KHULNA UNIVERSITY

Learn, Lead and Live

OBE OUTCOME BASED EDUCATION

2021-22
and onwards

Undergraduate Curriculum

Fisheries and Marine Resource Technology Discipline

Life Science School

OUTCOME-BASED CURRICULUM

BACHELOR OF SCIENCE IN FISHERIES (HONOURS)

Fisheries and Marine Resource Technology Discipline
Khulna University
June 2022

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OUTCOME BASED EDUCATION

01 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	BSc in Fisheries (Honours)
Discipline/Program Offering Entity (POE)	Fisheries and Marine Resource Technology Discipline
School	Life Science School
Awarding Institution	Khulna University
Location	Khulna, 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	2021-22 and onwards

02 Name of the University

Khulna University

03 Vision of the University

Creation of global leaders who will contribute to make knowledge-based just society through accelerating inclusive and transformative growth of Bangladesh and the world. The university aims to achieve this vision through scholarly enquiry and contribution to the global knowledge pool.

04 Mission of the University

University Mission & Details

UM1	Explore human potential to the fullest extent and produce self-motivated, aspiring leaders to work for the betterment of the humankind based on wisdom, freethinking, creativity and unhindered intellectual exercises.
UM2	Ensure a transformative educational experience that enables creative learning, entrepreneurship and inquisitiveness among the students.
UM3	Create an inclusive research environment that enables graduates to make demonstrable economic and social impacts through translating knowledge and innovation into practice driven by moral values and professional ethics.

UM = University Mission

05 Name of the Discipline/Program Offering Entity (POE)

Fisheries and Marine Resource Technology Discipline

06 Vision of the Discipline/POE

To be a globally recognized center of excellence in education, research, entrepreneurs for sustainable fisheries and marine resource development

07 Mission of the Discipline/POE

Discipline Mission & Details

M1	To generate pioneer scholars through quality education in all aspects of fisheries sciences.
M2	To conduct innovative research for the improvement of fisheries sector.
M3	To establish an effective collaboration with reputed institutions of home and abroad for strengthening institutional capacity.
M4	To promote a culture of continuous learning to build up a knowledge-based community, dynamic leadership, and competent civil services.

M = Mission of the Discipline/POE

08 Objectives of the Discipline/POE

Discipline Objectives & Details

01	To provide quality education and to maintain the highest academic standard in all aspects of fisheries and marine science in line with the international standard of education;
02	To build up high level analytical and critical thinking skills for solving emerging problems in the field of fisheries and marine science;
03	To undertake fundamental and applied research in order to endow developed knowledge and experience to students;
04	To enhance communication skills, leadership capacity, adaptability, and social interactions;
05	To impart technology based and need oriented higher education befitting the age;
06	To generate skilled manpower in order to fulfill the global demands by equitable participation.

O = Objective of the Discipline/POE

09 Name of the Degree

Bachelor of Science in Fisheries (Honours)

10 Description of the Program

Fisheries and Marine Resources Technology Discipline (FMRT) is one of the important disciplines under Life Science School of Khulna University, which started its journey in 1992, the second year of establishment of Khulna University. The Bachelor of Science in Fisheries (Honours) program was started with a view to better utilization and sustainable development of fisheries and marine resources in Bangladesh. The Bay of Bengal with its huge coast lines along Bangladesh has made the country a unique piece of land enriched with brackish and marine water fish. Particularly the Khulna region has the world-famous mangrove forests 'Sundarbans' which is harboring more than 400 small and medium-size creeks within it. This area is an ideal breeding and nursery ground for many fishes. Surrounds by such natural resources the FMRT Discipline launched the program with a mandate to establish an avenue for education and research in all aspects of fisheries and marine science. The course-curriculum followed in the program includes multifaceted subjects in aquaculture, fish biology, fish ecology, fish genetics and biotechnology, coastal resource management, post-harvest technology and quality control. In addition to these professional courses, the program also offers courses on socioeconomics, statistics, GIS and remote sensing, computer application, biostatistics etc. The Major strengths of the program are continually updated syllabus, interdisciplinary approach of the courses with the support of experienced faculty members, well-equipped laboratories and experimental fish farms. The program is generating quality graduates who are competent enough to meet the future challenges of fisheries related issues for the sustainable development of fisheries sector.

11 Graduate Attributes

	Graduate Attributes	Domain
GA1	Comprehensive knowledge skill pertinent to fisheries and marine science	Fundamental
GA2	Apply knowledge and skill in practice	Fundamental
GA3	Critical thinking, problem solving and decision making skills	Thinking
GA4	Competency in ICT skills	Personal
GA5	Entrepreneurship skills	Personal
GA6	Lifelong learning skills	Personal
GA7	Leadership and communication skills	Social
GA8	Ethics and morality	Social

GA = Graduate Attributes

12 Program Educational Objectives (PEOs)

	Program Educational Objectives	Domain
PEO1	To conceptualize the basic knowledge, theories, principles, processes and procedures of the areas including aquaculture, genetics, management, post harvest technology and oceanography.	Fundamental
PEO2	To demonstrate analytical and critical thinking skills to solve emerging problems through the application of fundamental principles.	Thinking
PEO3	To develop skill to demonstrate safe and acceptable skills in field and laboratory works and independent research.	Fundamental
PEO4	To enhance the communication skill in written, oral and interactive presentation.	Personal
PEO5	To facilitate enthusiasm in making scientific investigation and realizing the roles of graduates on industrial, environmental, social and economic aspects nationally and globally.	Social
PEO6	To flourish moral and ethical values in all spheres of life.	Social

PEO = Program Educational Objective

13 Program Learning Outcomes (PLOs)

After successful completion of the degree, the learners will be able to:

A. Fundamental Skills	
PLO1	apply acquired knowledge and understanding in various aspects of fisheries and marine resources;
PLO2	explore different issues and find out probable strategies to manage and produce fisheries and marine resources with limited supervision;
PLO3	use available resources to carry out any work in the laboratory and field following the safety rules and regulations;
PLO4	expose innovative ideas, credentials and intellectuals in all levels of responsibilities; tackle any situation independently getting information from various secondary sources; collect, arrange and analyze required data and make decision for probable solution for any raised problem;
B. Social Skills	
PLO5	demonstrate social values and practice professional ethics in the conduct of science;
PLO6	communicate and interact effectively for social, academic and professional purposes;
C. Thinking Skills	
PLO7	judge the veracity and value of scientific outcomes related to fisheries and marine bioscience;
D. Personal Skills	
PLO8	demonstrate the ability to incorporate entrepreneurial and managerial skills in planning daily activities;
PLO9	apply ICT skills for information management in daily and professional life.

