrate aeration and hydraulic systems of a fish farm.	PLO_1, PLO_3
	CLO4	Plan a farm layout and hatchery including nurseries and grow out units for carp, catfish, tilapia and shellfish farms and estimate the construction and operating cost.	PLO_1,PLO_3, PLO_7
	CLO5	Describe waste water treatment and disposal techniques.	PLO_1, PLO_3, PLO_7

Course Contents		**CLOs**
1	Introduction: Definition, scope, application of the principles of aquaculture engineering, aquaculture systems: land based, water based and specialized systems and their site selection process.	CLO1
2	Basic hydraulic systems: Basic relationships in hydraulic systems, types of pumps and its installation procedures. Water flow through channel, pipe, sluice gate, monk, tidal gate and pen stock gate.	CLO3
3	Design, construction and operation of fish and shellfish hatcheries: Basic data, calculation of water requirement, temperature requirement, and technological design and connecting facilities.	CLO4
4	Project planning and designing, farm layout including nurseries and grow out units for carp, catfish, tilapia and shellfish farms.	CLO4
5	Design of specialized aquaculture systems: Cages, raceways, tanks,	CLO1

	recirculatory system, on-bottom and off-bottom culture systems.	
6	Aeration systems: Oxygen budget; types of blowers, aerators, compressors and oxygenation systems.	CLO3
7	Construction process: Contract, tender and bid; bill of quantity, project costing, project site management, project monitoring and project ancillaries.	CLO2
8	Wastewater treatment and disposal: Types of wastes in aquaculture farms, waste management and wastewater treatment by physical, chemical and biological methods. Sterilization and disinfection of farm units by different physical and chemical methods.	CLO5

Mapping CLOs with the Teaching-Learning and Assessment Strategy		
CLOs	**Teaching-Learning Strategy**	**Assessment Strategy**
CLO1	Lecture, Demonstration, Question-Answering	Quiz, Short and Narrative questions.
CLO2	Lecture, Group discussion, Question-Answering	Quiz, Short and Narrative questions.
CLO3	Lecture, Video-clip, Question-Answering	Short and Narrative questions.
CLO4	Lecture, Assignment, Presentation, Question-Answering	Assignment, Presentation, Short and Narrative questions.
CLO5	Lecture, group discussion, Question-Answering	Short and Narrative question

Learning Materials	
Text Book	1. Tidwell, J. H. 2012. Aquaculture Production Systems, Willy-Blackwell and World Aquaculture Society. USA. pp. 440. 2. Lawson, T. B. 1995. Fundamentals of Aquaculture Engineering. Chapman and Hall. An International Thomson Publishing Company, New York, USA. 3. FAO. 1884. Inland Aquaculture Engineering, Food and Agricultural Organizations of the United Nations, Rome, Italy.
Supplementary Readings	1. Hochleithner, M. 2012. Aquaculture Technology: Fishfarming and Equipment, AquaTech, USA. 2. Lekang**,** O. 2007. Aquaculture Engineering, Wiley-Blackwell. pp. 352. 3. Coche, A. G. and J. F. Muir. 1992. FAO Training Service, Simple Methods for Aquaculture, FAO, UNO, Rome, Italy. 4. Gray, C.W. 1990. A Guide to Shrimp and Prawn Hatchery Techniques in Bangladesh. BAFRU, IOA, University of Stirling, Scotland, UK. 5. Breverage, M.C.M. 1987. Cage Aquaculture Fishing News Book, Surry, UK. 6. Pillay, T.V.R. 1993 Aquaculture Principles and Practices. Fishing News Books, London, UK

Assessment Pattern

CIE- Continuous Internal Evaluation (40 Marks)					
Bloom's Category Marks (out of 40)	**Class test (10)**	**Assignment submission (05)**	**Presentation (05)**	**Quizzes (10)**	**Attendance (10)**
Remember				05	
Understand	2			05	
Apply	4	01			
Analyze	4				
Evaluate		02			10
Create		01	05		

SSE- Semester End Examination (60 Marks)	
Bloom's Category	**Tests**
Remember	5
Understand	10
Apply	15
Analyze	15
Evaluate	10
Create	5

Course Code: 0831GED 322	Level-3	Semester-II
Course Title: Farm Design and Construction Sessional		
Course Status: Core		
Credit: 1.0		
Prerequisite(s): None		
Rationale	This course is designed to acquire practical knowledge and skills on planning, designing and construction of aquaculture systems using different materials, and their operational procedures in the laboratory and in the field context.	

Course Learning Outcomes	**By the end of the course, the students will be able to:**		**Mapping with PLOs**
	CLO1	Analyze water quality parameters for	PLO_3, PLO_3, PLO_7

(CLOs)		developing water quality index for fish farming	
	CLO2	Illustrate and explain different land, and water based aquaculture and specialized aquaculture systems and their associated systems components	PLO_3, PLO_4
	CLO3	Explain a typical earthen pond construction	PLO_3, PLO_4
	CLO4	Auditing aquaculture farm standard through visit and direct observations	PLO_1, PLO_6

Course Contents		**CLOs**
1	Water quality determination and developing an index for standard aquaculture	CLO1
2	Types of water pumps and different water supply system in aquaculture farms	CLO2
3	Oxygenation and aeration in intensive aquaculture system, oxygen demand determination, and setting aeration devices	CLO2
4	Designing earthen pond complex and planning through plane table and counter survey	CLO3
5	Designing cage farm and construction, cost-effective analysis of a cage farm	CLO2
6	Recirculatory aquaculture system (RAS) design and its operation	CLO2
7	Investigation on raceway aquaculture system	CLO2
8	Studies on biofloc aquaculture system	CLO2
9	Design and planning a typical fish hatchery complex	CLO2
10	Studies on basic civil engineering materials and calculation of the materials and cost required to design and construct an unit area	CLO2
11	Visiting an aquaculture farm and make an audit using a standard certification checklist.	CLO4

Mapping CLOs with the Teaching-Learning and Assessment Strategy		
CLOs	**Teaching-Learning Strategy**	**Assessment Strategy**
CLO1	Lecture, Hands-on practice, Question-Answering	Quiz, Short and Narrative question, Practical Note Book, Viva voce.
CLO2	Lecture, Artefact, Group discussion, Question-Answering	Quiz, Presentation, Short and Narrative question, Practical Note Book, Viva voce.
CLO3	Lecture, Demonstration, Question-	Short and Narrative

	Answering	question,Practical Note Book, Viva voce.
CLO4	Lecture, Demonstration, Group discussion, Question-Answering	Short and Narrative question, Practical Note Book, Viva voce.
CLO5	Lecture, Field visit, Question-Answering	Report writing, Short and Narrative question, Practical Note Book, Viva voce.

Learning Materials	
Text Book	1. Pillay, T. V. R. 1984. Inland Aquaculture Engineering. Food and Agricultural Organizations of the United Nations, Rome, Italy. 596 pp. 2. Giovannini, P. 1991. Aquaculture Systems Engineering. American Society of Agricultural Engineers, USA.pp.93. 3. Wheaton, F. W. 1985. Aquaculture Engineering. Robert E. Kroger Publications, Florida, USA.pp.69.
Supplementary Readings	1. Coche, A. G. and J. F. Muir. 1992. FAO Training Service, Simple Methods for Aquaculture, FAO, UNO, Rome, Italy. 123pp. 2. Coche, A. G. and T. Laughlin. 1998. Training Series, Topographic Tools. FAO, Rome, Italy. 3. Coche, A. G., J. F. Muir and T. Laughlin. 1995. Training Series, Pond Construction. FAO, Rome, Italy. Pp.256.

Assessment Pattern

CIE- Continuous Internal Evaluation (40 Marks)					
Bloom's Category Marks (out of 40)	**Class test (10)**	**Assignment (05)**	**Notebook/ Presentation (05)**	**Quizzes (10)**	**Attendance (10)**
Remember				05	
Understand	02			05	
Apply	04				
Analyze	04	01			
Evaluate		02			10
Create		02	05		

SEE- Semester End Examination (60 Marks)	
Bloom's Category	**Tests**
Remember	5
Understand	5
Apply	20

Analyze	10
Evaluate	10
Create	10

Course Code: 0831 FBG 321	**Year:** Third	**Semester:** Second
Course Title: Fish Biotechnology		
Course Status: Core		
Credit: 2.0		
Prerequisite(s): None		
Rationale	Students interested in pursuing a career in fish molecular biology and biotechnology should become familiar with the scope and applications of molecular biology and biotechnology, gene cloning and gene transfer methods, as well as various DNA markers and their applications in fisheries and aquaculture.	

	By the end of the course, the students will be able to:		**Mapping with PLOs**
Course Learning Outcomes (CLOs)	CLO 1	Discuss the overview, scope and applications of biotechnology in fisheries and aquaculture.	PLO_1, PLO_2 PLO_3
	CLO 2	Illustrate the restriction enzyme with its applications, creation of recombinant DNA molecule, cDNA synthesis, cloning vector, isolation of gene and creation of gene library.	PLO_1, PLO_2 PLO_4
	CLO 3	Explain different molecular markers and techniques for identification and genetic improvement of fish and shellfish.	PLO_1, PLO_2, PLO_6
	CLO 4	Describe the methods of gene transfer, chromosomal integration and expression of transgene with its applications, biosafety of genetically engineered fish, environmental and food safety.	PLO_1, PLO_2, PLO_9
	CLO 5	Communicate scientific concepts both verbally and in writing	PLO_5

Course Contents		**CLOs**
1	**Introduction:** Overview of molecular biology and biotechnology, scope of molecular biology and biotechnology, applications of biotechnology in fisheries and aquaculture.	CLO1
2	**Recombinant DNA technology:** Restriction endonucleases, creation of recombinant DNA molecules, cloning vectors, gene cloning, creation of gene library, isolation of a specific gene.	CLO2

3	**Molecular techniques:** Electrophoresis, Southern blotting, northern blotting, western blotting, Polymerase Chain Reaction (PCR).	CLO3
4	**DNA markers:** Principles and techniques of RFLP, RAPD, AFLP and microsatellite DNA markers and their applications.	CLO3
5	**Transgenic technology:** Methods of gene transfer in fish, genomic integration and expression of transgenes, applications.	CLO 4 and CLO5
6	**Biosafety:** Biosafety of genetically engineered fish, environmental safety and food safety, Cartagena Protocol.	CLO 4 and CLO5

Mapping CLOs with the Teaching-Learning and Assessment Strategy		
CLOs	**Teaching-Learning Strategy**	**Assessment Strategy**
CLO1	Lecturing, Socratic method, presentation, assignment, Question-Answering	Quiz, Assignment, Exit ticket Short and Narrative question.
CLO2	Lecturing, problem based learning, presentation, assignment, Question-Answering	Quiz, One minute paper, Short and Narrative question
CLO3	Lecturing, group discussion, videotape, Question-Answering	Quiz, Assignment, peer teaching, Short and Narrative question
CLO4	Lecturing, group discussion, presentation, Question-Answering	Quiz, Assignment, Exit slip, Short and Narrative question
CLO5	Lecturing, group discussion, presentation, assignment, Question-Answering	Quiz, Assignment, Exit slip, Short and Narrative question

Learning Materials	
Text Book	1. Kingsman, S. M. and A. J. Kingsman. 1989. Genetic Engineering. Blackwell Scientific Publications. 522 pp. 2. Primrose, S. B., R. M. Twyman and R. W. Old. 2002. Principles of Gene Manipulation. 6th Edition. Blackwell Publishers, London. 480 pp. 3. Walker, J. M. and R. Rapley. 2008. Molecular Biomethods. 2nd Edition. Humana Press. 1124 pp. 4. Watson, J. D., M. Gilman, J. Witkowski and M. Zoller. 1992. Recombinant DNA (2nd Edition). Scientific American Books. W. H. Freeman and Company, New York. 5. Alberts, B., A. Johnson, J. Lewis, M. Raff, K. Roberts and P. Walter. 2008. Molecular Biology of the Cell. 5th Edition. Garland Science
Supplementary Readings	

Assessment Pattern

CIE- Continuous Internal Evaluation (40 Marks)					
Bloom's Category Marks (out of 40)	**Class test (10)**	**Assignment (05)**	**Notebook/ Presentation (05)**	**Quizzes (10)**	**Attendance (10)**
Remember				05	
Understand	02			05	
Apply	04				
Analyze	04	01			
Evaluate		02			10
Create		02	05		

SEE- Semester End Examination (60 Marks)	
Bloom's Category	**Tests**
Remember	5
Understand	5
Apply	20
Analyze	10
Evaluate	10
Create	10

Level-3, Semester-II		
Course Code: 0831FMN321	**Year:** Third	**Semester:** Second
Course Title: Fish Population Dynamics		
Course Status: Core		
Credit: 3.0		
Prerequisite(s): None		
Rationale	In this course, students will learn about fish population dynamics through lectures and discussion. It covers concept of fish population dynamics, key population parameters and their uses to formulate sustainable exploitation and management measures.	

	By the end of the course, the students will be able to:		**Mapping with PLOs**
Course Learning Outcomes (CLOs)	CLO1	Discuss introductory aspect and importance of fish population dynamics study.	PLO1
	CLO2	Explain distribution and abundance of individual fish population.	PLO1
	CLO3	Explain size relationships and length selectivity to fishing gears.	PLO1
	CLO4	Discuss the estimation of population parameters.	PLO1, PLO4
	CLO5	Describe the relationship among population dynamics, stock assessment, and fisheries management.	PLO1, PLO2, PLO4
	CLO6	Communicate and work effectively in groups in developing presentations.	PLO5, PLO9, PLO10

Course Contents		CLOs
1	**Introduction:** Definitions, scope and importance.	CLO1
2	**Distribution and abundance:** The concept of unit stock, identification and separation of unit stocks, spacing within a unit stock, relative abundance, marking and tagging, absolute abundance of fish populations and their estimations.	CLO2
3	**Size relationships and gear selectivity:** Linear regression, length-length and length-weight relationships, and condition of fish populations, gear selectivity, trawl and gill nets selectivity.	CLO3
4	**Growth:** Definition and types, acquaintance with different growth models, procedures for estimating the parameters of the von Bertalanffy and other growth curves using data from length-frequency analysis, hard part analysis, mark-recapture experiment, and graphical & computer-based analyses.	CLO4, CLO5
5	**Reproduction:** Definition, timing of reproduction, length & age at sexual maturity, frequency of spawning, semelparity& iteroparity, fecundity.	CLO4, CLO5
6	**Recruitment:** Definition, timing of recruitment, length and age at	CLO4,

	recruitment, factors affecting recruitment and stock-recruitment relationships.	CLO5
7	**Mortality:** Factors causing mortality, concept of mortality equation, estimation of total mortality by age-based & length-based catch curves, natural and fishing mortalities and their estimations.	CLO4, CLO5
8	**Life history patterns:** Species life history strategy and its environment, effects related to stock density, concept of r- and k- selection of species, Bet-hedging.	CLO6
9	**Fish stock assessment:** Prelude of fish stock assessment, yield estimation	CLO4, CLO5

Mapping CLOs with the Teaching-Learning and Assessment Strategy		
CLOs	**Teaching-Learning Strategy**	**Assessment Strategy**
CLO1	Lecturing, group discussion, presentation, assignment, Question-Answering	Quiz, Assignment, Short and Narrative question, MCQ, Fill in the Gap
CLO2	Lecturing, showing video clip, group discussion, presentation, assignment, Question-Answering	Quiz, Assignment, Short and Narrative question, MCQ, Fill in the Gap
CLO3	Lecturing, group discussion, showing video clip, presentation, assignment, Question-Answering	Quiz, Assignment, Short and Narrative question, MCQ, Fill in the Gap
CLO4	Lecturing, group discussion, presentation, Question-Answering	Quiz, Assignment, Short and Narrative question, MCQ, Fill in the Gap
CLO5	Lecturing, group discussion, presentation, assignment, Question-Answering	Quiz, Assignment, Short and Narrative question, MCQ, Fill in the Gap
CLO6	Assignment preparation and submission, and Student presentation	Class attendance, individual presentation

Learning Materials	
Text Book	1. King, M. 1995. Fisheries Biology, Assessment and Management. Fishing News Books. 342 pp. 2. Pauly, D. 1984. Fish population dynamics in tropical waters. A manual for use with programmable calculators. ICLARM, Manila. 325 pp. 3. Ricker, W. E. 1975. Computation and interpretation of biological
Supplementary Readings	

Assessment Pattern

CIE- Continuous Internal Evaluation (40 Marks)					
Bloom's Category	**Class**	**Assignment**	**Presentation**	**Quizzes**	**Attendance**

Marks (out of 40)	test (10)	submission (05)	(05)	(10)	(10)
Remember				05	
Understand	02			05	
Apply	04				
Analyse	04	01			
Evaluate		02			10
Create		02	05		

SSE- Semester End Examination (60 Marks)	
Bloom's Category	**Tests**
Remember	5
Understand	10
Apply	15
Analyse	15
Evaluate	10
Create	5

Level-3, Semester-II		
Course Code: 0831FMN322	**Year:** Third	**Semester:** Second
Course Title: Fish Population Dynamics Sessional		
Course Status: Core		
Credit: 1.0		
Prerequisite(s): None		
Rationale	In this course, students will learn practical knowledge about estimation of population parameters and their utilization to calculate maximum exploitation level of yield of fisheries resources through lectures and demonstrations and discussion.	

	By the end of the course, the students will be able to:		**Mapping with PLOs**
Course Learning Outcomes (CLOs)	CLO1	Discuss sample collection, data recording and Microsoft Excel software exercise.	PLO1, PLO7
	CLO2	Calculation of fish population relative and absolute abundances.	PLO1
	CLO3	Estimation of size relationships of fish population.	PLO1
	CLO4	Determination of spawning seasons and fecundity of fish population.	PLO1, PLO4

Course Contents		CLOs
1	Sampling considerations for gathering information of fish populations, recording the length and weight of fish in a sample, exercise of Microsoft Excel software	CLO1
2	Population relative and absolute abundances.	CLO2
3	Length-length and length-weight relationships, and condition factors of fish populations	CLO3
4	Spawning seasons by gonadosomatic index and external feature of gonads, and fecundity.	CLO4
5	FAO-ICLARM Stock Assessment Tools II (FiSAT), its applications on computer for fish stock assessment.	CLO1
6	Field trip to major fishing habitats for collection of samples from populations.	CLO1

Mapping CLOs with the Teaching-Learning and Assessment Strategy		
CLOs	**Teaching-Learning Strategy**	**Assessment Strategy**
CLO1	Lecture, Multi-media presentation, demonstration, Question-Answering, Short video presentation, Field visit, Sample collection, Lab work, and Data collection & management	Quiz, Assignment, Short question, MCQ, Fill in the Gap, Viva voce, Notebook
CLO2	Lecture, Multi-media presentation, demonstration, Question-Answering, Short video presentation, Lab work, and Data collection & management	Quiz, Assignment, Short question, MCQ, Fill in the Gap, Viva voce, Notebook
CLO3	Lecture, Multi-media presentation, demonstration, Question-Answering, Short video presentation, Lab work, and Data collection & management	Quiz, Assignment, Short question, MCQ, Fill in the Gap, Viva voce, Notebook
CLO4	Lecture, Multi-media presentation, demonstration, Question-Answering, Short video presentation, Lab work, and Data collection & management	Quiz, Assignment, Short question, MCQ, Fill in the Gap, Viva voce, Notebook

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

Assessment Pattern

CIE- Continuous Internal Evaluation (40 Marks)					
Bloom's Category Marks (out of 40)	**Class test (10)**	**Assignment submission (05)**	**Notebook/ Presentation (05)**	**Quizzes (10)**	**Attendance (10)**
Remember				05	
Understand	02			05	
Apply	04				
Analyse	04	01			
Evaluate		02			10
Create		02	05		

SSE- Semester End Examination (60 Marks)	
Bloom's Category	**Tests**
Remember	05
Understand	05
Apply	20
Analyse	10
Evaluate	10
Create	10

Third Year Second Semester		
Course Code: 0831 FST 321	**Level-3**	**Semester-II**
Course Title: Fishery Products and By-Products Technology		
Course Status: Core		
Credit: 2.0		
Prerequisite(s): None		
Rationale	This course will coverage a widespread of the most fundamental and advanced aspects on products and by-products of fish and shellfishes, value addition, development and improvement of fishery products and safety of the products in the context of human health. Students will acquire problem-solving skills by analyzing problems related to product quality and safety throughout the food chain.	

	By the end of the course, the students will be able to:		Mapping with PLOs
Course Learning Outcomes (CLOs)	CLO1	Describe the scientific knowledge and understanding of the biochemical processes in raw materials during post-harvest storage and their transformation into products.	PLO1, PLO4, PLO9 & PLO10
	CLO2	Determine the scientific knowledge and understanding of ecology, detection and combat microorganisms in various fish and fishery products.	PLO1, PLO9 & PLO10
	CLO3	Distinguish the scientific knowledge in different technologies and aspects of fishery product development in relation to consumer behavior.	PLO2, PLO9 & PLO10
	CLO4	Assess appropriate methods to improve the quality and extend shelf life of the products as well as add value for income generation.	PLO9 & PLO10
	CLO5	Create to solve problems related to product quality and safety along the food chain.	PLO2, PLO4, PLO9 & PLO10

Course Contents		CLOs
1	**Low-temperature processed products (**Chilled and frozen fishery products): Differentscientific, technical and technological problems and development of chilled and frozen fishery products in Bangladesh.	CLO1 & CLO3
2	**Cured products (Dried, Salted, Smoked and Fermented Products):** Types, scientific, technological problems of products, storage and marketing of dried, salted, smoked and fermented products. Fish powder-based fishery products.	CLO1, CLO2 & CLO4
3	**Canned products:** Spoilage of canned products, microbiological and chemical spoilage of canned fishery products, physical examination of canned products quality, Technological problems and resolutions of quality canned fishery products.	CLO1, CLO2, CLO4 & CLO5
4	**Surimi and diversified value-added fishery products:** Introduction to various fish mince- and surimi-based products such as- fish ball, fish finger, fish stick, fish sausages, fish burger, kamaboko, chikuwa, fish pickles, fish soup powder, katsuabushi, etc. Principles of protein gelation, heat induced muscle protein gelation mechanism.	CLO3, CLO4 & CLO5
5	**Fishery by- products:** Fish meal, fish silage, fish oil, fish gelatin, fish protein hydrolyzate (FPH), fish protein concentrate (FPC), fish glue, isinglass chitin, chitosan etc.	CLO3, CLO4 & CLO5

6	**Seaweed and seaweed-based products:** Seaweed, health benefits, active ingredients and functional properties, Processing of different seaweeds like *Kolarpa, Hypnea, Nori, Kombu*, etc., Methods of different seaweed based products development - onigiri, seaweed cake, biscuits, etc. Manufacture of commercial ingredients from seaweed.	CLO1, CLO2, CLO4 & CLO5

Mapping CLOs with the Teaching-Learning and Assessment Strategy		
CLOs	**Teaching-Learning Strategy**	**Assessment Strategy**
CLO1	Lecture, presentation and discussion	Quizzes, short questions and assignment
CLO2	Lecture and presentation, questions answering and discussion	Quizzes, short questions, assignment and narrative questions
CLO3	Lecture, presentation, questions answering, discussion and case studies	Assignment, narrative questions, poster submission and field reports
CLO4	Lecture, presentation, questions answering, discussion, filed report and video clip	Short questions, assignment, poster submission and narrative questions
CLO5	Lecture, presentation, discussion, simulation and video clip	Short questions, assignment and narrative questions

Learning Materials	
Text Book	1. Hall, G. M. 1997. Fish processing technology. Blakie Academic & Professional, London, Weinheim, New York, Melbourne, Madras. 2. Gopakumar, K. 1997. Tropical fishery products, Science Publishers, Inc. 3. Nowsad, A. K. M. A. 2007. Participatory Training of Trainers: A New Approach Applied in Fish Processing. Bangladesh Fisheries Research Forum. Bangladesh. 4. Tanikawa, E., T. Motohiro and M. Akiba. 1985. Marine products in Japan, Published by KoseishaKoseikaku Co., Ltd., Tokyo. 5. Windsor, M. and S. Barlow. 1981. Introduction to Fishery by-products. Fishing News Books Ltd.
Supplementary Readings	1. Motohiro, T., K. Hashimoto, H. Kadota, and T. Tokunaga. 1992. Science of Processing Marine products, Vol. I & II. Kanagawa International Fisheries Training Center. Japan International Cooperation Agency. 2. Nowsad, A. K. M. A. 1995. Low-cost Fish Processing in Coastal Bangladesh. BGD/97/017/Field Doc. 5/2005, FAO, Bangladesh. 3. Proceeding of conference on-Handling, Processing and Marketing of Tropical Fish. 1976. Tropical Product Institute, London. 4. Ruiter, A. 1995. Fish and Fishery Products; composition, nutritive

	properties and stability. CAB International, UK. 5. Zaitsev, V. P. 1965. Preservation of Fish Products by Refrigeration. U.S. Department of Commerce.

Assessment Pattern

CIE- Continuous Internal Evaluation (40 Marks)					
Bloom's Category Marks (out of 40)	**Class test (10)**	**Assignment (05)**	**Notebook/ Presentation (05)**	**Quizzes (10)**	**Attendance (10)**
Remember				05	
Understand	01			05	
Apply	02	01			
Analyze	04	01			
Evaluate	03	03			10
Create			05		

SEE- Semester End Examination (60 Marks)	
Bloom's Category	**Tests**
Remember	5
Understand	5
Apply	10
Analyze	20
Evaluate	15
Create	05

Third Year Second Semester		
Course Code: 0831 FST 322	**Year:** Third	**Semester:** Second
Course Title: Fishery Products and By-Products Technology Sessional		
Course Status: Core		
Credit: 1.0		
Prerequisite(s): None		
Rationale	In this course, students will learn and be demonstrated in various production technologies and aspects of fishery products and by products for income generation, as well as quality development and improvement.	

Course	**By the end of the course, the students will be able**	**Mapping with**

Learning Outcomes (CLOs)	to:		PLOs
	CLO1	Identify basic facilities and requirements of a fishery products laboratory.	PLO1 & PLO4
	CLO2	Evaluate the quality of different types of fish and fishery products.	PLO1
	CLO3	Develop new technology to produce fishery product in relation to consumer behavior.	PLO2
	CLO4	Make a development plan for product quality and safety along the food chain.	PLO8 & PLO9

Course Contents		CLOs
1	Acquaintance with fishery products laboratory, its facilities and requirements	CLO1
2	Preparation of wet fish, fish fillet, *shashimi* and fish loins and observation of their quality	CLO1 & CLO3
3	Study on the traditional and improved sun-dried fishery products	CLO2 & CLO3
4	Study on traditional and improved salted products from hilsa and determination of salt content.	CLO3 & CLO4
5	Study on traditional and improved smoked fish and shrimp products and observation of their quality	CLO3 & CLO4
6	Study on traditional and improved fermented products and observation of their quality	CLO3 & CLO4
7	Study on mince and mince-based value added fish products, such as fish ball, fish finger, fish stick, fish burger etc.	CLO3 & CLO4
8	Study on surimi and surimi-based products, such as kamaboko, chikuwa, hanpen, agemono, etc.	CLO2, CLO3 & CLO4
9	Field visit to dried, fermented fishery product making industry in national and international	CLO2, CLO3 & CLO4

Mapping CLOs with the Teaching-Learning and Assessment Strategy		
CLOs	**Teaching-Learning Strategy**	**Assessment Strategy**
CLO1	Lecture, presentation and demonstration	Short question, spotting, practical note book (PNB) and viva-voce
CLO2	Lecture, presentation, questions answering, demonstration and discussion	Short question, spotting, practical note book (PNB) and viva-voce
CLO3	Lecture, questions answering, demonstration and discussion	Short questions, spotting, practical note book (PNB) and viva-voce
CLO4	Lecture, demonstration, discussion and simulation	Spotting, practical note book (PNB) and viva-voce

Learning Materials	
Text Book	1. Balachandran, K. K. 2001. Post-harvest Technology of Fish and Fish Products. Daya Publishing House, Delhi – 110035. India. 2. Donald. 1968. (ed.). The Freezing Preservation of Foods. The Avi Publishing Company, INC. 3. Gopakumar, K. 1997. Tropical fishery products, Science Publishers, Inc. 4. Kuang, K. H., K. Miwa and M. B. Salim. (eds.). 1991. Proceedings of seminar on-Advances in Fishery Post-harvest Technology in Southeast Asia. SEAFDEC, Singapore. 5. Martin, A. M. 1994. (ed.). Fisheries Processing: Biotechnological Applications. Chapman and Hall, London. 6. Nowsad, A.K.M.A. 2007. Participatory Training of Trainers: A New Approach Applied in Fish Processing. Bangladesh Fisheries Research Forum. Bangladesh.
Supplementary Readings	1. Proceeding of conference on-Handling, Processing and Marketing of Tropical Fish. 1976. Tropical Product Institute, London. 2. Ruiter, A. 1995. Fish and Fishery Products; composition, nutritive properties and stability. CAB International, UK. 3. Tanikawa, E., T Motohiro and M. Akiba. 1985. Marine products in Japan, Published by KoseishaKoseikaku Co., Ltd., Tokyo. 4. Zaitsev, V. P. 1965. Preservation of Fish Products by Refrigeration. U.S. Department of Commerce.