PLO = Program Learning Outcome

14 Mapping Mission of the University with PEOs

PEOs \ Missions	UM1	UM2	UM3
PEO1	3	2	2
PEO2	3	2	2
PEO3	2	2	3
PEO4	2	3	1
PEO5	2	2	3
PEO6	3	1	3

Level of association: 3=High, 2=Medium, 1=Low

15 Mapping PLOs with PEOs

Program Learning Outcomes (PLOs)		Program Educational Objectives (PEOs)					
		PEO1	PEO2	PEO3	PEO4	PEO5	PEO6
Fundamental Domain	PLO1	●			●		
	PLO2	●	●	●		●	
	PLO3	●	●	●		●	
	PLO4	●	●	●	●		
Social Domain	PLO5					●	●
	PLO6				●	●	●
Thinking Domain	PLO7		●	●		●	
Personal Domain	PLO8				●	●	●
	PLO9		●	●	●		

16 Mapping Courses with PLOs

Course Code and Course Title	Program Learning Outcomes (PLOs)								
	Fundamental Domain				Social Domain		Thinking Domain	Personal Domain	
	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8	PLO9
First Year First Term									
0831 06 FMRT 1101: Fisheries Zoology	●	●			●				●
0831 06 FMRT 1102: Fisheries Zoology Sessional	●	●	●	●			●		
0831 06 FMRT 1103: Fresh Water Ecology	●	●				●		●	
0831 06 FMRT 1104: Fresh Water Ecology Sessional and Field Work	●	●	●	●			●		●
0831 06 FMRT 1105: Aquatic Resources	●	●		●	●			●	
0831 06 FMRT 1106: Aquatic Resources Sessional and Field Work	●		●	●			●		
0610 06 CSE 1150: Spread Sheet Analysis Lab	●	●					●	●	
0531 06 Chem 1151: Chemistry	●	●			●	●			●
0531 06 Chem 1152: Chemistry Sessional	●	●		●			●		
0231 06 Eng 1153: Communicative English	●	●			●			●	●
0541 06 Math 1155: Mathematics	●	●			●			●	
First Year Second Term									
0831 06 FMRT 1201: Estuarine and Marine Ecology	●	●			●			●	
0831 06 FMRT 1202: Estuarine and Marine Ecology Sessional and Field Work	●	●		●	●		●		●
0831 06 FMRT 1203: Planktology	●	●	●			●		●	●
0831 06 FMRT 1204: Planktology Sessional and Field Work	●	●			●		●		●
0831 06 FMRT 1205: Fish Biochemistry	●	●			●			●	
0831 06 FMRT 1206: Fish Biochemistry Sessional	●	●				●	●		●
0831 06 FMRT 1207: Ichthyology	●	●				●		●	
0831 06 FMRT 1208: Ichthyology Sessional and Field Work	●	●					●		
0811 06 Soil 1251: Soil Science	●	●			●			●	
0811 06 Soil 1252: Soil Science Sessional and Field Work	●	●		●	●	●	●	●	
0533 06 Phy 1253: Physics	●	●			●			●	
0533 06 Phy 1254: Physics Sessional	●	●			●		●		

Course Code and Course Title	Program Learning Outcomes (PLOs)								
	Fundamental Domain				Social Domain		Thinking Domain	Personal Domain	
	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8	PLO9
Second Year First Term									
0831 06 FMRT 2101: Fisheries Microbiology	●	●	●	●			●	●	
0831 06 FMRT 2102: Fisheries Microbiology Sessional and Field Work	●	●	●		●	●	●		●
0831 06 FMRT 2103: Fish Physiology	●	●	●	●		●	●	●	
0831 06 FMRT 2104: Fish Physiology Sessional	●	●	●	●	●		●		●
0831 06 FMRT 2105: Fish Nutrition and Feed Formulation	●	●	●	●			●	●	
0831 06 FMRT 2106: Fish Nutrition and Feed Formulation Sessional and Field Work	●	●	●		●	●		●	●
0831 06 FMRT 2107: Shellfish Biology	●	●		●			●		●
0831 06 FMRT 2108: Shellfish Biology Sessional and Field Work	●	●	●		●	●			●
0831 06 FMRT 2109: Fundamentals of Aquaculture	●	●	●	●			●	●	
0831 06 FMRT 2110: Fundamentals of Aquaculture Sessional and Field Work	●	●	●	●	●	●			●
0831 06 FMRT 2111: Fisheries Systematics and Evolution	●	●	●	●			●	●	
0831 06 FMRT 2112: Fisheries Systematics and Evolution Sessional and Field Work	●	●	●	●	●	●	●		●
0610 06 CSE 2150: Database and Statistical Analysis Lab	●	●	●	●	●		●		●
Second Year Second Term									
0831 06 FMRT 2201: Freshwater Aquaculture	●	●			●		●	●	
0831 06 FMRT 2202: Freshwater Aquaculture Sessional and Field Work	●	●	●	●		●	●		●
0831 06 FMRT 2203: Live Food Culture	●	●	●		●		●	●	
0831 06 FMRT 2204: Live Food Culture Sessional	●	●	●	●		●	●		●
0831 06 FMRT 2205: Physical Oceanography	●	●	●		●		●	●	
0831 06 FMRT 2206: Physical Oceanography Sessional and Field Work	●	●	●	●		●	●		●
0731 06 URP 2250: GIS and Remote Sensing Sessional and Field Work	●	●	●	●	●		●		●
0542 06 Stat 2251: Principles of Statistics	●	●	●		●		●	●	
0542 06 Stat 2252: Principles of Statistics Sessional	●	●	●	●		●	●		●
0314 06 Soc 2255: Rural Sociology	●	●		●	●	●	●	●	

Course Code and Course Title	Program Learning Outcomes (PLOs)								
	Fundamental Domain				Social Domain		Thinking Domain	Personal Domain	
	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8	PLO9
Third Year First Term									
0831 06 FMRT 3101: Coastal Aquaculture and Mariculture	●	●			●		●	●	
0831 06 FMRT 3102: Coastal Aquaculture and Mariculture Sessional and Field Work	●	●	●				●	●	
0831 06 FMRT 3103: Chemical and Geological Oceanography	●	●	●	●	●	●			
0831 06 FMRT 3104: Chemical and Geological Oceanography Sessional and Field Work	●	●	●	●	●	●	●	●	●
0831 06 FMRT 3107: Fish Harvest Technology	●	●	●		●		●	●	
0831 06 FMRT 3108: Fish Harvest Technology Sessional and Field Work	●	●	●				●		
0831 06 FMRT 3109: Integrated Coastal Zone Management	●	●	●		●	●		●	
0831 06 FMRT 3111: Aqua Farm Design and Construction	●	●	●	●					
0831 06 FMRT 3112: Aqua Farm Design and Construction Sessional and Field Work	●	●	●	●			●		
0542 06 Stat 3151: Biostatistics				●			●		●
0542 06 Stat 3152: Biostatistics Sessional				●			●		●
Third Year Second Term									
0831 06 FMRT 3201: Fish Population Dynamics	●	●	●	●			●		
0831 06 FMRT 3202: Fish Population Dynamics Sessional and Field Work	●	●		●					
0831 06 FMRT 3203: Fish Breeding and Hatchery Management	●	●	●				●		
0831 06 FMRT 3204: Fish Breeding and Hatchery Management Sessional and Field Work		●	●	●			●	●	
0831 06 FMRT 3207: Fish Parasitology and Disease	●	●	●				●		
0831 06 FMRT 3208: Fish Parasitology and Disease Sessional and Field Work	●	●				●		●	
0831 06 FMRT 3211: Marine Botany	●	●	●						
0831 06 FMRT 3212: Marine Botany Sessional and Field Work	●	●	●	●					
0610 06 CSE 3250: Computer Programming	●	●	●	●		●		●	●
0511 06 BGE 3251: Principles of Genetics	●	●	●	●	●	●	●	●	
0511 06 BGE 3252: Principles of Genetics Sessional			●	●		●	●	●	●
0111 06 Res 3251: Research Methodology	●	●	●	●	●	●	●		
0111 06 Res 3252: Research Methodology Sessional	●		●	●	●		●	●	●