Assessment Pattern

CIE- Continuous Internal Evaluation (40 Marks)					
Bloom's Category Marks (out of 40)	**Class test (10)**	**Assignment (05)**	**Notebook/ Presentation (05)**	**Quizzes (10)**	**Attendance (10)**
Remember				05	
Understand				05	
Apply	02	01			
Analyze	03	03			
Evaluate	04	01			10
Create	01		05		

SEE- Semester End Examination (60 Marks)	
Bloom's Category	**Tests**
Remember	5
Understand	5
Apply	15

Analyze	10
Evaluate	20
Create	05

Course Code: 0831 MFO 321	**Level: 3**	**Semester: II**
Course Title: Law of the Sea and Ocean Governance		
Department: Core		
Credit Hours: 2.0		
Prerequisite(s): None		
Rationale	In this course students will learn basic concept of on the legal regime of maritime zones according to UNCLOS. There is an opportunity to study maritime boundaries particularly different types of territories in sea and know the functional marine zones and legal implications of EEZ.	

	By the end of the course, the students will be able to:		**Mapping with PLOs**
Course Learning Outcomes (CLOs)	CLO 1	Know the concept and evolution of the law of the sea	PLO_1, PLO_2
	CLO 2	Apply knowledge about the international laws and regulations about the sea	PLO_1, PLO_2
	CLO 3	Analyze rights and duties of coastal and other states in different maritime zones	PLO_1, PLO_2, PLO_3
	CLO 4	Explain how to resolve various marine disputes, the peaceful use of marine resources, conduct uninterrupted scientific research and prevent marine pollution	PLO_1, PLO_2, PLO_9
	CLO 5	Analyze both factual and legal issues related to the law of the sea cases	PLO_1, PLO_2, PLO_5
	CLO 6	Evaluate the different legal regime of maritime zones according to UNCLOS	PLO_1, PLO_2, PLO_5
	CLO 7	Justify the past decisions, and predict future decisions by inventing new legal policies	PLO_1, PLO_2, PLO_9

	Course Contents	**CLOs**
1	**Introduction to the Law of the Sea**: Concept, History of the law of the sea, The United Nations Conferences and Conventions, UNCLOS, The U.N. Law of the Sea Convention 1982.	CLO1, CLO6

2	**Territorial Sea**: The legal regime of the internal waters and territorial waters, base lines, Bays, Bays bordered by more than one state, Jurisdiction in internal waters, The maritime dispute and implications of the judgment of the ITLOS and PCA on maritime boundary Bangladesh-Myanmar & Bangladesh-India. The competences of the coastal state, innocent passage, concerning fisheries, security and defense, customs and fiscal, navigation, competences concerning the exploration and exploitation of the seabed and its subsoil.	CLO1, CLO2, CLO3, CLO4, CLO5
3	**Functional Contiguous zone and EEZ**: The contiguous zone and its function, the EEZ and its legal implications, right of the coastal states, rights that all states have in the EEZ, delimitation principles.	CLO 1, CLO 2, CLO 3, CLO 4, CLO 5
4	**The Legal regime of the continental shelf and Deep-sea bed**: The legal concept on continental shelf, delimitation of the continental shelf between opposite and adjacent states, the right of the coastal state, general concept on deep sea bed, the natural resources of the deep-sea bed, the legal regime for the deep-sea bed, the international sea bed authority.	CLO 1, CLO 2, CLO 3, CLO 4, CLO 5
5	**The Legal regime of the high seas**: Freedom of the high seas, the freedom of the navigation, the freedom of the fisheries, the freedom of scientific research, jurisdiction on the high seas.	CLO 1, CLO 2, CLO 3, CLO 4, CLO 5
6	**Marine Scientific Research**: Legal problems and solution: the Geneva rules, different convention on the sea, international law of fisheries, research installation.	CLO 5, CLO 6, CLO 7
7	**Governance:** Marine spatial plan and marine protected area of Bangladesh, Regulation and Governance for the Conservation of Living Marine Resources, Contemporary Threats to Maritime Security.	CLO 1, CLO 4, CLO 5, CLO 7

Learning Materials	
Text Book	1. Law of the sea, United Nations, UNCLOS 1982 Convention 2. The Law of the sea, R. R. Churchill and A. V. Lowe, Juris Publishing, Inc., ISBN: 1578230292.
Supplementary Readings	1. Marine policy: an introduction to governance and international law of the oceans by Mark Zacharias.

Mapping CLOs with the Teaching-Learning and Assessment Strategy		
CLOs	**Teaching-Learning Strategy**	**Assessment Strategy**
CLO1	Lecture and multi-media presentation, asking questions and answers	Quiz, open book exam, short and Narrative answer
CLO2	Lecture, multi-media presentation, Problem based learning and group discussion	Quiz, Exit slips, short and Narrative answer
CLO3	Lecture, Socratic method, and multi-media	Quiz, One-minute paper, short

	presentation	and Narrative answer
CLO4	Lecture, multi-media presentation, Peer teaching and group discussion	Quiz, One-minute paper, short and Narrative answer
CLO5	Lecture, multi-media presentation, brainstorming and group discussion	Quiz, exit ticket, short and Narrative answer

Assessment Pattern

CIE- Continuous Internal Evaluation (40 Marks)					
Bloom's Category Marks (out of 40)	**Class test (10)**	**Assignment submission (05)**	**Presentation (05)**	**Quizzes (10)**	**Attendance (10)**
Remember				05	
Understand	2			05	
Apply	4	01			
Analyze	4				
Evaluate		02			10
Create		01	05		

SSE- Semester End Examination (60 Marks)	
Bloom's Category	**Tests**
Remember	5
Understand	10
Apply	15
Analyze	15
Evaluate	10
Create	5

Course Code: 0831 AQC 411	Level-4,	Semester-I
Course Title: Fish Nutrition		
Course Status: Core		
Credit: 3.0		
Prerequisite(s): None		
Rationale	This course is designed to provide the students with the basic principle of fish nutrition, individual nutrients, their digestion, absorption, metabolism, biochemical function, and nutritional disorders in cultured fish and shellfish.	

	By the end of the course, the students will be able to:		**Mapping with PLOs**
Course Learning Outcomes (CLOs)	CLO1	Identify the role of nutrition to boost aquaculture production.	PLO_1, PLO_2, PLO_3
	CLO2	Interpret the classifications, functions, digestion and absorption, and requirements of individual nutrients.	PLO_1, PLO_2, PLO_3
	CLO3	Integrate the energy produced from individual nutrients.	PLO_1, PLO_2, PLO_3
	CLO4	Analyze the disorders that arise from nutritional deficiency.	PLO_1, PLO_2, PLO_3
	CLO5	Develop larval and broodstock diets.	PLO_1, PLO_2, PLO_3

Course Contents		**CLOs**
1	Introduction: Feed and nutrients, role of nutrition in aquaculture practices, terminology used in fish nutrition.	CLO1 and CLO 5
2	Protein: Classification and functions, quantitative dietary protein requirements for fish and crustaceans, amino acid requirement, factors affecting amino acid requirement, amino acid availability, importance of amino acid profile in fish nutrition, protein metabolism, evaluation of protein quality.	CLO2 and CLO 5
3	Lipid: Classification and function of lipids, dietary lipid requirement of fish and shellfish, essential fatty acid requirement of fish and shellfish, biosynthesis and metabolism of fatty acids, importance of fatty acid profile in fish nutrition.	CLO2 and CLO 5
4	Carbohydrates: Classification, functions, and metabolism of carbohydrate, utilizations of dietary carbohydrates and fibre in fish and shellfish.	CLO2 and CLO 5
5	Vitamins and minerals: Classification and general functions, dietary sources and requirement of vitamins and minerals for fish and	CLO2 and

	shellfish.	CLO 5
6	Energy metabolism in cultivable fish and shellfish: Partitioning of biological energy, specific dynamic action, energy requirement, energy balance equation and its use in aquaculture, factors affecting energy requirements, dietary energy sources, protein-energy ratio.	CLO3 and CLO 5
7	Digestion and absorption of nutrients: Digestive fluids and enzymes, digestion and absorption of protein, fat and carbohydrate, digestibility, determination of feed digestibility, factors affecting digestibility.	CLO2 and CLO 5
8	Nutritional disorders: Disorders due to deficiency/excess of protein, lipid, carbohydrate, vitamins and minerals in fish and shellfish.	CLO4 and CLO 5
9	Larval and broodstock nutrition: Energy partitioning for reproduction, effect of dietary quality on reproductive output, nutritional requirements.	CLO1 and CLO 5

Mapping CLOs with the Teaching-Learning and Assessment Strategy		
CLOs	**Teaching-Learning Strategy**	**Assessment Strategy**
CLO1	Lecture, Group discussion, Question-Answering	Quiz, Short and Narrative question.
CLO2	Lecture, Paper work, Graphical Presentation, Question-Answering	Quiz, Synopsis,Presentation, Short and Narrative question.
CLO3	Lecture, Paper work, Presentation, Question-Answering	Synopsis, Presentation, Short and Narrative question.
CLO4	Lecture, Group discussion, Question-Answering	Short and Narrative question.
CLO5	Lecture, Paper work, Presentation, Group discussion, Question-Answering	Synopsis, Presentation, Short and Narrative question

Learning Materials	
Text Book	9. De Silva, S.S., Anderson T.A., 1995. Fish nutrition in aquaculture. Chapman & Hall, London. 319 pp. 10. Halver, J.E., 1988. Fish Nutrition. Academic Press, New York. 798 pp. 11. Hepher, B., 1990. Nutrition of Pond Fishes. Cambridge University Press, Cambridge. 388 pp. 12. Lovell, T., 1998. Nutrition and Feeding of Fish. Kluwer Academic
Supplementary Readings	1. AOAC, 2000. Official Methods of Analysis 17th Edition, Association of Official Analytical Chemists, Washington DC. 2200 pp. 2. Goddard, S., 1996. Feed Management in Intensive Aquaculture, Chapman & Hall, Dept. BC, 115 Fifth Avenue, New York, NY 10003. 194 pp. 3. Guillaume, J., Kaushik, S., Bergot P., Metailler, R., 2001. Nutrition and Feeding of Fish and Crustaceans. Praxis Publishing, Chichester, UK. 408 pp. 4. New, M.B., 1987. Feed and Feeding of Fish and Shrimp. ADCP/REP/87/26, UNDP/FAO, Rome. 275 pp.

5. Steffens, W., 1989. Principles of Fish Nutrition. Ellis Horwood Ltd., West Sussex. 384 pp.
6. Tacon, A.G.J., 1990. Standard Methods for the Nutrition and Feeding of Farmed Fish and Shrimp. Argent Laboratories Press, Washington. 454 pp.
7. Tacon, A.G.J. Basurco, B., 1997. Feeding Tomorrow's Fish. CIHEAM/FAO/IEO, Zaragoza (Espana). 307pp.

Assessment Pattern

CIE- Continuous Internal Evaluation (40 Marks)					
Bloom's Category Marks (out of 40)	**Class test (10)**	**Assignment submission (05)**	**Presentation (05)**	**Quizzes (10)**	**Attendance (10)**
Remember				05	
Understand	2			05	
Apply	4	01			
Analyze	4				
Evaluate		02			10
Create		01	05		

SSE- Semester End Examination (60 Marks)	
Bloom's Category	**Tests**
Remember	5
Understand	10
Apply	15
Analyze	15
Evaluate	10
Create	5

Course Code: 0831 AQC 412	Level-4,	Semester-I
Course Title: Fish Nutrition Sessional		
Course Status: Core		
Credit: 1.0		
Prerequisite(s): None		
Rationale	The course will provide the students a hands-on experience on proximate composition analysis of different fish, feed ingredients and compound feeds, digestibility of fish feeds and growth performances under different feeding practices in field conditions.	

	By the end of the course, the students will be able to:		**Mapping with PLOs**
Course Learning Outcomes (CLOs)	CLO1	Design a nutrition laboratory with safety procedures.	PLO_3
	CLO2	Develop nutritional work related to proximate composition analysis of fish, feed ingredients, and compound feeds; and digestibility estimation of different fish feed.	PLO_3, PLO_4, PLO_{10}
	CLO3	Experiment growth performances under different feeding practices in field conditions.	PLO_3, PLO_{10}
	CLO4	Investigate the current scenario of aquaculture nutrition by visiting the farm.	PLO_6

	Course Contents	**CLOs**
1	Introduction to laboratory equipment and safety procedures.	CLO1
2	Proximate composition analysis, feed ingredients, compounded feed and naturally produced food and carcass samples: a) moisture/ dry matter, b) protein, c) lipid, d) ash, and e) crude fibre.	CLO2
3	Techniques for faecal collection.	CLO2
4	Determination of chromic oxide content in feed and fecal sample for the determination of digestibility.	CLO2
5	Analysis of growth responses, food conversion and protein utilization.	CLO3
6	Study of growth performances under different feeding practices in field conditions	CLO3
7	Aquaculture farm visit	CLO4

Mapping CLOs with the Teaching-Learning and Assessment Strategy		
CLOs	**Teaching-Learning Strategy**	**Assessment Strategy**
CLO1	Lecture, Demonstration, Question-Answering	Quiz, Demonstration, Short and Narrative question, Practical Note Book, Viva voce.
CLO2	Lecture, Lab work, Question-Answering	Quiz, Short and Narrative question, Practical Note Book, Viva voce.
CLO3	Lecture, Feeding experiment, Data collection, Analysis, Question-Answering	Short and Narrative question, Practical Note Book, Viva voce.
CLO5	Lecture, Group discussion, Report writing, Question-Answering	Short and Narrative question, Practical Note Book, Viva voce.

Learning Materials	
Text Book	13. De Silva, S.S., Anderson T.A., 1995. Fish nutrition in aquaculture. Chapman & Hall, London. 319 pp. 14. Halver, J.E., 1988. Fish Nutrition. Academic Press, New York. 798 pp. 15. Hepher, B., 1990. Nutrition of Pond Fishes. Cambridge University Press, Cambridge. 388 pp. 16. Lovell, T., 1998. Nutrition and Feeding of Fish. Kluwer Academic
Supplementary Readings	1. AOAC, 2000. Official Methods of Analysis 17th Edition, Association of Official Analytical Chemists, Washington DC. 2200 pp. 2. Guillaume, J., Kaushik, S., Bergot, P., Metailler, R., 2001. Nutrition and Feeding of Fish and Crustaceans. Praxis Publishing, Chichester, UK. 408 pp. 3. Halver, J.E., 1989. Fish Nutrition 2nd Edition. Academic Press. 388 pp. 4. Steffens, W., 1989. Principles of Fish Nutrition. Ellis Horwood Ltd., West Sussex. 384 pp. 5. Tacon, A.G.J., 1990. Standard Methods for the Nutrition and Feeding of Farmed Fish and Shrimp. Vol. I-II. Argent Laboratories Press, Redmond, Washington, USA. 454 pp.