Course Code and Course Title	Program Learning Outcomes (PLOs)								
	Fundamental Domain				Social Domain		Thinking Domain	Personal Domain	
	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8	PLO9
Fourth Year First Term									
0831 06 FMRT 4101: Fish Processing	●	●	●				●		
0831 06 FMRT 4102: Fish Processing Sessional and Field Work		●		●	●	●	●	●	
0831 06 FMRT 4103: Fish Pathology and Immunology	●	●	●	●			●		
0831 06 FMRT 4104: Fish Pathology and Immunology Sessional and Field Work		●		●	●		●	●	
0831 06 FMRT 4105: Fish Biotechnology and Genetic Engineering	●	●	●	●			●		●
0831 06 FMRT 4106: Fish Biotechnology and Genetic Engineering Sessional		●	●			●	●		
0831 06 FMRT 4107: Aquaculture Extension	●	●			●	●	●	●	
0831 06 FMRT 4108: Aquaculture Extension Sessional and Field Work				●	●	●	●	●	
0831 06 FMRT 4110: Proposal Development	●	●	●	●	●	●	●	●	●
0831 06 FMRT 4113: Fish Food Safety and Quality Control					●		●	●	●
0521 06 ES 4151: Environmental Impact Assessment	●	●	●				●	●	●
0512 06 BGE 4154: Bioinformatics Sessional	●	●	●			●	●		●
Fourth Year Second Term									
0831 06 FMRT 4201: Aquatic Pollution and Toxicology	●	●	●	●			●		
0831 06 FMRT 4202: Aquatic Pollution and Toxicology Sessional and Field Work		●		●	●		●		
0831 06 FMRT 4203: Fisheries Management and Conservation	●	●	●	●	●		●	●	
0831 06 FMRT 4204: Fisheries Management and Conservation Sessional and Field Work		●	●	●	●	●	●	●	
0831 06 FMRT 4205: Fish Pharmacology	●	●	●	●			●		
0831 06 FMRT 4206: Fish Pharmacology Sessional and Field Work	●	●		●	●		●		
0831 06 FMRT 4209: Mangrove Fisheries	●	●				●	●	●	●
0831 06 FMRT 4210: Thesis	●	●	●	●	●	●	●	●	●
0831 06 FMRT 4213: Fisheries Products and By-products	●			●	●	●	●	●	
0311 06 Econ 4251: Fisheries Economics	●	●			●	●	●	●	
0521 06 ES 4253: Climate Change and Fisheries	●	●				●	●	●	

17 Structure of the Curriculum

a)	Duration of the Program	04 Years	08 Terms
b)	Admission Requirements	The applicants having HSC or equivalent degree will be eligible for admission into this program. Other terms and conditions are set or revised periodically by the appropriate authority.	
c1)	Graduating Credits / Total Minimum Credit Requirement to Complete the Program	160	
c2)	Available Credits	Total 191 credits including core 145 and optional 46 credits	
d)	Total Class Weeks in a Term*	14	
e)	Minimum CGPA Requirements for Graduation	2.50	
f)	Maximum Academic Years of Completion	07 Years	

*Term Duration

Teaching and Learning	Preparatory Leave	Term Final Examination	Term Break	Total
14 Weeks	2 Weeks	4 Weeks	2 Weeks	22 Weeks

g1) Area-wise Credit Distribution

Area	Course Type	Number of Courses	Credits	Total Credits
General Education (GED) Courses**	Theory	13	37	56
	Sessional	12	19	
Core/Compulsory Courses	Theory	28	83	111
	Sessional	28	28	
Optional/Elective Courses	Theory	7	15	18
	Sessional	3	3	
Capstone Courses***	Sessional	2	6	6
	Total	93	191	191

**29.32% from GED courses

*** Thesis, project, internship etc. courses

g2) Category of Courses

Area	Course Type	Course Title	Credits
General Education (GED) Courses	Theory	01. Chemistry 02. Communicative English 03. Mathematics 04. Soil Science 05. Physics 06. Principles of Statistics 07. Rural Sociology 08. Biostatistics 09. Principles of Genetics 10. Research Methodology 11. Climate Change and Fisheries 12. Fisheries Economics 13. Environmental Impact Assessment	37

Area	Course Type	Course Title	Credits
	Sessional	01. Chemistry Sessional 02. Soil Science Sessional and Field Work 03. Physics Sessional 04. Spread Sheet Analysis Lab 05. Data Base and Statistical Analysis Lab 06. Principles of Statistics Sessional 07. GIS and Remote Sensing Sessional and Field Work 08. Principles of Genetics Sessional 09. Research Methodology Sessional 10. Computer Programming 11. Biostatistics Sessional 12. Bioinformatics Sessional	19
Core/ Compulsory Courses	Theory	01. Fisheries Zoology 02. Fresh Water Ecology 03. Aquatic Resources 04. Estuarine and Marine Ecology 05. Planktology 06. Fish Biochemistry 07. Ichthyology 08. Fisheries Microbiology 09. Fish Physiology 10. Fish Nutrition and Feed Formulation 11. Shellfish Biology 12. Fundamentals of Aquaculture 13. Freshwater Aquaculture 14. Live Food Culture 15. Physical Oceanography 16. Coastal Aquaculture and Mariculture 17. Chemical and Geological Oceanography 18. Fish Harvest Technology 19. Fish Population Dynamics 20. Fish Breeding and Hatchery Management 21. Fish Parasitology and Disease 22. Fish Processing 23. Fish Pathology and Immunology 24. Fish Biotechnology and Genetic Engineering 25. Aquaculture Extension 26. Aquatic Pollution and Toxicology 27. Fisheries Management and Conservation 28. Fish Pharmacology	83
	Sessional	01. Fisheries Zoology Sessional 02. Fresh Water Ecology Sessional and Field Work 03. Estuarine and Marine Ecology Sessional and Field Work 04. PlanktologySessional and Field Work 05. Fish Biochemistry Sessional 06. Ichthyology Sessional and Field Work 07. Fisheries Microbiology Sessional and Field Work 08. Fish Physiology Sessional 09. Fish Nutrition and Feed Formulation Sessional and Field Work 10. Shellfish Biology Sessional and Field Work 11. Fundamentals of Aquaculture Sessional and Field Work 12. Freshwater Aquaculture Sessional and Field Work	28