Assessment Pattern

CIE- Continuous Internal Evaluation (40 Marks)					
Bloom's Category Marks (out of 40)	**Class test (10)**	**Assignment (05)**	**Notebook/ Presentation (05)**	**Quizzes (10)**	**Attendance (10)**
Remember				05	
Understand	02			05	
Apply	04				
Analyze	04	01			

Evaluate		02			10
Create		02	05		

SSE- Semester End Examination (60 Marks)	
Bloom's Category	**Tests**
Remember	5
Understand	5
Apply	20
Analyze	10
Evaluate	10
Create	10

Course Code	0831FBG 411	**Year:** Fourth	**Semester:** First
Course Title	Genetics and Fish Breeding		
Course Status	Core		
Credit	3.0		
Prerequisite(s)	None		
Rationale	The students will learn the basic genetic and breeding principles and techniques and their applications for genetic improvement and conservation of fish stocks. This course is aimed at attracting students, who are interested in aquaculture species, but students interested in natural populations and genetics in general will be benefited from taking the course too.		

	By the end of the course, the students will be able to:		**Mapping with PLOs**
Course Learning Outcomes (CLOs)	CLO1	Discuss the objectives of fish breeding and the problems faced by breeders.	PLO1, PLO2, PLO5, PLO6, PLO9
	CLO2	Apply genetic principles and techniques to manage and conserve wild and captive populations.	PLO1, PLO2, PLO4, PLO5, PLO9
	CLO3	Explicate complex inheritance of quantitative phenotypes. Explain genetic and environmental sources of variation and the role of environment on phenotypes.	PLO1, PLO4, PLO5, PLO9, PLO10
	CLO4	Apply genetic principles and techniques to improve the economic value and performance of farm fish. To consider and use the tools available to maximize response to genetic selection.	PLO1, PLO2, PLO5, PLO9
	CLO5	Set up and develop a breeding program at the farm and participate in planning and implementation of breeding programs at the population level. Propose problem solutions that can occur in breeding of different fish species.	PLO1, PLO4, PLO5

Course Contents		**CLOs**
1	Introduction: Overview of fish genetic resources of Bangladesh, scope and potential of genetics in aquaculture and fisheries.	CLO1
2	Genetics of populations: Genetic variability in a population, gene pool and gene frequency, Hardy-Weinberg Equilibrium, factors influencing gene and genotype frequency.	CLO2

3	Genetics of quantitative phenotypes: Quantitative phenotypic variation and its components, characteristics of quantitative inheritance, gene-environment interaction, environmental factors affecting productivity; polygenic inheritance.	CLO3
4	Selection: Heritability and selection response, basic types of selection programs, individual selection, family selection and mass selection, tandem selection, independent culling, selection index.	CLO4
5	Hybridization: Types of cross breeding program, uses of hybridization, heterosis, recurrent selection, impact of hybridization, planning of cross breeding programs.	CLO5
6	Inbreeding: Genetic effects of inbreeding and practical applications, inbreeding co-efficient and its calculation, inbreeding depression, control of inbreeding accumulation, effective breeding number and genetic drift.	CLO5
7	Chromosome manipulation: Gynogenesis, androgenesis, polyploidy, sex-reversal and production of monosex populations.	CLO4
8	Recent developments in genetics: Genetic engineering- applications and biosafety of GMOs.	CLO4

Mapping CLOs with the Teaching-Learning and Assessment Strategy		
CLOs	**Teaching-Learning Strategy**	**Assessment Strategy**
CLO1	Lecture and multi-media presentation, asking questions and answers	Quiz, open book exam, short and Narrative answer
CLO2	Lecture, multi-media presentation, Problem based learning, and group discussion	Quiz, Exit slips, short and Narrative answer
CLO3	Lecture, Socratic method, and multi-media presentation	Quiz, One minute paper, short and Narrative answer
CLO4	Lecture, multi-media presentation, Peer teaching and group discussion	Quiz, One minute paper, short and Narrative answer
CLO5	Lecture, multi-media presentation, brainstorming and group discussion	Quiz, exit ticket, short and Narrative answer

Learning Materials

Text Books	1. Tave, D. 1993. Genetics for Fish Hatchery Managers (2nd Edition), Van Nostrand Reinhold, New York. 415pp. 2. Falconer, D. S. and T. F. C. Mackay. 1996. Introduction to Quantitative Genetics (4th Edition), Longman, England. 463 pp. 3. Shah, M. S. 2010. Genetics of Aquaculture and Fisheries Management. 269 pp.

	4. Gjedrem, T. 2005. Selection and breeding programs in Aquaculture. Springer. 364 pp. 5. Purdom, C. E. 1992. Genetics and Fish Breeding. Chapman and Hall.
Supplementary Readings	1. Tave, D. 1999. Inbreeding and Broodstock. Management. FAO Technical Paper No.392. Tave, D. 1995. Selective Breeding Programs for Medium-sized Fish Farms. FAO Fisheries Technical Paper No. 352, Rome. 122 pp. 2. Hartland, D. L. and A. G. Clark. 2007. Principles of Population Genetics. 4th Edition. Sinaur and Associates, Sunderland, M.A. 652 pp. 3. Mostafa, S. 1999 (ed.) Genetics in Sustainable Fisheries Management. Fishing News Books. 4. Reddy, P. V. G. K. 1999. Genetic Resources of the Indian Major Carps, FAO Fisheries Technical Paper No. 387. 5. Best, T. M. 2007. Ecological and Genetic Implications of Aquaculture Activities. Springer. 545 pp. 6. Kirpichnikov, V. S. 1981. Genetic Bases of Fish Selection. Springe-Verlag, New York. 7. Ryman, N. and F. Utter. 1987 (eds.) Population Genetics and Fishery Management. University of Washington Press Seattle and London.

Assessment Pattern

CIE- Continuous Internal Evaluation (40 Marks)					
Bloom's Category Marks (out of 40)	**Class test (10)**	**Assignment (05)**	**Notebook/ Presentation (05)**	**Quizzes (10)**	**Attendance (10)**
Remember				05	
Understand	02			05	
Apply	04				
Analyze	04	01			
Evaluate		02			10
Create		02	05		

SEE- Semester End Examination (60 Marks)	
Bloom's Category	**Tests**
Remember	5
Understand	5
Apply	20

Analyze	10
Evaluate	10
Create	10

Course Code	0831FBG 412	**Year:** Fourth	**Semester:** First
Course Title	Genetics and Fish Breeding Sessional		
Course Status	Core		
Credit	1.0		
Prerequisite(s)	None		
Rationale	The students will have opportunity to analyze practical problems using the latest techniques in population and quantitative genetics and breeding. Students will develop skills needed to operate a fish breeding center as well as in public services and genetics laboratories.		

	By the end of the course, the students will be able to:		**Mapping with PLOs**
Course Learning Outcomes (CLOs)	CLO1	Demonstrate skill to identify problems and state a hypotheses. Carry out genetic studies in the laboratory and field; analyze and interpret experimental data using population genetics tools.	PLO1, PLO2, PLO5
	CLO2	Analyze simple but realistic problems in the inheritance of quantitative characters and selection of quantitative characters using tools from quantitative genetics.	PLO1, PLO2, PLO4, PLO5, PLO9
	CLO3	Produce monosex fish and identify male and female juveniles by microscopic studies.	PLO1, PLO4, PLO5, PLO6, PLO10
	CLO4	Conduct chromosome manipulation studies	PLO1, PLO2, PLO5, PLO6
	CLO5	Write a laboratory report.	PLO1, PLO3, PLO4, PLO5, PLO9

Course Contents		**CLOs**
1	Collection, length-weight measurement and frequency distribution to study quantitative phenotypes of fishes.	CLO1
2	Lab test for population genetics to see how the genetics of populations can be modeled using Hardy-Weinberg population genetics and to see the effects of various deviations from the Hardy-Weinberg assumptions on the allele frequencies of a population (micro-evolution).	CLO1

3	Techniques of starch gel electrophoresis and calculation of gene and genotype frequencies from allozyme data/ blood group data.	CLO1
4	Calculation of heritability and expected response from selection differential and heritability, estimation of inbreeding coefficient, estimation of effective population size.	CLO2
5	Study of hormonal sex-reversal using androgen and/or estrogen hormones. Feeding the fry every day and observation.	CLO3
6	Identification of sexes of juvenile fish by aceto-carmine squash method to evaluate the results of sex-reversal experiments.	CLO3
7	Study of chromosome manipulation techniques to produce polyploidy and gynogenetic fish and familiarization with cryopreservation techniques.	CLO4
8	Visiting different government and privately-owned fish hatcheries to know the brood stock management practices by the hatchery operations and to learn the genetic problems currently faced by the hatchery operators and fish farmers.	CLO5
9	Students shall maintain a record of everything done in the practical and field sessions in a Practical Note Book to be signed and checked by teacher(s) concerned. Viva voce test will form an essential part of the Practical Examinations.	CLO5

Mapping CLOs with the Teaching-Learning and Assessment Strategy		
CLOs	**Teaching-Learning Strategy**	**Assessment Strategy**
CLO1	Lecture, demonstration, and multi-media presentation, asking questions and answers	Quiz, Exit slips, Viva voce, short and Narrative answer
CLO2	Lecture, demonstration, multi-media presentation, assignment and group discussion	Quiz, one minute paper, Viva voce, short and Narrative answer
CLO3	Lecture, report writing and multi-media presentation; microscopic observation	Quiz, one minute paper, Viva voce, short and Narrative answer
CLO4	Lecture, demonstration, multi-media presentation, assignment and group discussion	Quiz, exit ticket, observation, Viva voce, short and Narrative answer presentation
CLO5	Lecture, demonstration, multi-media presentation and group discussion	Quiz, report, Infograhic, Viva voce, short and Narrative answer

Learning Materials

Text Books	6. Tave, D. 1993. Genetics for Fish Hatchery Managers (2nd Edition), Van Nostrand Reinhold, New York. 415pp.

	7. Tave, D. 1995. Selective Breeding Programs for Medium-sized Fish Farms. FAO Fisheries Technical Paper No. 352, Rome. 122 pp. 8. Tave, D. 1999. Inbreeding and Broodstock. Management. FAO Technical Paper No.392. 9. Gjdrem, T. and M. Baranski. 2009. Selective Breeding in Aquaculture. Springer. 221 pp. 10. Ryman, N. and F. Utter. 1987 (eds.) Population Genetics and Fishery Management. University of Washington Press Seattle and London. 11. Falconer, D. S. and T. F. C. Mackay. 1996. Introduction to Quantitative Genetics (4th Edition), Longman, England. 463 pp. 12. Krauter, K. and M. Winey. 2012. Practical Genetics for the 21st Century. Flatworld Knowledge. 13. Lutz, C. G. 2001. Practical genetics for Aquaculture. Fishing News Books. Blackwell Science.
Supplementary Readings	

Assessment Pattern

CIE- Continuous Internal Evaluation (40 Marks)					
Bloom's Category Marks (out of 40)	**Class test (10)**	**Assignment (05)**	**Notebook/ Presentation (05)**	**Quizzes (10)**	**Attendance (10)**
Remember				05	
Understand	02			05	
Apply	04				
Analyze	04	01			
Evaluate		02			10
Create		02	05		

SEE- Semester End Examination (60 Marks)	
Bloom's Category	**Tests**
Remember	5
Understand	5
Apply	20
Analyze	10

Evaluate	10
Create	10

Level-4, Semester-I		
Course Code: 0831 GED 411	**Year: Fourth**	**Semester: First**
Course Title: Research Methodology		
Course Status: GED		
Credit: 2.0		
Prerequisite(s): None		
Rationale	In this course, students will learn how a plan is valuable for fisheries research, how to make a research plan and how to evaluate the research project through lectures and discussion.	

Course Learning Outcomes (CLOs)	**By the end of the course, the students will be able to:**		**Mapping with PLOs**
	CLO1	Write a research plan.	PLO1, PLO7
	CLO2	Know about statistical analysis of data with their interpretation.	PLO4, PLO7
	CLO3	Write scientific report, paper and thesis.	PLO4, PLO7, PLO10
	CLO4	Evaluate a research project.	PLO4, PLO5
	CLO5	Communicate and work effectively in groups in developing presentations.	PLO5, PLO9, PLO10

	Course Contents	**CLOs**
1	**Introduction:** Fisheries research- Goals, objectives, rationale and outcomes. Types of research, steps in solving a problem. Planning- Definition, rational planning, outcome, theory and approach. Monitoring and evaluation- Objectives and functions.	CLO1
2	**SWOT (strength, weakness, opportunities and threats) analysis for fisheries research:** Ponds, reservoirs and lakes, floodplains and rivers, coastal waters, coral reefs and soft bottom shelves.	CLO4
3	**Environmental impact assessment (EIA):** Need for an EIA, steps in the EIA process, operational EIA.	CLO4
4	**Sampling and its types:** Concept, types and their advantages and disadvantages.	CLO2
5	**Methods of data collection:** Concept of data, data collection methods with their advantages and disadvantages, data collection instruments, forms of instruments with their merits and demerits.	CLO5
6	**Research Proposal:** Concept, major component, common mistakes in proposal writing.	CLO1
7	**General principle of scientific writing:** Justification, objectives, outcomes, approach of scientific writing.	CLO3
8	**Statistical analysis and interpretation:** Concept, importance, types,	CLO2

	variables, hypothesis, correlations and regressions, interpretation of analysis.	

Mapping CLOs with the Teaching-Learning and Assessment Strategy		
CLOs	**Teaching-Learning Strategy**	**Assessment Strategy**
CLO1	Lecturing, Question-Answering, group discussion, Assignment, Graphical presentation	Quiz, Assignment, Short and Narrative question, MCQ, Fill in the Gap
CLO2	Lecturing, Question-Answering, group discussion, Assignment, Graphical presentation	Quiz, Assignment, Short and Narrative question, MCQ, Fill in the Gap
CLO3	Lecturing, Question-Answering, group discussion, Assignment, Graphical presentation	Quiz, Assignment, Short and Narrative question, MCQ, Fill in the Gap
CLO4	Lecturing, Question-Answering, group discussion, Assignment, Graphical presentation	Quiz, Assignment, Short and Narrative question, MCQ, Fill in the Gap
CLO5	Lecturing, Question-Answering, group discussion, Assignment, Graphical presentation	Quiz, Assignment, Short and Narrative question, MCQ, Fill in the Gap
CLO6	Assignment preparation and submission, and Student presentation	Class attendance, individual presentation

Learning Materials	
Text Book	1. Berkes, F., Mahon, R., McConny, P., Pollnac, R. and Pomeroy, R., 2001. Managing small-scale fisheries: Alternative directions and methods. International Development Research Centre, Singapore, 310 pp. 2. Clark, J.R., 1996. Coastal zone management handbook. Lewis Publishers, 694 pp. 3. Hamlisch, R., 1989. Methodology and guidelines for fisheries development planning with special reference to developing countries in the African region. Food and Agriculture Organization, Rome, 61 pp. 4. ICLARM, 1999. Aquatic resources research in developing countries: Data and evaluation by region and research system. ICLARM, Manila, Philippines, 131 pp. 5. Kay, R. and Alder, J., 1999. Coastal planning and management. Spon Press, London, 375 pp.
Supplementary Readings	

Assessment Pattern

CIE- Continuous Internal Evaluation (40 Marks)					
Bloom's Category Marks (out of 40)	**Class test (10)**	**Assignment submission (05)**	**Presentation (05)**	**Quizzes (10)**	**Attendance (10)**
Remember				05	
Understand	02			05	
Apply	04				
Analyse	04	01			
Evaluate		02			10
Create		02	05		

SSE- Semester End Examination (60 Marks)	
Bloom's Category	**Tests**
Remember	5
Understand	10
Apply	15
Analyse	15
Evaluate	10
Create	5

Forth Year First Semester		
Course Code: 0831 GED 413	**Year:** Forth	**Semester:** First
Course Title: Food Safety and Ethics		
Course Status: General		
Credit: 2.0		
Prerequisite(s): None		
Rationale	In this course, students will familiarize about the general principles of safety and ethics on food and fish products, and official inspection practices in Bangladesh, EU, India, Japan and US-FDA. The students will also be taught the basic concepts of food laws and regulation, food laws and regulation in nationally and internationally, as well as the applied knowledge on the food laws and safety assessment of food especially in fish and fishery products.	