Area	Course Type	Course Title	Credits
Core/ Compulsory Courses		13. Live Food Culture Sessional 14. Physical Oceanography Sessional and Field Work 15. Coastal Aquaculture and Mariculture Sessional and Field Work 16. Chemical and Geological Oceanography Sessional and Field Work 17. Fish Harvest Technology Sessional and Field Work 18. Fish Population Dynamics Sessional and Field Work 19. Fish Breeding &Hatchery Management Sessional and Field Work 20. Fish Parasitology Sessional and Field Work 21. Fish Processing Sessional and Field Work 22. Fish Pathology and Immunology Sessional and Field Work 23. Fish Biotechnology and Genetic Engineering Sessional 24. Aquaculture Extension Sessional and Field Work 25. Aquatic Pollution and Toxicology Sessional and Field Work 26. Fisheries Management and Conservation Sessional and Field Work 27. Fish Pharmacology Sessional and Field Work 28. Aquatic Resources Sessional and Field Work	
Optional/ Elective Courses	Theory	01. Fisheries Systematics and Evolution 02. Integrated Coastal Zone Management 03. Aqua Farm Design and Construction 04. Marine Botany 05. Fish Food Safety and Quality Control 06. Mangrove Fisheries 07. Fisheries Products and By-products	15
	Sessional	01. Fisheries Systematics and Evolution Sessional and Field Work 02. Aqua Farm Design and Construction Sessional 03. Marine Botany Sessional and Field Work	3
Capstone Courses	Sessional	01. Proposal Development 02. Thesis	6
		Total	191

18 Year/Term-wise Distribution of Courses

Course Code	Course Title	Course Status	Contact Hours/Week		Credits	Prerequisites
			Theory	Sessional		
First Year First Term						
0831 06 FMRT 1101	Fisheries Zoology	Core	3		3	None
0831 06 FMRT 1102	Fisheries Zoology Sessional	Core		1.5	1	None
0831 06 FMRT 1103	Fresh Water Ecology	Core	3		3	None
0831 06 FMRT 1104	Fresh Water Ecology Sessional and Field Work	Core		1.5	1	None
0831 06 FMRT 1105	Aquatic Resources	Core	3		3	None
0831 06 FMRT 1106	Aquatic Resources Sessional and Field Work	Core		1.5	1	None
0610 06 CSE 1150	Spread Sheet Analysis Lab	Optional		3.0	2	None
0531 06 Chem 1151	Chemistry	Core	3		3	None
0531 06 Chem 1152	Chemistry Sessional	Core		1.5	1	None
0231 06 Eng 1153	Communicative English	Core	3		3	None
0541 06 Math 1155	Mathematics	Optional	3		3	None
Total	Core Courses: 09, Optional Courses: 02, Theory Courses: 06, Sessional Courses: 05		18.0	9.0	24.0	
			27.0			
First Year Second Term						
0831 06 FMRT 1201	Estuarine and Marine Ecology	Core	3	–	3	None
0831 06 FMRT 1202	Estuarine and Marine Ecology Sessional and Field Work	Core	–	1.5	1	None
0831 06 FMRT 1203	Planktology	Core	3	–	3	None
0831 06 FMRT 1204	Planktology Sessional and Field Work	Core	–	1.5	1	None
0831 06 FMRT 1205	Fish Biochemistry	Core	3	–	3	None
0831 06 FMRT 1206	Fish Biochemistry Sessional	Core	–	1.5	1	None
0831 06 FMRT 1207	Ichthyology	Core	3	–	3	None
0831 06 FMRT 1208	Ichthyology Sessional and Field Work	Core	–	1.5	1	None
0811 06 Soil 1251	Soil Science	Optional	3	–	3	None
0811 06 Soil 1252	Soil Science Sessional and Field Work	Optional	–	1.5	1	None
0533 06 Phy 1253	Physics	Optional	3	–	3	None
0533 06 Phy 1254	Physics Sessional	Optional	–	1.5	1	None
Total	Core Courses: 08, Optional Courses: 04, Theory Courses: 06, Sessional Courses: 06		18.0	9.0	24.0	
			27.0			

Course Code	Course Title	Course Status	Contact Hours/Week		Credits	Prerequisites
			Theory	Sessional		
Second Year First Term						
0831 06 FMRT 2101	Fisheries Microbiology	Core	3	-	3	None
0831 06 FMRT 2102	Fisheries Microbiology Sessional and Field Work	Core	-	1.5	1	None
0831 06 FMRT 2103	Fish Physiology	Core	3	-	3	None
0831 06 FMRT 2104	Fish Physiology Sessional	Core	-	1.5	1	None
0831 06 FMRT 2105	Fish Nutrition and Feed Formulation	Core	3	-	3	None
0831 06 FMRT 2106	Fish Nutrition and Feed Formulation Sessional and Field Work	Core	-	1.5	1	None
0831 06 FMRT 2107	Shellfish Biology	Core	3	-	3	None
0831 06 FMRT 2108	Shellfish Biology Sessional and Field Work	Core	-	1.5	1	None
0831 06 FMRT 2109	Fundamentals of Aquaculture	Core	3	-	3	None
0831 06 FMRT 2110	Fundamentals of Aquaculture Sessional and Field Work	Core	-	1.5	1	None
0831 06 FMRT 2111	Fisheries Systematics and Evolution	Optional	2	-	2	None
0831 06 FMRT 2112	Fisheries Systematics and Evolution Sessional and Field Work	Optional	–	1.5	1	None
0610 06 CSE 2150	Database and Statistical Analysis Lab	Optional	–	3	2	None
Total	Core Courses: 10, Optional Courses: 03, Theory Courses: 06, Sessional Courses: 07		17.0	12.0	25.0	
			29.0			
Second Year Second Term						
0831 06 FMRT 2201	Freshwater Aquaculture	Core	3	–	3	None
0831 06 FMRT 2202	Freshwater Aquaculture Sessional and Field Work	Core	–	1.5	1	None
0831 06 FMRT 2203	Live Food Culture	Core	2	–	2	None
0831 06 FMRT 2204	Live Food Culture Sessional	Core	–	1.5	1	None
0831 06 FMRT 2205	Physical Oceanography	Core	3	–	3	None
0831 06 FMRT 2206	Physical Oceanography Sessional and Field Work	Core	–	1.5	1	None
0532 06 URP 2250	GIS and Remote Sensing Sessional and Field Work	Optional	-	3	2	None
0542 06 Stat 2251	Principles of Statistics	Core	3	–	3	None
0542 06 Stat 2252	Principles of Statistics Sessional	Core	–	3	2	None
0314 06 Soc 2255	Rural Sociology	Optional	3	–	3	None
Total	Core Courses: 08, Optional Courses: 02, Theory Courses: 05, Sessional Courses: 05		14.0	10.5	21.0	
			24.5			

Course Code	Course Title	Course Status	Contact Hours/Week		Credits	Prerequisites
			Theory	Sessional		
Third Year First Term						
0831 06 FMRT 3101	Coastal Aquaculture and Mariculture	Core	3	-	3	None
0831 06 FMRT 3102	Coastal Aquaculture and Mariculture Sessional and Field Work	Core	-	1.5	1	None
0831 06 FMRT 3103	Chemical and Geological Oceanography	Core	3	-	3	None
0831 06 FMRT 3104	Chemical and Geological Oceanography Sessional and Field Work	Core	-	1.5	1	None
0831 06 FMRT 3107	Fish Harvest Technology	Core	3	-	3	None
0831 06 FMRT 3108	Fish Harvest Technology Sessional and Field Work	Core	-	1.5	1	None
0831 06 FMRT 3109	Integrated Coastal Zone Management	Optional	2	-	2	None
0831 06 FMRT 3111	Aqua Farm Design and Construction	Optional	2	-	2	0831 06 FMRT 2109
0831 06 FMRT 3112	Aqua Farm Design and Construction Sessional and Field Work	Optional	-	1.5	1	0831 06 FMRT 2110
0542 06 Stat 3151	Biostatistics	Core	3	-	3	0542 06 Stat 2251
0542 06 Stat 3152	Biostatistics Sessional	Core	-	3	2	0542 06 Stat 2252
Total	Core Courses: 08, Optional Courses: 03, Theory Courses: 06, Sessional Courses: 05		16.0	9.0	22.0	
			25.0			
Third Year Second Term						
0831 06 FMRT 3201	Fish Population Dynamics	Core	3	–	3	None
0831 06 FMRT 3202	Fish Population Dynamics Sessional and Field Work	Core	-	1.5	1	None
0831 06 FMRT 3203	Fish Breeding and Hatchery Management	Core	3	–	3	None
0831 06 FMRT 3204	Fish Breeding and Hatchery Management Sessional and Field Work	Core	-	1.5	1	None
0831 06 FMRT 3207	Fish Parasitology and Disease	Core	3	–	3	None
0831 06 FMRT 3208	Fish Parasitology and Disease Sessional and Field Work	Core	-	1.5	1	None
0831 06 FMRT 3211	Marine Botany	Optional	2	–	2	None
0831 06 FMRT 3212	Marine Botany Sessional and Field Work	Optional	-	1.5	1	None
0610 06 CSE 3250	Computer Programming	Optional	-	3	2	None
0511 06 BGE 3251	Principles of Genetics	Core	3	–	3	None
0511 06 BGE 3252	Principles of Genetics Sessional	Core	-	1.5	1	None
0111 06 Res 3253	Research Methodology	Core	3	–	3	None
0111 06 Res 3254	Research Methodology Sessional	Core	-	3	2	None
Total	Core Courses: 10, Optional Courses: 03, Theory Courses: 06, Sessional Courses: 07		17.0	13.5	26.0	
			30.5			

Course Code	Course Title	Course Status	Contact Hours/Week		Credits	Prerequisites
			Theory	Sessional		
Fourth Year First Term						
0831 06 FMRT 4101	Fish Processing	Core	3	–	3	None
0831 06 FMRT 4102	Fish Processing Sessional and Field Work	Core	–	1.5	1	None
0831 06 FMRT 4103	Fish Pathology and Immunology	Core	3	–	3	None
0831 06 FMRT 4104	Fish Pathology and Immunology Sessional and Field Work	Core	–	1.5	1	None
0831 06 FMRT 4105	Fish Biotechnology and Genetic Engineering	Core	3	–	3	None
0831 06 FMRT 4106	Fish Biotechnology and Genetic Engineering Sessional	Core	–	1.5	1	None
0831 06 FMRT 4107	Aquaculture Extension	Core	3	–	3	None
0831 06 FMRT 4108	Aquaculture Extension Sessional and Field Work	Core	–	1.5	1	None
0831 06 FMRT 4110	Proposal Development	Core	–	4	2	None
0831 06 FMRT 4113	Fish Food Safety and Quality Control	Optional	2	–	2	None
0512 06 ES 4151	Environmental Impact Assessment	Optional	2	–	2	None
0512 06 BGE 4154	Bioinformatics Sessional	Optional	–	1.5	1	None
Total	Core Courses: 09, Optional Courses: 03, Theory Courses: 06, Sessional Courses: 06		16.0	11.5	23.0	
			27.5			
Fourth Year Second Term						
0831 06 FMRT 4201	Aquatic Pollution and Toxicology	Core	3	–	3	None
0831 06 FMRT 4202	Aquatic Pollution and Toxicology Sessional and Field Work	Core	-	1.5	1	None
0831 06 FMRT 4203	Fisheries Management and Conservation	Core	3	–	3	None
0831 06 FMRT 4204	Fisheries Management and Conservation Sessional and Field Work	Core	–	1.5	1	None
0831 06 FMRT 4205	Fish Pharmacology	Core	3	–	3	None
0831 06 FMRT 4206	Fish Pharmacology Sessional and Field Work	Core	-	1.5	1	None
0831 06 FMRT 4209	Mangrove Fisheries	Optional	3	–	3	None
0831 06 FMRT 4210	Thesis	Core	–	8	4	0831 06 FMRT 4110
0831 06 FMRT 4213	Fisheries Products and By-products	Optional	2	–	2	None
0311 06 Econ 4251	Fisheries Economics	Core	3	–	3	None
0532 06 ES 4253	Climate Change and Fisheries	Optional	2	–	2	None
Total	Core Courses: 08, Optional Courses: 03, Theory Courses: 07, Sessional Courses: 04		19.0	12.5	26.0	
			31.5			

19 Course Description

First Year First Term			
Course Code: 0831 06 FMRT 1101		Year: First	Term: First
Course Title	Fisheries Zoology		
Course Status	Core		
Credit	3.0		
Prerequisite(s)	None		
Rationale	This course is designed to orient students about the basic biology of aquatic organisms, the classification and/or group, major zoological terminology of aquatic organisms and to reveal the diversity with their ecological and economical importance, and grossly to link the significance of gaining such knowledge in Fisheries Science.		

Course Contents		CLOs
Section A		
1	Introduction: Definitions of basic and important zoological terms; Objectives, scopes and importance of studying Fisheries Zoology; Basics of animal classification; Phylogeny;	1, 2
2	Identification and characterization: General characteristics of available living aquatic resources; Key characters of their identification with examples.	1, 2
3	Basic biology - I: Vertebrate morphology and physiology: Structures and functions of representative aquatic vertebrates (e.g., fish, aq. mammals etc.)	1, 2
4	Basic biology - II: Invertebrate Morphology and physiology: Structures and functions of representative aquatic invertebrates of important animal taxa (e.g., mollusks, arthropods, nematode, coelenterata, annelid, echinoderms etc.)	1, 2
Section B		CLOs
5	Ecological and economic significance of the aquatic animals: Ecological and economic significance of different aquatic animals.	2, 3
6	Concept and principles of evolution: Origin and history of life; Evolution; Mutation; Adaptation; Selection; Variation; Co-evolution; Micro- and macro-evolution; Speciation; Extinction, Analysis of fossil records; Principles, evidence and process of evolution; Trends in evolution; Quantification of evolutionary changes and rates.	4
7	Adaptative radiation of animals with special emphasis on adaptation to aquatic life: Adaptation and adaptative radiation, adaptation of animals to aquatic life with special reference to temperature, salinity, current, depth, light etc.	2, 4
8	Ethics and welfare: Animal ethics, rights, laws; Human-Animal relationships; How animals ought to be treated; Animal welfare and services	2, 4