	By the end of the course, the students will be able to:		**Mapping with PLOs**
Course Learning Outcomes (CLOs)	CLO1	Identify organization of food laws and regulation, programs of fish inspection and quality control (FIQC), organizational structure, duties and responsibilities and inspection services of FIQC in Bangladesh.	PLO1 & PLO4
	CLO2	Summarize the food laws and safety control regulations for fish and fishery products, with updated version of EU, USFDA rules and regulations of food laws and safety for fish and fishery products.	PLO2 & PLO5
	CLO3	Determine the traceability, steps of implementing traceability in fish and shrimp value chain, national residue control plan (NRCP) and its policy, planning, implementation and monitoring.	PLO2, PLO5, PLO6 & PLO10
	CLO4	Validate the regulations to control the food laws and safety aspects through national and international standard bodies on the fish and fishery products produced in Bangladesh.	PLO1 & PLO10

Course Contents		CLOs
1	**Introduction:** Objectives, scope and impacts of food safety and laws, food safety organizations, inspection and legislation, the importance of inspection; organizational structure of food safety program, duties and responsibilities of food safety officer.	CLO1 & CLO2
2	**Food laws and regulations:** Food laws and competent authority; fish feed	CLO2

	and animal feed act, fish hatchery act, update version as well as previous acts with amendments, EU and USFDA regulation and guidelines. Concept of halal food, Food ethics, Sustainability in Food Safety.	
3	**Inspection of fish food products:** Fresh, chilled, precooked, frozen fish, smoked fish, dried, salted fish, canned fish, marinades and heat processed fish; fish flavor and quality. Hygiene and safety aspect of fish and fishery products.	CLO1 & CLO2
4	**Traceability:** Legal background, benefits and steps of implementing traceability in fish and shrimp value chain. Pre-requisite of traceability, traceability implementation in developing countries, certification and accreditation procedure, constrain/ weakness and improvement of the system, Traceability protocols, standards and sustainability of tuna canned fishery industry.	CLO1, CLO2 & CLO4
5	**National Standards:** NationalResidue Control Plan-(NRCP), Bangladesh Standard Testing Institute (BSTI), Department of Fisheries (DoF) policy guidelines, role, planning, implementation and monitoring of national standards and specifications.	CLO3
6	**International standards and legislation:** CODEX standards, International Organization of Standardization (ISO-9000-4), International Commission on Microbiological Specification of Foods (ICMSFs), FDA, EU standards and specification for different fishery products, Rapid Alert System for Feed and Food (RASFF).	CLO1, CLO2, CLO3 & CLO4

Mapping CLOs with the Teaching-Learning and Assessment Strategy		
CLOs	**Teaching-Learning Strategy**	**Assessment Strategy**
CLO1	Lecture, presentation and questions answering	Quizzes, short questions and assignment
CLO2	Lecture, presentation, questions answering and discussion	Quizzes, short questions, assignment and narrative questions
CLO3	Lecture, presentation, discussion and project	Short questions, assignment, poster submission and narrative questions
CLO4	Lecture, presentation, discussion, field report and simulation	Short questions, assignment, poster submission and narrative questions

Learning Materials	
Text Book	1. Fish and Fishery Products Official Controls Protocol. Department of Fisheries, Bangladesh Competent Authority (2015). Ministry of Fisheries and Livestock, Government of the Peoples Republic of Bangladesh. 2. Fish and Fishery Products Hazards and Controls Guidance Fourth

	Edition – APRIL 2011. Department Of Health And Human Services, Public Health Service, Food And Drug Administration, Center For Food Safety And Applied Nutrition, Office Of Food Safety. 3. H.H. Huss (2004). Assessment and Management of Seafood Safety and Quality. FAO Fisheries Technical Paper 444 4. Bonnell, A. D. 1994. Quality Assurance in Seafood Processing: A Practical Guide. Chapman & Hall, London. 208 pp.
Supplementary Readings	1. Connell, J. J. 1980. Control of Fish Quality. Fishing News Books Ltd. (2nd Edition). England. 222 pp. 2. Kramer, A. and B. A. Twigg. 1966. Fundamentals of Quality Control for the Food Industry. The Avi. Publishing Co. Inc., Westport. 3. Kreuzer, R. 1971. (ed.). Fish Inspection and quality control. Fishing News Books. Ltd. London. 4. Botta, J. R. 1995. Evaluation of Seafood Freshness Quality. VCH Publishers, Inc. New York. 5. Bremer, H. A. 2002. Safety and Quality Issues in Fish Processing. CRC Press, 2002 -Technology & Engineering. 507 pp.

Assessment Pattern

CIE- Continuous Internal Evaluation (40 Marks)					
Bloom's Category Marks (out of 40)	**Class test (10)**	**Assignment (05)**	**Notebook/ Presentation (05)**	**Quizzes (10)**	**Attendance (10)**
Remember				05	
Understand				05	
Apply	02	01			
Analyze	02	02			
Evaluate	04	02			10
Create	02		05		

SEE- Semester End Examination (60 Marks)	
Bloom's Category	**Tests**
Remember	5
Understand	5
Apply	10
Analyze	10
Evaluate	20
Create	10

Course Code: 0831 MFO 411	**Level-4**	**Semester-I**
Course Title: Coastal and Marine Pollution		
Department: Core		
Credit Hours: 2.0		
Prerequisite(s): None		
Rationale	This course is designed mainly for students of marine fisheries and oceanography disciplines to teach various sources of marine pollution, kinds of pollutant and their impacts on marine resources and to learn how to manage that pollution, ocean management and marine pollution alleviation programs. It will provide student an understanding to identify the root causes of marine pollution as well as different prevention method for controlling pollution in marine environment.	

	By the end of the course, the students will be able to:		**Mapping with PLOs**
Course Learning Outcomes (CLOs)	CLO 1	Know the different types of coastal and marine pollution and pollutants.	PLO_1, PLO_2
	CLO 2	Evaluate the present status of impacts of coastal and marine pollution.	PLO_1, PLO_2
	CLO 3	Understand major pollution issues that threaten marine and coastal areas.	PLO_1, PLO_2, PLO_3
	CLO 4	Categorize the natural and anthropogenic hazards on marine and coastal environment.	PLO_1, PLO_2, PLO_9
	CLO 5	Analyze the effects of pollution on aquatic biota and public health.	PLO_1, PLO_2, PLO_9
	CLO 6	Know the various management, policies, laws and regulations for the protection and conservation of the good environmental status of the marine and coastal environment.	PLO_1, PLO_2, PLO_5

	Course Contents	**CLOs**
1	**Introduction:** Concept of pollution and pollutants, different types, point & non-point sources of pollution in the coastal and marine environment, hazardous waste, natural and anthropogenic sources of marine pollutants, transport and dispersion of marine pollutants, effect of pollutants on marine organisms; green-house gases: sources, effect on global warming and sea-	CLO 1, CLO 2, CLO 3
2	**Agro-chemical and sewage pollutions:** Concept, types and sources, effects on biota, pesticides, persistent organic pollutants (pops), dirty dozens, endocrine disrupting chemicals, polycyclic aromatic hydrocarbons, lethal and sub-lethal responses, acute and long-term toxicity, eutrophication and its effect in food web and ecosystem.	CLO 1, CLO 2, CLO 4, CLO 5

3	**Industrial and heavy metals pollution:** Concept, sources and types of industrial and heavy metal pollution; major polluting industries, toxic pollutants from tanneries, textiles, chemical industries, shipbreaking industries, pollutant from different culture practice on marine waters, effects of effluents on marine ecosystem, thermal pollution, ETP, waste water treatment; effects of heavy metals on aquatic biota and public health, bioaccumulation and bio magnification of lead, cadmium, chromium &	CLO 1, CLO 2, CLO 4, CLO 5
4	**Plastic and micro-plastic pollution**: Concept, sources and types, characteristics, ghost gear, bioaccumulation, impacts on marine organisms, marine food web, toxicity and its effects on world ocean, human and ecosystems, mitigation measures.	CLO 1, CLO 2, CLO 4, CLO 5
5	**Oil pollution:** Concept, types of hydrocarbon, sources of hydrocarbon, fate of oil on the surface water of the ocean, impact of oil on marine ecosystem, Removal technique of oil from surface water of the ocean.	CLO 1, CLO 2, CLO 5
6	**Pollution management and regulation:** Concept and general principles of international law relating to marine pollution; marine pollution conventions and law of the sea to control marine pollution, ballast water management and marine invasive species control; desalination plants,effluent treatment plant (ETP), EIA process.	CLO 6

Mapping CLOs with the Teaching-Learning and Assessment Strategy		
CLOs	**Teaching-Learning Strategy**	**Assessment Strategy**
CLO1	Lecturing, Question-Answering, group discussion, Assignment, Graphical presentation	Quiz, Assignment, Short and Narrative question, MCQ, Fill in the Gap
CLO2	Lecturing, Question-Answering, group discussion, Assignment, Graphical presentation	Quiz, Assignment, Short and Narrative question, MCQ, Fill in the Gap
CLO3	Lecturing, Question-Answering, group discussion, Assignment, Graphical presentation	Quiz, Assignment, Short and Narrative question, MCQ, Fill in the Gap
CLO4	Lecturing, Question-Answering, group discussion, Assignment, Graphical presentation	Quiz, Assignment, Short and Narrative question, MCQ, Fill in the Gap
CLO5	Lecturing, Question-Answering, group discussion, Assignment, Graphical presentation	Quiz, Assignment, Short and Narrative question, MCQ, Fill in the Gap
CLO6	Assignment preparation and submission, and Student presentation	Class attendance, individual presentation

Learning Materials	
Text Book	1. R. B. Clark (2001) Marine Pollution, Oxford University Press, NY. 2. Islam, M.A., 1994. Toxic Chemicals and Hazardous Wastes: Bangladesh Context. Department of Environment, Dhaka.

	3. CarlJ.Sindermann,2005.Coastalpollution:Effectson livingresourcesandhumans(MarineScienceSeries).
Supplementary Readings	1. Water Pollution by A.K. Tripallhi 2. Heavy Metal in the Marine Environment by R.W. Furness 3. Introduction to Water Resources Environmental Issues by Karie L Pennington

Assessment Pattern

CIE- Continuous Internal Evaluation (40 Marks)					
Bloom's Category Marks (out of 40)	**Class test (10)**	**Assignment (05)**	**Notebook/ Presentation (05)**	**Quizzes (10)**	**Attendance (10)**
Remember				05	
Understand				05	
Apply	02	01			
Analyze	02	02			
Evaluate	04	02			10
Create	02		05		

SEE- Semester End Examination (60 Marks)	
Bloom's Category	**Tests**
Remember	5
Understand	5
Apply	10
Analyze	10
Evaluate	20
Create	10

Course Code: 0831 AQC 421	Level-4	Semester-II
Course Title: Fish Feed Technology		
Course Status: Core		
Credit: 3.0		
Prerequisite(s): None		

Rationale	This course is designed to provide the students about the importance of fish feed in aquaculture and introduce students to different feedstuffs for feed formulation, manufacturing, storage, feeding regime, and legal aspects of aquafeed production.

	By the end of the course, the students will be able to:		**Mapping with PLOs**
Course Learning Outcomes (CLOs)	CLO1	Justify the importance as well as scope of fish feed in aquaculture.	PLO_1, PLO_2, PLO_3
	CLO2	Identify various aspects of feedstuffs used in aquafeed.	PLO_1, PLO_2, PLO_3
	CLO3	Implement different activities of commercial fish feed manufacture.	PLO_1, PLO_2, PLO_3
	CLO4	Interpret different aspects of feeding regime.	PLO_1, PLO_2, PLO_3
	CLO5	Develop an authorized structure for fish feed industries in Bangladesh.	PLO_8

	Course Contents	**CLOs**
1	Introduction: Scope, importance and brief review on nutritional requirements of cultivable fish and shellfish, current status of commercial aquafeeds, types of aquafeeds.	CLO1
2	Feedstuffs: Significance of feedstuff of animal and plant origin, manufacture, processing, chemical properties, physiological properties, feeding value, recommended inclusion levels and legal aspects of conventional and unconventional feedstuffs applied in aquaculture.	CLO2
3	Non-nutrient components of feeds: Water, binders, fibre, antioxidants, feeding stimulants, pigments, antibiotics and growth promoters.	CLO2
4	Antinutritional/toxic factors: Antinutrients in plant feedstuffs including the mode of action and processing methods to reduce their toxic effects, adventitious toxic factors of plant and animal origin.	CLO2
5	Feed formulations and manufacture: Criteria for feedstuff selection, Pearson's square hand formulation, spreadsheet formulation and least-cost feed formulations for semi-intensive and intensive culture of fish and crustaceans, types of machineries and basic steps of commercial feed manufacturing.	CLO3
6	Feed storage and quality control: Deteriorative changes in feedstuffs and feeds during storage with preventive measures.	CLO3
7	Feeding regimes: Feeding levels and feeding frequency, compensatory	CLO4

	feeding, methods of feed presentation in aquaculture.	
8	Laws and regulations: National fish feed and animal feed law, definition, controlling authority, licensing authority, standard limit in feed ingredients uses, legal offense, process of legal practice and punishment, international code of conducts for inclusion of different feed ingredients in fish feed.	CLO5

Mapping CLOs with the Teaching-Learning and Assessment Strategy		
CLOs	**Teaching-Learning Strategy**	**Assessment Strategy**
CLO1	Lecture, Group discussion Presentation, Question-Answering	Quiz, Short and Narrative question.
CLO2	Lecture, Paper work, Presentation, Question-Answering	Quiz, Report writing, Presentation, Short and Narrative question.
CLO3	Lecture, Video-clip, Discussion, Question-Answering	Report writing, Presentation, Short and Narrative question.
CLO4	Lecture, Video-clip, Discussion, Question-Answering	Report writing, Presentation, Short and Narrative question.
CLO5	Lecture, Group discussion, Question-Answering	Short and Narrative question.