Course Learning Outcomes (CLOs)	Upon successful completion of the course, the students will be able to:		Mapping with PLOs
	CLO1	State the general information about concern phylum and scientific classification, habit and habitat, external morphology, different internal organ systems, food and feeding habit, life cycle etc. of a representative species of concern phylum.	1, 2, 3, 6, 7
	CLO2	Apply these concepts in fisheries and aquaculture sector in future.	1, 2, 3, 6, 7
	CLO3	Describe the ecological and economic importance of aquatic animals	1, 2, 3, 6, 7
	CLO4	Write the concept of evolution, adaptation, adaptative radiation and adaptation to aquatic life and ethics also.	1, 2, 3, 4, 5, 6, 7

Mapping CLOs with the Teaching-Learning and Assessment Strategy

CLOs	Teaching-Learning Strategy	Assessment Strategy
CLO1	Lecture, enquiry-based learning and video tape	Class test
CLO2	Lecture and enquiry-based learning	Assignment
CLO3	Lecture and Group Discussion	Presentation
CLO4	Lecture and video tape	Quiz

Learning Materials

Recommended Readings	Kotpal, R.L., 2009. Modern Text Book of Zoology Invertebrates. Print Asia. Jordan, E.L and P.S. Verma, 1980. Invertebrate Zoology. Chand and Company Ltd. Barnes, R.D., 1978. Invertebrate Zoology. WB Saunders Co., Philadelphia, London.
Supplementary Readings	King, M., 2007. Fisheries Biology. John Wiley and Sons.

Course Code: 0831 06 FMRT 1102		Year: First	Term: First
Course Title	Fisheries Zoology Sessional		
Course Status	Core		
Credit	1.0		
Prerequisite(s)	None		
Rationale	This course is designed to disseminate information on identification of the important aquatic fauna of Bangladesh and to know the dissection procedure, identification of internal organ system of some important aquatic fauna.		

	Course Contents/Tasks	CLOs
1	Identification and study of aquatic organisms especially the important aquatic fauna of Bangladesh.	1
2	Dissection of major organ systems of a typical Crustacea, Bivalvia, Gastropsda, Asteroidea and Pisces.	2
3	Collection and preservation of zoological specimens.	3

	Upon completion of this course the students will be able to:		Mapping with PLOs
Course Learning Outcomes (CLOs)	CLO1	Identify the important aquatic fauna of Bangladesh.	1, 3, 4, 5, 7
	CLO2	Compare the external and internal organ system of important aquatic fauna of Bangladesh.	1, 3, 4, 5, 7, 9
	CLO3	State the preservation technique of zoological specimens.	1, 3, 4, 5, 7

Mapping CLOs with the Teaching-Learning and Assessment Strategy

CLOs	Teaching-Learning Strategy	Assessment Strategy
CLO1	Lecture and demonstration	Practical exam, Viva
CLO2	Demonstration, enquiry based learning	Practical exam, Viva
CLO3	Demonstration, enquiry based learning	Practical exam, Viva

Learning Materials

Recommended Readings	Kotpal, R.L., 2009. Modern Text Book of Zoology Invertebrates. Print Asia. Jordan, E.L and P.S. Verma, 1980. Invertebrate Zoology. Chand and Company Ltd. Barnes, R.D., 1978. Invertebrate Zoology. WB Saunders Co., Philadelphia, London.
Supplementary Readings	King, M., 2007. Fisheries Biology. John Wiley and Sons.

Course Code: 0831 06 FMRT 1103		Year: First	Term: First
Course Title	Freshwater Ecology		
Course Status	Core		
Credit	3.0		
Prerequisite(s)	None		
Rationale	The contents of this course will provide the basic concept of aquatic environments, particularly the freshwater one. Students will be able to enrich their knowledge on ecology and ecosystem dynamics, aquatic habitats, biotic and abiotic factors, population & community and their relation with abiotic environments, nutrients recycling and ecosystems energetic.		

Course Contents		CLOs
	Section A	
1	Introduction: Definition, subdivision and its relation to other sciences, importance in human civilization.	1
2	Ecosystem: Basic concept on ecosystem, ecological factors, ecological niche, trophic level, food chain, food web and trophic structure.	1
3	Major ecological factors: interaction and dynamics in various freshwater environments with their comparison.	1
4	Ecology classification of freshwater habitat: Concept of unite, lotic and lentic habitats. Classification of pond, Lake Stream, zonation of pond, lake and stream.	2
5	Ecological classification of freshwater organisms: Classification according to the position in the energy or food chain, mode of life. Freshwater and flora, nature of the benthic & pelagic communities, nature of the communities in the various zones of freshwater habitat.	3
6	Riverine Ecology: Definition, types of river, classification of river, roles of river in the human civilization, origin and pathway of the major rivers in	
	Section B	CLOs
7	Relationship between the population and communities in the fresh water habitat: Positive interaction: Communalism, mutualism and cooperation; Negative interaction: Antibiosis predation, parasitism and competition.	4
8	Production and decomposition of organic matter in the freshwater ecosystem: Concept of productivity, measurement of primary productivity, man's use of primary production.	5
9	Fundamentalconcept of freshwater ecosystem energetic: Basic types of biogeo- chemical cycles, energy flow in a community, N2 cycle, sulfur cycle, phosphorus cycle, CO2 cycle and recycle path way.	6
10	Principles pertaining to limiting factors: "Liebig's Low of minimum", Shelfords "Law of tolerance," combined concepts of limiting factors and ecological indicators.	7
11	Community ecology: Community concept, community classification, Composition, structure, stratification, periodicity, ecological succession-, concept of the climax, standing crops, carrying capacity, ecotones and edge effect.	8
12	Population ecology: The biotic community and population, ecological dominance, population density, population age distribution, population dispersal, aggregation and Allele's principle.	9

Course Learning Outcomes (CLOs)	Upon successful completion of the course, the students will be able to:		Mapping with PLOs
	CLO1	Understand the basic concept on ecology and ecosystems and their functions and interaction	1, 2
	CLO2	Assess different freshwater habitat and their types	1, 2
	CLO3	Express the concept of different communities (benthic and pelagic) distribution in different types of aquatic habitats	1, 2, 4
	CLO4	Assess the impacts of river on human civilization and the ways the different populations in a community interact each with other	1, 2, 6
	CLO5	Understand the mechanisms of primary production and decomposition in the ecosystem	1, 2
	CLO6	Narrates the energy cycles and processes of energy flow in the ecosystems	1, 2
	CLO7	Understand the limiting factors in ecosystems and their role in ecosystem functions	1, 2
	CLO8	Understand the community concept includes its composition, structure, stratification, and succession	1, 2, 4
	CLO9	Understand the population concept includes its distribution, dispersion, and agreegation	1, 2, 4

Mapping CLOs with the Teaching-Learning and Assessment Strategy

CLOs	Teaching-Learning Strategy	Assessment Strategy
CLO1	Lecture	Written Exam
CLO2	Lecture	Assignment
CLO3	Lecture	Written Exam
CLO4	Lecture, Audio-visual material	Quiz
CLO5	Lecture, Audio-visual material	Oral Presentation
CLO6	Audio-visual Lecture and Group Discussion	Assignment
CLO7	Lecture	Written Exam
CLO8	Lecture, Audio-visual materials	Written Exam
CLO9	Lecture, Audio-visual materials	Oral Presentation