Learning Materials	
Text Book	17. De Silva, S.S., Anderson, T.A., 1995. Fish nutrition in aquaculture. Chapman & Hall, London, 319 pp. 18. Hertramptf, J.W., Piedad-Pascual, F., 2000. Hand book on ingredients for aquaculture feeds. Kluwer Academic Publishers, London, 573p. 19. Steffens, W., 1989. Principles of Fish Nutrition. Ellis Horwood, 384pp. 20. Halver, J.E., 1989. Fish Nutrition (2nd Edition). Academic Press, 388 pp. 21. Tacon, A.G.J., 1990. Standard Methods for the Nutrition and Feeding of Farmed Fish and Shrimp. Argent Laboratories Press, Washington, 454 pp. 22. Goddard, S., 1996. Feed Management in Intensive Aquaculture, Chapman & Hall, Dept. BC, 115 Fifth Avenue, New York, NY 10003, 194 pp. 23. Guillaume, J., Kaushik, S., Bergot, P. and Metailler, R., 2001. Nutrition and Feeding of Fish and Crustaceans. Praxis Publishing
Supplementary Readings	

Assessment Pattern

CIE- Continuous Internal Evaluation (40 Marks)					
Bloom's Category Marks (out of 40)	**Class test (10)**	**Assignment submission (05)**	**Presentation (05)**	**Quizzes (10)**	**Attendance (10)**
Remember				05	
Understand	2			05	

Apply	4	01			
Analyze	4				
Evaluate		02			10
Create		01	05		

SSE- Semester End Examination (60 Marks)	
Bloom's Category	**Tests**
Remember	5
Understand	10
Apply	15
Analyze	15
Evaluate	10
Create	5

Course Code: 0831 AQC 422	Level-4	Semester-II
Course Title: Fish Feed Technology sessional		
Course Status: Core		
Credit: 1.0		
Prerequisite(s): None		
Rationale	The course will provide the students with practical knowledge and skills on different fish feed ingredients used for compound fish feed preparation, formulation, proximate composition analysis of feed, and performances of these prepared feeds in field conditions for safe and quality fish production .	

	By the end of the course, the students will be able to:		**Mapping with PLOs**
Course Learning Outcomes (CLOs)	CLO1	List down different laboratory equipment and safety procedures.	PLO_3, PLO_4
	CLO2	Evaluate different fish feed ingredients used for compound fish feed preparation.	PLO_3, PLO_4
	CLO3	Formulate compound fish feed.	PLO_3, PLO_4, PLO_{10}
	CLO4	Outline the procedures of proximate composition analysis of the prepared fish feed.	PLO_3, PLO_4, PLO_{10}

	CLO5	Determine the performances of prepared fish feed under different feeding practices in field conditions.	PLO_3, PLO_4, PLO_{10}

Course Contents		CLOs
1	Introduction to laboratory equipment and safety procedures.	CLO1
2	Quick test for feedstuffs evaluation: a) Bulk density measurement b) Non-protein nitrogen in fish meal	CLO2
3	Formulation of a supplemental and balanced feed using square technique for semi-intensive and intensive aquaculture respectively.	CLO3
4	Analysis of prepared diets for their proximate composition.	CLO4
5	Determination of fish growth parameters such as weight gain, specific growth rate, food conversion ratio, protein efficiency ratio, apparent net protein utilization and energy retention through laboratory trial using a prepared diet.	CLO5
6	Visit to a commercial feed manufacturing plant.	CLO3 and CLO4

Mapping CLOs with the Teaching-Learning and Assessment Strategy		
CLOs	**Teaching-Learning Strategy**	**Assessment Strategy**
CLO1	Lecture, Demonstration, Question-Answering	Quiz, Demonstration, Short and Narrative question Practical Note Book, Viva voce.
CLO2	Lecture, Demonstration, Question-Answering	Quiz, Short and Narrative question, Practical Note Book, Viva voce.
CLO3	Lecture, Feed manufacture, Question-Answering	Short and Narrative question, Practical Note Book, Viva voce.
CLO4	Lecture, Lab work, Question-Answering	Short and Narrative question, Practical Note Book, Viva voce.
CLO5	Lecture, Feeding Experiment, Data analysis Question-Answering	Short and Narrative question, Practical Note Book, Viva voce.

Learning Materials	
Text Book	24. De Silva, S.S., Anderson, T.A., 1995. Fish nutrition in aquaculture. Chapman & Hall, London, 319 pp. 25. Hertramptf, J.W., Piedad-Pascual, F., 2000. Hand book on ingredients for aquaculture feeds. Kluwer Academic Publishers, London, 573 p. 26. New, M.B., 1987. Feeds and Feeding of fish and shrimp. ADCP/REP/87/26. UNDP/FAO, Rome, 275 pp. 27. Steffens, W. (1989). Principles of Fish Nutrition. Ellis Horwood, 384pp. 28. Halver, J.E. (1989). Fish Nutrition (2nd Edition). Academic Press.
Supplementary Readings	1. ADCP, 1980. Fish Feed Technology. ADCP/REP/80/11 UNDP/FAO. Rome. 395 pp. 2. ADCP, 1980. Fish Feeds and Feeding in Developing Countries. ADCP/REP/ 83/18, ADCP/FAO. 97 pp. 8 3. AOAC, 2000. Official Methods of Analysis. 17 Edition. Association of official analytical chemists. Washington DC. 2200 pp. 4. Goddard, S., 1996. Feed management in intensive aquaculture. Chapman and Hall, New York. 194 pp. 5. Guillaume, S.K., Bergot, P., Metailler, R., 2001. Nutrition and Feeding of Fish and Crustaceans. Springer-Praxis Publishing, UK. 408 pp.

Assessment Pattern

CIE- Continuous Internal Evaluation (40 Marks)					
Bloom's Category Marks (out of 40)	**Class test (10)**	**Assignment (05)**	**Notebook/ Presentation (05)**	**Quizzes (10)**	**Attendance (10)**
Remember				05	
Understand	02			05	
Apply	04				
Analyze	04	01			
Evaluate		02			10
Create		02	05		

SEE- Semester End Examination (60 Marks)	
Bloom's Category	**Tests**
Remember	5
Understand	5
Apply	20
Analyze	10
Evaluate	10
Create	10

Course Code: 0831 AQC 423	Level-4	Semester-II
Course Title: Fish Pharmacology		
Course Status: Core		
Credit: 2.0		
Prerequisite(s): None		
Rationale	This course is designed to provide a broad theoretical knowledge on fish pharmacology and medicine to treat fish using any therapeutic drugs or chemicals.	

	By the end of the course, the students will be able to:		**Mapping with PLOs**
Course Learning Outcomes (CLOs)	CLO1	Explain the properties, types, and sources of drugs with their pharmacodynamics and pharmacokinetics.	PLO_1, PLO_6
	CLO2	Apply the mode of action of drugs and methods of drug administration in fish.	PLO_3, PLO_5, PLO_6
	CLO3	Describe use, abuse and controlling of commercial aquamedicines in aquaculture of Bangladesh.	PLO_3, PLO_5, PLO_6
	CLO4	Discuss chemotherapeutic drugs with their source, classification and doses.	PLO_3, PLO_5, PLO_6
	CLO5	Illustrate prescription writing.	PLO_1, PLO_5, PLO_6

	Course Contents	**CLOs**
1	Principles of pharmacology and medicine: terminologies, branches; pharmacopoeia; drugs and medicines; properties, types and source of drugs; drug nomenclature and classification. pharmacodynamics and pharmacokinetics of drugs; role of fish pharmacology in aquaculture.	CLO1
2	Drug Administration: selection of drugs and their mode of actions; methods of application; withdrawal period; safety of fish medicine: aspect of safety, safety to target species, operator, consumer and environment.	CLO2
3	Commercial aqua medicines: categories, trade and generic name, their doses and dosages; pharmaceutical companies; abuse and off-label use.	CLO3
4	Law of aquaculture drug: aim of legislation; legal control in-feed medication; environmental safety legislation; market authorization; guideline for the control of aquaculture medicinal products and future	CLO3

	development.	
5	Chemotherapeutic drugs: anti-protozoan, antiparasitic, antiviral, antibacterial, antifungal, antihelminth drugs and pharmacodynamic agents	CLO4
6	Prescription writing: types and parts of prescription, rational use of drugs and rational prescribing, irrational prescribing; drug incompatibilities & adverse effects; withdrawal period.	CLO5

Mapping CLOs with the Teaching-Learning and Assessment Strategy		
CLOs	**Teaching-Learning Strategy**	**Assessment Strategy**
CLO1	Lecture, Assignment, Presentation, Question-Answering	Quiz, Assignment, Presentation Short and Narrative question.
CLO2	Lecture, Group discussion, Presentation, Question-Answering	Quiz, Presentation, Short and Narrative question.
CLO3	Lecture, Assignment, Presentation, Question-Answering	Assignment, Presentation Short and Narrative question.
CLO4	Lecture, Assignment, Presentation, Question-Answering	Assignment, Presentation Short and Narrative question.
CLO5	Lecture, Group discussion, Presentation, Question-Answering	Presentation, short and Narrative question

Learning Materials	
Text Book	4. Treves-Brown, K, M. 1989. Applied fish Pharmacology. Kluwer Academic publishers, The Netherlands. 5. Brown, L. 1994. Aquaculture for Veterinarians: Fish Husbandry and Medicine eragamon, Press Oxford. 6. Richard D. Howland, Mary Julia Mycek, Richard A. Harvey, Pamela C. Champe 2005. Pharmacology 6th edition (Lippincott Illustrated Reviews Series).
Supplementary Readings	7. Brown, L. 1994. Aquaculture for Veterinarians: Fish Husbandry and Medicine Pergamon Press Oxford. 545 pp 8. Stoskoipf M K. 1993. Fish medicine. W B Saunders company philadelphia. 882 p. 9. Noga E J. 1996. Fish disease. Diagnosis and treatment. Mosby-Year book Inc., St. Louis, Missouri.367p.

Assessment Pattern

CIE- Continuous Internal Evaluation (40 Marks)					
Bloom's Category Marks (out of 40)	**Class test (10)**	**Assignment submission (05)**	**Presentation (05)**	**Quizzes (10)**	**Attendance (10)**
Remember				05	

Understand	2			05	
Apply	4	01			
Analyze	4				
Evaluate		02			10
Create		01	05		

SSE- Semester End Examination (60 Marks)	
Bloom's Category	**Tests**
Remember	5
Understand	10
Apply	15
Analyze	15
Evaluate	10
Create	5

Course Code	0831FBG 421	**Year:** Fourth	**Semester:** Second
Course Title	Broodstock and Hatchery Management		
Course Status	Core		
Credit	2.0		
Prerequisite(s)	None		
Rationale	Knowledge of broodstock and hatchery management will help improve of the brood and seed quality and fish production. Students will acquire knowledge on basic requirements of a hatchery, its construction and operation, broodstock production, maintenance and their transportation, water quality management, induced breeding and fry rearing of economically important fish species.		

	By the end of the course, the students will be able to:		**Mapping with PLOs**
Course Learning Outcomes (CLOs)	CLO1	Depict the present status and scope of fish hatcheries in Bangladesh, criteria for establishment of fish hatcheries and their essential components.	PLO1, PLO2, PLO3, PLO6
	CLO2	Classify fish hatcheries and incubators.	PLO1, PLO2, PLO5, PLO6, PLO8, PLO10
	CLO3	Explain broodstock development and management, impact of brood management on fish production; operational management of hatcheries, water quality management of fish hatcheries.	PLO1, PLO2, PLO3, PLO4, PLO5, PLO6, PLO8, PLO10
	CLO4	Analyze control of spawning, handling of eggs and incubation, rearing of larvae and fry.	PLO1, PLO2, PLO3, PLO5, PLO8, PLO10
	CLO5	Interpret conditioning, anesthetization and transportation of live fish using traditional and modern transportation techniques.	PLO1, PLO2, PLO5, PLO6, PLO7, PLO8, PLO10

Course Contents		**CLOs**
1	Importance of fish hatchery: Present status and role of hatchery to meet the fish seed requirements in Bangladesh.	CLO1, CLO2, CLO3
2	Fish Hatchery: Site selection, essential components - types of incubators, hatching trays, catfish troughs, hatching jars, circular incubator, bottle hatchery, hapa and vertical tray incubators, their advantages and disadvantages prawn and shrimp hatchery components	CLO2

3	Broodstock management: Overview of present brood management practices, domestication of broodstock, impact of brood management on fish production; brood rearing strategies.	CLO3
4	Operational management of hatchery: Species selection, manpower, economic considerations, budgeting, cost-benefit analysis and economic viability.	CLO3
5	Water management in hatchery: Water supply and treatment, treatment of water for reuse, water pollutants from hatchery.	CLO3
6	Spawning and egg handling: Inducing agents, artificial spawning methods, control of spawning, egg incubation and hatching.	CLO4
7	Larvae and fry rearing: First feeding, feed particle size, live food for larvae	CLO4
8	Live fish transportation: Importance, conditioning, equipment, traditional versus modern transportation systems.	CLO5
9	Cryopreservation of gametes, live and cryogenic gene banking.	CLO5

Mapping CLOs with the Teaching-Learning and Assessment Strategy		
CLOs	**Teaching-Learning Strategy**	**Assessment Strategy**
CLO1	Lectures, Problem based learning, Interactive learning, video clip and Fishbowl discussion	Quiz, Exit slip, Assignment and Presentation, Narrative question
CLO2	Lectures, Problem based learning, Q/A session, Group studies and Discussion.	Quiz, Artifacts, Assignment and Presentation, Narrative question
CLO3	Lectures, Case based learning, Interactive learning, Q/A session, Group discussion.	Quiz, One minute paper, Assignment and Presentation, Narrative question
CLO4	Lectures, Problem based learning, Q/A session, Group studies.	Quiz, Observation, Assignment and Presentation, Narrative question
CLO5	Lectures, Problem based learning, Interactive learning, Q/A session, Group Discussion.	Quiz, Exit slip, Assignment and Presentation, Narrative question

Learning Materials

Text Books	14. Haylor, G. 1998. A Fish Hatchery Manual for Africa Pisces Press Ltd, Stirling, Scotland. 15. Jhingran, V. G and R. S. V. Pullin. 1985. A Hatchery Manual for Common, Chinese and Indian Major Carps. Asian Development Bank and International Centre for Living Aquatic Resources Management, Manila, Philippines. 191p. 16. Wedemeyer, G. A. 2002. Fish Hatchery Management. American Fisheries Society Publication.