Learning Materials

Recommended Readings	Reid, G.K., 1961. Ecology of inland waters and estuaries. Odum, E.P. and Barrett, G.W., 1971. Fundamentals of ecology (Vol. 3). Philadelphia: Saunders. Barnes, R.S.K. and Mann, K.H. eds., 2009. Fundamentals of aquatic ecology. John Wiley & Sons. Day, J.W., 1989. Estuarine ecology. John Wiley & Sons. Chapman, V.J., 1977. Wet coastal ecosystems: introduction. Ecosystems of the World PIT).
Supplementary Readings	Leivinton, J.S., 1966. Marine Ecology. John wiley and sons Inc., New York. Longhurst, A.R., 1981. Analysis of marine ecosystems. Academic Press. MacArthur, R.H., 1972. Geographical ecology: patterns in the distribution of species. Princeton University Press. Pitcher, T., Hart, P.J. and Paul, J.B., 1982. Fisheries ecology (No. 597: 504.4

Course Code: 0831 06 FMRT 1104		Year: First	Term: First
Course Title	Fresh Water Ecology Sessional and Field Work		
Course Status	Core		
Credit	1.0		
Prerequisite(s)	None		
Rationale	This course is designed to disseminate various freshwater species; their collection, identification and preservation techniques; demonstrate different zonation models; comparative study of water quality from different freshwater systems and sample collection and volumetric measurement of primary productivity.		

	Course Contents/Tasks	CLOs
1	Study of the various species of different fresh water environment.	1
2	Collection, identification & preservation of different biotic & abiotic communities in fresh water environment.	1
3	Study of the communities in the various zones of fresh water habitats	2
4	Preparation of different types of zonation model in different aquatic environment.	2
5	Study of riverine life.	2
6	Comparative study of water quality from pond, lake, stream & river. Measurement of primary productivity in different freshwater environment.	3

	Upon successful completion of the course, the students will be able to:		Mapping with PLOs
Course Learning Outcomes (CLOs)	CLO1	Identification of various species from different types of freshwater habitats. Acquire knowledge on different abiotic factors and how do they function	1, 2
	CLO2	How do zonation occurs in aquatic habitats and role of zonation on community formation	1, 2, 4
	CLO3	Techniques of primary production and different water quality parameters measurement	2, 3

Mapping CLOs with the Teaching-Learning and Assessment Strategy

CLOs	Teaching-Learning Strategy	Assessment Strategy
CLO1	Field visit, Laboratory work	Oral presentation, viva
CLO2	Field visit, Group discussion	Assignment, viva
CLO3	Field visit, Laboratory work	Assignment, viva

Learning Materials

Recommended Readings	Reid, G.K., 1961. Ecology of inland waters and estuaries. Odum, E.P. and Barrett, G.W., 1971. Fundamentals of ecology (Vol. 3). Philadelphia: Saunders. Barnes, R.S.K. and Mann, K.H. eds., 2009. Fundamentals of aquatic ecology. John Wiley & Sons
Supplementary Readings	Day, J.W., 1989. Estuarine ecology. John Wiley & Sons. Chapman, V.J., 1977. Wet coastal ecosystems: introduction. Ecosystems of the World.

Course Code: 0831 06 FMRT 1105	Year: First	Term: First
Course Title	Aquatic Resources	
Course Status	Core	
Credit	3.0	
Prerequisite(s)	None	
Rationale	The course is designed to provide information on different types of aquatic habitats, potential resources therein, present status of the resources, their exploitation and future prospects.	

	Course Contents	CLOs
	Section A	
1	Introduction: concepts of water types, aquatic habitats, aquatic resources, exploration and exploitation and potentials of aquatic resources;	1, 2
2	Aquatic resources: water, habitats, biotic resources, fisheries biodiversity, fishing ground and stock, social and economic importance, and potentials of aquatic resources;	1, 2
3	Resource use: culture and capture fisheries, inland and open water fisheries, fresh and marine water production, exploration and exploitation, culture potentials of aquatic resources;	2
4	Management and development: organizational set up for administration, development, research, training and extension work.	3
	Section B	CLOs
5	Abiotic resources: renewable resources: wave, tide, salinity and temperature gradient, minerals;	1, 4
6	Energy production: Energy production from renewable resources, wave, tide, salinity and temperature gradient;	4
7	Recreational uses: aquarium fishes, its trade, importance, problems and prospects, and scope for development; Recreational uses of coastal aquatic resources.	1, 5
8	Fish trade: commercially important fishes; marketing channel, local and international market.	6

	Upon successful completion of the course, the students will be able to:		Mapping with PLOs
Course Learning Outcomes (CLOs)	CLO1	Describe types of water, aquatic habitats, resources and fisheries biodiversity, exploration and exploitation, and potentials and socio-economic importance of aquatic resources.	1, 2
	CLO2	Explain different types of fisheries production and culture potentials of the resources.	1, 2, 7
	CLO3	Describe the organizational set up for fisheries development and management.	1, 2
	CLO4	Explain concepts of renewable abiotic resources and describe power production from different renewable resources.	1, 2
	CLO5	Explain scope of recreational uses of aquatic resources and recognize aquarium fish trades and its potentials.	1, 2, 7
	CLO6	Compare fish trades both in local and international markets.	1, 2, 7

Mapping CLOs with the Teaching-Learning and Assessment Strategy

CLOs	Teaching-Learning Strategy	Assessment Strategy
CLO1	Lecture	Quiz
CLO2	Lecture and Enquiry based learning	Assignment
CLO3	Lecture and Group Discussion	Class test
CLO4	Lecture	Quiz
CLO5	Lecture and video tape	Quiz
CLO6	Group discussion	Presentation, Final Exam

Learning Materials

Recommended Readings	Rahman, A.A., 1989. Freshwater fishes of Bangladesh. Zoological Soc. of Bangladesh. MoF, 2014. Fisheries Statistical Report of Bangladesh 2012-13.
Supplementary Readings	Ahmed, Z.U., Begum, Z.T., Hassan, M.A., Khondker, M., Kabir, S.M.H., Ahmad, M.A.T.A., Ahmed, A.T.A., Rahman, A.K.A. and Haque, E.U., 2008. Encyclopedia of flora and fauna of Bangladesh. Asiatic Society of Bangladesh, Dhaka.

Course Code: 0831 06 FMRT 1106	Year: First	Term: First
Course Title	Aquatic Resources Sessional and Field Work	
Course Status	Core	
Credit	1.0	
Prerequisite(s)	None	
Rationale	The course is designed to visit different types of aquafarms, processing factories and institutions as well as to collect and identify different fresh, brackish and marine water specimens.	