	17. Al-hajj, A B. and A. S. D. Farmaer. 1984. Shrimp Hatchery Manual. Safut. Kuwit for Institute for Scientific Research. 18. BAFRU (Bangladesh Agricultural and Fisheries Resources Unit). 1990. A guide to Shrimp and Prawn Hatchery Techniques in Bangladesh. Stirling, Scotland, HAFRU/ Institute of Aquaculture. 19. Billard, R. 1995. Culture. Praxis Publishing, Chichester, UK. 20. Black, K. D and A. D. Pickerin. 1998. Biology and Cultivation of Fish. Fishing News Books Ltd. Faroham, Surey, England. 21. Chondar, S. L. 1994. Induced Carp Breeding. 3rd Edition. CBS Publishers and Distributers. 142 p. 22. Lee C. S., M. S. Su and I. C. Liao. 1991. Finfish Hatchery in Asia (Proceedings of Finfish Hatchery in Asia'91). Tungakang Marine Laboratory, Taiwan. 23. Piper, R. G., I. B. McElwan, L. E. Orme, J. P. McCraren, L. G. Fowler and J. R. Leanard. 1998. Fish Hatchery Management. US Department of Interior Fish and Wildlife Service, Washington D.C. 24. Woynarovich, E. and L. Horvath, L. 1984 The Artificial Propagation of Warm-water Finfishes, a manual for extension. FAO Fisheries Technical Paper 201.
Supplementary Readings	

Assessment Pattern

CIE- Continuous Internal Evaluation (40 Marks)					
Bloom's Category Marks (out of 40)	**Class test (10)**	**Assignment submission (05)**	**Presentation (05)**	**Quizzes (10)**	**Attendance (10)**
Remember				05	
Understand	2			05	
Apply	4	01			
Analyze	4				
Evaluate		02			10
Create		01	05		

SEE- Semester End Examination (60 Marks)	
Bloom's Category	**Tests**

Remember	5
Understand	10
Apply	15
Analyze	15
Evaluate	10
Create	5

Course Code	0831FBG 422	**Year:** Fourth	**Semester:** Second
Course Title	Broodstock and Hatchery Management Sessional		
Course Status	Core		
Credit	1.0		
Prerequisite(s)	None		
Rationale	Students will achieve skills of broodstock and hatchery management for improvement of brood and seed quality and fish production. Students will acquire practical skill on construction and operation of hatchery, broodstock production and maintenance, water quality management, hands-on training on induced breeding and fry rearing of economically important fish species.		

	By the end of the course, the students will be able to:		**Mapping with PLOs**
Course Learning Outcomes (CLOs)	CLO1	Illustrate the layout of fish and shrimp hatchery.	PLO1, PLO2, PLO3, PLO6
	CLO2	Identify ready to spawn brood fish and examine their sex.	PLO1, PLO2, PLO5, PLO6, PLO8, PLO10
	CLO3	Discuss the current state and practical problems of Government and private hatcheries.	PLO1, PLO2, PLO3, PLO4, PLO5, PLO6, PLO8, PLO10
	CLO4	Visit to Government and private hatcheries.	PLO1, PLO2, PLO3, PLO5, PLO8, PLO10

Course Contents		CLOs
1	Drawing the layout of typical fish and shrimp hatchery	CLO1
2	Selection of breeders, handling and management. (a) Sex identification and selection of the ready-to-spawn breeders. (b) Collection of PG, preparation of PG and HCG extracts. (c) Dose calculation of inducing agents, injection, stripping and fertilization.	CLO2, CLO3
3	Use of incubators for hatching of eggs: (a) Incubation of fertilized eggs in different types of incubators. (b) Study of fertilization, hatching and survival rates	CLO3
4	Field visit to commercial fish and shrimp hatcheries	CLO2, CLO3, CLO4

Mapping CLOs with the Teaching-Learning and Assessment Strategy		
CLOs	**Teaching-Learning Strategy**	**Assessment Strategy**
CLO1	Lectures, Demonstration, Problem based learning, Interactive learning, Q/A session, Group studies and Discussion, Practical Note Book.	Short questions, Quiz, Oral test, and Artifact.
CLO2	Lectures, Demonstration, Problem based learning, Interactive learning, Q/A session, Group studies and Discussion, Practical Note Book.	Short questions, Quiz, Oral test, dissect and display.
CLO3	Lectures, Demonstration, Problem based learning, Interactive learning, Q/A session, Group studies and Discussion, Practical Note Book.	Short questions,, Quiz, Oral test
CLO4	Lectures, Demonstration, Problem based learning, Interactive learning, Q/A session, Group studies and Discussion, Practical Note Book.	Short question, Quiz, Oral test, report.

Learning Materials

Text Books	1. Al-hajj, A. B. and A. S. D. Farmaer. 1984. Shrimp Hatchery Manual. Safut. Kuwit for Institute for Scientific Research. 2. BAFRU (Bangladesh Agricultural and Fisheries Resources Unit). 1990. A guide to Shrimp and Prawn Hatchery Techniques in Bangladesh. Stirling, Scotland, HAFRU/ Institute of Aquaculture. 3. Billard, R. 1995. Culture. Praxis Publishing, Chichester, UK. 4. Black, K. D and A. D. Pickerin. 1998. Biology and Cultivation of Fish.

	Fishing News Books Ltd. Faroham, Surrey, England. 5. Chondar, S. L. 1994. Induced Carp Breeding. 3rd Edition. CBS Publishers and Distributers. 142 p. 6. Lee C. S., M. S. Su and I. C. Liao. 1991. Finfish Hatchery in Asia (Proceedings of Finfish Hatchery in Asia'91). Tungakang Marine Laboratory, Taiwan. 7. Piper, R. G., I. B. McElwan, L. E. Orme, J. P. McCraren, L. G. Fowler and J. R. Leanard. 1998. Fish Hatchery Management. US Department of Interior Fish and Wildlife Service, Washington D.C. 8. Woynarovich, E. and L. Horvath, L. 1984 The Artificial Propagation of Warm-water Finfishes, a manual for extension. FAO Fisheries Technical Paper 201.
Supplementary Readings	

Assessment Pattern

CIE- Continuous Internal Evaluation (40 Marks)					
Bloom's Category Marks (out of 40)	**Class test (10)**	**Assignment submission (05)**	**Presentation (05)**	**Quizzes (10)**	**Attendance (10)**
Remember				05	
Understand	2			05	
Apply	4	01			
Analyze	4				
Evaluate		02			10
Create		01	05		

SEE- Semester End Examination (60 Marks)	
Bloom's Category	**Tests**
Remember	5
Understand	10
Apply	15
Analyze	15
Evaluate	10
Create	5

Level-4, Semester-II		
Course Code: 0831 GED 421	**Year:** Fourth	**Semester:** Second
Course Title: Climate Science for Sustainable Fisheries Development		
Course Status: GED		
Credit: 3.0		
Prerequisite(s): None		
Rationale	In this course is designed to provide orientation regarding mechanisms of climate change development, their effects and impacts on earth surface and organisms, adaptations measures and negotiation to mitigation of impacts and its future strategies of developing countries.	

	By the end of the course, the students will be able to:		**Mapping with PLOs**
Course Learning Outcomes (CLOs)	CLO 1	Know about climate change, causes of climate change and responsible drivers of climate change in the world.	PLO1
	CLO 2	Identify the drivers of climate change and their effects and impacts.	PLO1, PLO5
	CLO 3	Describe how climate change affects aquatic ecosystem and terrestrial environment, causes of sea level rise and abrupt environmental change and result of ocean circulation and acidification.	PLO1, PLO5
	CLO 4	Illustrate how climate change impact on fresh water aquaculture and natural fish production, coastal and marine fisheries production in national and global aspects.	PLO3, PLO6
	CLO 5	Evaluate vulnerability and adaptation to climate change and how climate change impacts on livelihood of the communities.	PLO6, PLO8
	CLO 6	Analyze ethical issues for negotiations of climate change in relation with developed and developing countries.	PLO8
	CLO 7	Communicate effectively individual and in groups works.	PLO5, PLO9, PLO10

Course Contents		CLOs
1	**Introduction to climate change:** Key concept of climate change, causes of climate change, drivers of climate change, global warming, greenhouse gas and its effects.	CLO 1
2	**Climate change and its effects:** Effect of climate change on aquatic ecosystem, floods, salinity intrusion, changes in temperature and	CLO 2

	precipitation, causes of sea level rise and abrupt environmental change and result of ocean circulation and acidification.	
3	**Climate change and its impacts:** Impacts of climate change on fresh water aquaculture and natural fish production, coastal and marine fisheries production in national and global aspects.	CLO 3
4	**Climate change effects on ecosystem and ecological processes:** Primary production, secondary production, food web impacts from plankton to fish, physiological effects and spawning, growth and recruitment processes, species invasions and diseases.	CLO 4
5	**Impacts of climate change on mangrove fisheries and biodiversity:** Impacts on mangrove forest, mangrove fisheries, biodiversity, coastal shrimp farms and coastal livelihood of Bangladesh.	CLO 5
6	**Vulnerability to climate change and adaptation:** Vulnerability to climate change and adaptation measures, climate change impacts on livelihood of the communities.	CLO 6
7	**Agreement and negotiations for climate change:** International agreement for climate change, involvement of international organization, importance of the agreements, global negotiations with developed and developing countries, global negotiations and responsibility of Bangladesh.	CLO 3 CLO 4 CLO 5 CLO 6

Mapping CLOs with the Teaching-Learning and Assessment Strategy		
CLOs	**Teaching-Learning Strategy**	**Assessment Strategy**
CLO1	Lecturing, Question-Answering, group discussion, Assignment, Graphical presentation	Quiz, Assignment, Short and Narrative question, MCQ, Fill in the Gap
CLO2	Lecturing, Question-Answering, group discussion, Assignment, Graphical presentation	Quiz, Assignment, Short and Narrative question, MCQ, Fill in the Gap
CLO3	Lecturing, Question-Answering, group discussion, Assignment, Graphical presentation	Quiz, Assignment, Short and Narrative question, MCQ, Fill in the Gap
CLO4	Lecturing, Question-Answering, group discussion, Assignment, Graphical presentation	Quiz, Assignment, Short and Narrative question, MCQ, Fill in the Gap
CLO5	Lecturing, Question-Answering, group discussion, Assignment, Graphical presentation	Quiz, Assignment, Short and Narrative question, MCQ, Fill in the Gap
CLO6	Lecturing, Question-Answering, group discussion, Assignment, Graphical presentation	Quiz, Assignment, Short and Narrative question, MCQ, Fill in the Gap
CLO7	Assignment preparation and submission, and Student presentation	Class attendance, individual presentation

Learning Materials	
Text Book	1. Barange, M., Bahri, T., Beveridge, M.C.M., Cochrane, K.L., Funge-Smith, S. and F. Poulain(Eds.). 2018. Impacts of climate change on fisheries and aquaculture: synthesis of current knowledge, adaptation and mitigation options. FAO Fisheries and Aquaculture Technical Paper No. 627. Rome, FAO. 628 pp. 2. Bloom, A.J. 2010. Global Climate Change: Convergence of Disciplines. Oxford University Press. 3. Phillips, B.F. and M.P. Ramírez. 2017. Climate Change Impacts on Fisheries and Aquaculture: A Global Analysis. John Wiley & Sons Ltd.
Supplementary Readings	1. Alam, A.B.M.S., Chowdhury, M.S.M. and Sobhan, I. 2012. Biodiversity of TanguarHaor: A Ramsar Site of Bangladesh Volume I: Wildlife, IUCN Bangladesh, Dhaka,Bangladesh, Pp. xi+234. 2. Bindoff, N.L., Cheung, W.W.L., Kairo, J.G., Arístegui, J., Guinder, V.A., Hallberg, R., Hilmi, N., Jiao, N., Karim, M.S., Levin, L., O'Donoghue, S., PurcaCuicapusa, S.R., Rinkevich, B., Suga, T., Tagliabue, A. and P. Williamson. 2019. Changing Ocean, Marine Ecosystems, and Dependent Communities. In: IPCC Special Report on the Ocean and Cryosphere in a Changing Climate [H.- O. Pörtner, D.C. Roberts, V. Masson-Delmotte, P. Zhai, M. Tignor, E. Poloczanska, K. Mintenbeck, A. Alegría, M. Nicolai, A. Okem, J. Petzold, B. Rama, N.M. Weyer (eds.)]. In press. 3. Ghimire, M., Kanksha and Vikas, Mayank, Climate Change – Impact on the Sundarbans, a Case Study (2012). International Scientific Journal: Environmental Science, 2(1):7-15, 2012. 4. Giri, S.S. (Ed.). 2016. Climate Change Impact on Coastal Fisheries and Aquaculture in South Asia. SAARC Agriculture Centre, Dhaka, Bangladesh.

Assessment Pattern

CIE- Continuous Internal Evaluation (40 Marks)					
Bloom's Category Marks (out of 40)	**Class test (10)**	**Assignment submission (05)**	**Presentation (05)**	**Quizzes (10)**	**Attendance (10)**
Remember				05	
Understand	02			05	
Apply	04				
Analyse	04	01			
Evaluate		02			10
Create		02	05		

SSE- Semester End Examination (60 Marks)	
Bloom's Category	**Tests**
Remember	5
Understand	10
Apply	15
Analyse	15
Evaluate	10
Create	5

Forth Year Second Semester		
Course Code: 0831 FST 421	**Year:** Forth	**Semester:** Second
Course Title: Quality Control of Fish and Fishery Products		
Course Status: Core		
Credit: 2.0		
Prerequisite(s): None		
Rationale	In this course, students will learn quality control with the basic and applied knowledge on quality of fish and fishery products, techniques of fish quality assessment, sanitation, HACCP and Traceability through lectures and demonstrations and discussion. It also covers the importance of quality control, quality control management strategies, and industrial management plant of fish and shrimp products.	

	By the end of the course, the students will be able to:		**Mapping with PLOs**
Course Learning Outcomes (CLOs)	CLO1	Summarize the quality, aspects of fish quality, quality attributes, quality program, quality control and quality assurance.	PLO1 & PLO4
	CLO2	Explain quality requirements of fishery raw materials and finished products, quality deterioration and defect in fishery products, fish flavor and quality, fish texture and quality.	PLO1 & PLO4
	CLO3	Assess modern approach to quality such as HACCP, traceability, sanitation in fish industries in relation to quality, techniques of quality assessment of fish and fishery products.	PLO1, PLO2, PLO4, PLO6 & PLO10
	CLO4	Justify different organizational bodies of quality	PLO1, PLO2,

		control and quality management information systems (QMIS) in relation to processing industry.	PLO4, PLO6 & PLO10

Course Contents		CLOs
1	**Introduction:** Concept of quality; various aspects of fish quality – Intrinsic quality, Quality defect and deterioration, Extrinsic quality, Factors affecting fish quality, quality attributes	CLO1 & CLO2
2	**Seafood Quality Assurance Programs:** Quality assurance and management systems in fish processing industry, cool chain maintains. GMP and hygienic practices in fish processing establishments. Hazards type and sources, hazard analysis and critical control points (HACCP), HACCP plan, worksheet, team and importance, Pre-requisite program (PRP).	CLO2, CLO3 & CLO4
3	**Organization of Quality Control:** Objectives and importance, Organogram of FIQC, Quality control programs of FIQC, Duties and responsibilities of Quality Control Officers and Inspectors.	CLO1 & CLO3
4	**Quality Defect and Deterioration in Fish and Fishery Products:** Defects and deterioration of finfish and shellfish, chilled, frozen, smoked, dried, salted fish, fermented, canned and marinated processed products. Quality requirement of fishery raw material and finished products.	CLO2 & CLO3
5	**Supply-Chain and Value-Chains Analysis:** Post-harvest losses of fish and fishery products, types, causes, impact and mitigation measures; Different actors in fish value-chain; Supply chain and value-chain analysis of fish and fishery products.	CLO1, CLO3 & CLO4
6	**Method of Hazard-based Quality and Risk Assessment:** sensory methods, mechanical or instrumental laboratory methods – chemical and biochemical analysis by sophisticated apparatus (GC-MS, LC-MS, HPLC, Spectrophotometer) and microbiological analysis. Hazard identification & assessment, characterization, and risk assessment.	CLO2, CLO3 & CLO4

Mapping CLOs with the Teaching-Learning and Assessment Strategy		
CLOs	**Teaching-Learning Strategy**	**Assessment Strategy**
CLO1	Lecture, presentation, questions answering and discussion	Quizzes, short questions and assignment
CLO2	Lecture, presentation, questions answering, discussion and field report	Quizzes, short questions, assignment and narrative questions
CLO3	Lecture, presentation, questions answering, discussion and video clip	Short questions, assignment, poster submission and narrative questions

CLO4	Lecture, presentation, discussion, field report and video clip	Short questions, assignment, poster submission and narrative questions

Learning Materials	
Text Book	1. Fish and Fishery Products Official Controls Protocol. Department of Fisheries, Bangladesh Competent Authority (2015). Ministry of Fisheries and Livestock, Government of the Peoples Republic of Bangladesh. 2. Fish and Fishery Products Hazards and Controls Guidance Fourth Edition – APRIL 2011. Department Of Health And Human Services, Public Health Service, Food and Drug Administration, Center For Food Safety And Applied Nutrition, Office Of Food Safety. 3. H.H. Huss (2004). Assessment and Management of Seafood Safety and Quality. FAO Fisheries Technical Paper 444. 4. Connell, J. J. (1980). Control of Fish Quality. Fishing News Books Ltd. (2nd Edition), England 222pp.
Supplementary Readings	1. Bonnell, A. D. (1994). Quality Assurance in Seafood Processing: A Practical Guide. Chapman & Hall, London, 208 pp. 2. Mansur, M. A. (2012). Fisheries Studies Part-II. Botomul, Dhaka. 352 pp. ISBN: 978-984-8796-14-6.

CIE- Continuous Internal Evaluation (40 Marks)					
Bloom's Category Marks (out of 40)	**Class test (10)**	**Assignment (05)**	**Notebook/ Presentation (05)**	**Quizzes (10)**	**Attendance (10)**
Remember				05	
Understand				05	
Apply	02	01			
Analyze	02	01			
Evaluate	04	03			10
Create	02		05		

SEE- Semester End Examination (60 Marks)	
Bloom's Category	**Tests**
Remember	5
Understand	5
Apply	5
Analyze	20
Evaluate	15
Create	10

Forth Year Second Semester		
Course Code: 0831 FST 422	**Year:** Forth	**Semester:** Second
Course Title: Quality Control of Fish and Fishery Products Sessional		
Course Status: Core		
Credit: 1.0		
Prerequisite(s): None		
Rationale	This course will enable the students with practical knowledge on quality of fish and fishery products, techniques of fish quality assessment, sanitation, HACCP through lectures and demonstrations, discussion and field visit. It also deals with the determination of the hazardous components inherent in fish and shrimp products through demonstration in the laboratory condition.	

	By the end of the course, the students will be able to:		**Mapping with PLOs**
Course Learning Outcomes (CLOs)	CLO1	Discuss quality, aspects of fish quality, quality attributes, quality programs, quality control and quality assurance.	PLO1 & PLO4
	CLO2	Determine the quality of fish, fishery raw materials and finished products, quality deterioration and defect in fishery products and chemical contaminant in fish and fishery products in comparison with the international standards.	PLO1 & PLO4
	CLO3	Differentiate quality assessment techniques of fish and fishery for HACCP, traceability, sanitation in fish industries.	PLO2, PLO4, PLO6 & PLO10
	CLO4	Generalize the quality management information system (QMIS) for quality control and HACCP plan of fish industries or organizations.	PLO2, PLO4, PLO6 & PLO10

	Course Contents	**CLOs**
1	Methods of assessing quality of Fish and Fishery Products: Sensory methods, Statistical methods Triangle Test, Duo-Trio Test and Quality Index method.	CLO1 & CLO3

2	Determination of Histamine of fish and fishery products as quality test.	CLO2, CLO3 & CLO4
3	Determination of TMA-N of fish and fishery products as quality test	CLO2 & CLO3
4	Study of practical aspects of HACCP: Identification of risk based hazards and control measures; Preparation of hazard analysis worksheet and HACCP plan for various products.	CLO1, CLO3 & CLO4
5	Principle and method of GC-MS analysis for identification of flavor components of fish and fishery products as quality test. HPLC method for determination of Antioxidant Activity of Fish Antioxidants.	CLO2, CLO3 & CLO4
6	Determination of Formalin of fish and fishery products as formalin test kit	CLO2, CLO3 & CLO4
7	Field Trip	CLO4

Mapping CLOs with the Teaching-Learning and Assessment Strategy		
CLOs	**Teaching-Learning Strategy**	**Assessment Strategy**
CLO1	Lecture, presentation and demonstration	Quizzes, short questions, spotting and practical note book (PNB)
CLO2	Lecture, presentation, questions answering, demonstration and discussion	Short questions, spotting and practical note book (PNB) and viva-voce
CLO3	Lecture, presentation, questions answering, demonstration, discussion, field report and video clip	Short questions, spotting and practical note book (PNB), poster submission and viva-voce
CLO4	Lecture, presentation, questions answering, demonstration and discussion	Short questions, spotting and practical note book (PNB) and viva-voce

Learning Materials	
Text Book	1. Connell, J. J. (1980). Control of Fish Quality. Fishing News Books Ltd. (2nd Edition), England 222pp. 2. Bonnell, A. D. (1994). Quality Assurance in Seafood Processing: A Practical Guide. Chapman & Hall, London, 208 pp. 3. Mansur, M. A. (2012). Fisheries Studies Part-II. Botomul, Dhaka. 352 pp. ISBN: 978-984-8796-14-6. 4. Seafood HACCP Alliance. (2001). Hazard Analysis Critical Control Point. Training Curriculum. Fourth Edition.
Supplementary Readings	1. Fish Inspection, Quality Control, and HACCP: A Global Focus. Proceedings of the Conference. Held May 19-24, 1996, Arlington, Virginia, USA. 2. Food and Drug Administration. 1996. Fish and Fisheries Products

	Hazard and Control Guide; 1st Edition. 3. Huss, H. H., L. Ababouch and L. Gram. 2003. Assessment and Management of Seafood Safety and Quality. Food and Agriculture Organization of the United Nations, Nature. 230 pp.

CIE- Continuous Internal Evaluation (40 Marks)					
Bloom's Category Marks (out of 40)	**Class test (10)**	**Assignment (05)**	**Notebook/ Presentation (05)**	**Quizzes (10)**	**Attendance (10)**
Remember				05	
Understand				05	
Apply	02	01			
Analyze	03	02			
Evaluate	03	02			10
Create	02		05		

SEE- Semester End Examination (60 Marks)	
Bloom's Category	**Tests**
Remember	5
Understand	5
Apply	10
Analyze	15
Evaluate	15
Create	10

Course Code: 0831 MFO 421	**Level-4**	**Semester-II**
Course Title: Marine GIS and Remote Sensing		
Department: Core		
Credit Hours: 2.0		
Prerequisite(s): None		
Rationale	Satellite data and GIS has become an important to study various aspects of oceanography. This course would provide a brief knowledge about GIS and remote sensing. To encompass oceanographic research and technological development resulting from manned and unmanned systems in Earth's orbit to observe and measure oceanographic parameters such as sea surface temperature, sea surface salinity, sea surface winds, waves, ocean currents and frontal regions.	

Course Learning	**By the end of the course, the students will be able to:**	**Mapping with PLOs**

Outcomes (CLOs)	CLO 1	Learn about the fundamental concepts of GIS.	PLO_1, PLO_2
	CLO 2	Explain GIS data along with its components.	PLO_1, PLO_6
	CLO 3	Understand about the fundamental concepts of remote sensing.	PLO_1, PLO_2, PLO_3
	CLO 4	Analyze different remote sensing sensor and satellite.	PLO_1, PLO_2, PLO_7
	CLO 5	Know the process of satellite data acquiring processing.	PLO_1, PLO_7, PLO_9
	CLO 6	Learn monitoring of different oceanic parameters such as sea surface temperature, sea surface salinity, surface current, sea level and chl-a.	PLO_1, PLO_2, PLO_6, PLO_7, PLO_9
	CLO 7	Learn about applications of GIS and satellite image processing and interpretation.	PLO_1, PLO_7, PLO_9

Course Contents		**CLOs**
1	**Introduction:** General introduction, history of development of GIS, GIS requirements, GIS and related technologies, applications of GIS, future directions of GIS.	CLO 1
2	**GIS:** Characteristics, component of GIS and sources of GIS data, raster and vector data model, basic understanding, understanding layers and attribute, images and rasters/grids, understanding rasters and vectors; storage requirement and their advantages and disadvantages.	CLO 2, CLO 7
3	**Remote sensing:** Concept, history of development of remote sensing and satellite oceanography, component of remote sensing and its applications, electromagnetic radiation, radiation interaction with the atmosphere, atmospheric windows, radiation - target interaction.	CLO 3, CLO 4
4	**Remote sensing platforms and sensor:** Remote sensing sensor platforms, marine observation sensors (TRMM, CZCS, AVHRR, MODIS, SeaWifS, TOPEX/Poseidon, ERS etc.), orbit, low earth orbit satellite, sun-synchronous satellite, medium earth orbit satellite, geostationary & geosynchronous satellite, ocean observation satellite.	CLO 4, CLO 5
5	**Oceanographic Applications of satellite:** Satellite for measurement of Sea Surface temperature (SST), Chlorophyll content, Potential fishing zone/Fish School Detection, Total suspended solids (TSSs), Wave height and spectra, Sea surface height, wind speed, Sea Surface current, front, circulation.	CLO 6, CLO 7

Learning Materials	
Text Book	1. Khandakar Hasan Mahmud, Text Book of GIS and Remote Sensing, 2013, Publisher: SujonesuProkashny, ISBN: 984-8727-02-37. 2. An Introduction to geographical Information Systems, by I Heywood, S Cornelius and S Carver, Pearson, ISBN: 027372259X. 3. Robinson, Ian S., Satellite Oceanography: An Introduction for Oceanographers and Remote-sensing Scientists, Ellis Horwood Limited, 1985, ISBN 9780137913930. 4. G. A. Maul, Introduction to Satellite Oceanography, MarlinusNijhoff Publishers, 1984.
Supplementary Readings	1. Geographic Information Systems: an introduction, by J Star and J Estes. Prentice-Hall, ISBN: 0133511235. 2. Remote Sensing: Models and methods for image processing, R.A.Schowengerdt, Academic Press (3rd Edition, 1997), ISBN: 0123694078. 3. Use of high-resolution Satellite data for Coastal Fisheries. RSC Series No.5. Remote Sensing Center, FAO (1991). 4. Remote Sensing Note, Japan Association of Remote Sensing *GIS.*

Assessment Pattern

CIE- Continuous Internal Evaluation (40 Marks)					
Bloom's Category Marks (out of 40)	**Class test (10)**	**Assignment (05)**	**Notebook/ Presentation (05)**	**Quizzes (10)**	**Attendance (10)**
Remember				05	
Understand				05	
Apply	02	01			
Analyze	03	02			
Evaluate	03	02			10
Create	02		05		

SEE- Semester End Examination (60 Marks)	
Bloom's Category	**Tests**
Remember	5
Understand	5
Apply	10
Analyze	15
Evaluate	15
Create	10

20.Grading and Evaluation (As per PSTU ordinance)

20.1 Grading Scale

a) Letter Grades and corresponding Grade Points will be awarded following provisions shown below:

20.1.1 Evaluation of Theory Courses

a) All theory courses will be evaluated out of 100 marks, the distribution of which is given below:

Sl. No.	Items	Marks
1	Attendance	10
2	Assignment and Presentation	10
3	Continues Evaluation (MCQ, Quiz, Fill in the gap, short question)	10
4	Class Test Examination	10
5	Semester Final Examination	60
	Total	**100**

b)The basis for awarding marks for class attendance and participation will be as follows:

Attendance & Participation	Marks
90% or above	10
85 to below 90%	9
80 to below 85%	8
75 to below 80%	7
70 to below 75%	6
65 to below 70%	5
60 to below 65%	4
Below 60%	0

20.1.2 Evaluation of Practical Courses

a) All practical courses will be evaluated out of 100 marks, the distribution of which is given below:

Sl. No.	Items	Marks
1	Attendance	10
2	Continues Evaluation (MCQ, Quiz, Fill in the gap, short question)	10
3	Class Test Examination	10
4	Assignment/Notebook	10
5	Semester Final Examination	60
	Total	**100**

b) Practical evaluation would be done through a laboratory test, quiz, practical note book,viva voce, performance/behavior of the students, etc. The course teacher(s) will complete every practical evaluation and share the result with the students within 2(two) weeks of conducting that item. Attendance and sessional evaluation mark sheets will be displayed on the Department's notice board/ website before starting the semester final examination.

20. 2. Grades(As per PSTU Rules and regulations)
20. 3. Grade Point Average (GPA) and Cumulative Grade Point Average (CGPA) (As per PSTU Rules and regulations)
20. 4. Course Withdrawal(As per PSTU Rules and regulations)
20. 5. Incomplete (I) courses(As per PSTU Rules and regulations)
20. 6. Retake(As per PSTU Rules and regulations)
20.7. Grade Improvement(As per PSTU Rules and regulations)
20. 8.Dropout(As per PSTU Rules and regulations)

Approval Records

Approving Authority	Date of Approval
Curriculum Committee of the Faculty	
Executive Committee of the Faculty	
BOS (if applicable)	
Academic Council	
Regent Board (if applicable)	

References

BAC 2021. Bangladesh Accreditation Council (BAC) Standards for Accreditation of Academic Program, BAC, Dhaka. pp.1-8.

UGC 2020. Template of Outcome Based Education (OBE) Curriculum(Revised). pp. 1-8.

BAC 2021. Bangladesh National Qualifications Framework (BNQF) Part B: Higher Education (level 7-10). pp. 1-29.