	Course Contents/Tasks	CLOs
1	Survey and orientation: commercial aqua farms, processing factories, organizations and institutions;	1
2	Species collection, preservation and identification: fresh, brackish and marine water specimens; a) Finfish; b) Shell fish and c) Marine algae.	2

	Upon successful completion of the course, the students will be able to:		Mapping with PLOs
Course Learning Outcomes (CLOs)	CLO1	Describe different types of commercial aquafarms, processing factories, organizations and institutions.	1, 2, 3, 4, 7
	CLO2	Collect, preserve and identify fresh, brackish and marine water specimens;	1, 2

Mapping CLOs with the Teaching-Learning and Assessment Strategy

CLOs	Teaching-Learning Strategy	Assessment Strategy
CLO1	Field visit, cooperative learning	Assignment, presentation
CLO2	Demonstration, enquiry based learning	Practical book assessment, Quiz, Viva

Learning Materials

Recommended Readings	Rahman, A.A., 1989. Freshwater fishes of Bangladesh. Zoological Soc. of Bangladesh. MoF, 2014. Fisheries Statistical Report of Bangladesh 2012-13.
Supplementary Readings	Ahmed, Z.U., Begum, Z.T., Hassan, M.A., Khondker, M., Kabir, S.M.H., Ahmad, M.A.T.A., Ahmed, A.T.A., Rahman, A.K.A. and Haque, E.U., 2008. Encyclopedia of flora and fauna of Bangladesh. Asiatic Society of Bangladesh, Dhaka.

Course Code: 0610 06 CSE 1150		Year: First	Term: First
Course Title	Spread Sheet Analysis Lab		
Course Status	Optional		
Credit	2.0		
Prerequisite(s)	None		
Rationale	Students are expected to learn the basics of computer applications in fisheries, so that they are capable of applying the gained knowledge the report writing of various courses.		

	Course Contents/Tasks	CLOs
1	Overviewof computer and available software for word processing and spreadsheet analysis.	1
2	Create, open, edit and save word files and database files.	1
3	Application of different data file formats, such as DBF, TXT, CSV, SHP etc.	2
4	Perform basic mathematical expressions such as sum, average, min, max, slope, intercept, correlation, linear equation, standard deviation, variance, co-efficient of variation (CV), count, histogram etc. using spreadsheet software.	2
5	Create graphs and tables using example data sets using spreadsheet software.	3
6	Summarize large data sets using Pivot-Table of spreadsheet software.	4

	Upon successful completion of the course, the students will be able to:		Mapping with PLOs
Course Learning Outcomes (CLOs)	CLO1	Create, edit and save database files for analysis	9
	CLO2	Understand basic mathematical expressions for statistical analysis of data	8, 9
	CLO3	Create graphs and tables from data	9
	CLO4	Write reports using word processors	4, 8, 9

Mapping CLOs with the Teaching-Learning and Assessment Strategy

CLOs	Teaching-Learning Strategy	Assessment Strategy
CLO1	Lecture, demonstration,	Quiz
CLO2	Lecture and demonstration	Lab test
CLO3	Lecture and demonstration	Lab test
CLO4	Lecture, case study, enquiry based learning	Assignment, Lab test

Learning Materials

Recommended Readings	Rahman, A.A., 1989. Freshwater fishes of Bangladesh. Zoological Soc. of Bangladesh. MoF, 2014. Fisheries Statistical Report of Bangladesh 2012-13.
Supplementary Readings	Ahmed, Z.U., Begum, Z.T., Hassan, M.A., Khondker, M., Kabir, S.M.H., Ahmad, M.A.T.A., Ahmed, A.T.A., Rahman, A.K.A. and Haque, E.U., 2008. Encyclopedia of flora and fauna of Bangladesh. Asiatic Society of Bangladesh, Dhaka.

Course Code: 0531 06 Chem 1151		Year: First	Term: First
Course Title	Chemistry		
Course Status	Core		
Credit	3.0		
Prerequisite(s)	None		
Rationale	This course is designed to provide fundamental concepts of volumetric analysis, chemical bonding, aliphatic & aromatic compounds, chemical kinetics and chemical equilibrium.		

Course Contents		CLOs
	Section A	
1	Volumetric analysis: Requirement of volumetric analysis, acidimetry and alkalimetry, standard solution, classification of the methods of volumetric analysis, types of titration, theory of neutralization reaction, heat of reaction, heat of formation, heat of combustion and heat of neutralization. Ionization of acid, base and salts; ionization of strong and weak electrolytes, theory of buffer solution, concept of pH.	1, 2
2	Chemical Kinetics: First and second order reactions and their simple treatment; Simple theories for reaction rate (only outline of Arritenuum theory); Determination of order of reaction; Collision theory.	2, 3, 7
3	Chemical Equilibria: Law of mass action; Effects of temperature, pressure and concentration on chemical equilibria; Relationship between Kp and Kc. Lachatelier and Barun principle.	7, 10
4	Spectroscopic analysis: Theory of spectroscopy, application of Beer-Lambert Law.	4, 5, 6
	Section B	CLOs
5	Chemical Bonding: Elementary different types of chemical bonding; Concept of hybridization; Molecular orbitals; Bond length and bind strength.	8, 11
6	Aliphatic and Aromatic Compounds: Nomenclature of organic compounds; Preparation and properties of alcohols; Halides; Aldehydes, Ketones and Carboxylic synthesis, properties, use, diazotization and diazonium compounds.	9, 12
7	Carboxylic acids and their derivatives: Nomenclature, synthesis, properties, use, diazotization and diazonium compounds.	11
8	Heterocyclic compounds: Occurrence, nomenclature, synthesis, properties and reactions.	13

	Upon successful completion of the course, the students will be able to:		Mapping with PLOs
Course Learning Outcomes (CLOs)	CLO1	Explain the bonding in different compounds	1, 2, 3
	CLO2	Describe the sources of organic compounds and classify them	3, 4, 7
	CLO3	Explain the properties and nature of organic compounds	3, 4, 7
	CLO4	Describe the uses and reactions of organic compounds and distinguish between them	4, 5, 7
	CLO5	Narrate different methods of preparation of organic compounds	3, 4, 7
	CLO6	Manipulate different methods of preparation and reactions of organic compounds	1, 5, 7
	CLO7	Follow the proper procedures and regulations for safe handling and use of chemicals.	1, 6, 7
	CLO8	Discuss the collision model of chemical reactions and how various factors such as temperature can affect reaction rate.	2, 3, 4
	CLO9	Distinguish between a first-order reaction and a second-order reaction.	1, 2, 7
	CLO10	Compare various processes, which are in equilibrium.	3, 4,
	CLO11	Explain the vapour pressure of liquids and their variation with temperature	3, 4, 7
	CLO12	Discuss the collision model of chemical reactions and how various factors such as temperature can affect reaction rate.	2, 4
	CLO13	Demonstrate a better understanding on the heterocyclic compounds	2, 7

Mapping CLOs with the Teaching-Learning and Assessment Strategy

CLOs	Teaching-Learning Strategy	Assessment Strategy
CLO1	Lecture	Quiz test
CLO2	Lecture	Class test, Exam
CLO3	Lecture	Class test, Exam
CLO4	Lecture	Class test, Exam
CLO5	Lecture	Class test, Exam
CLO6	Lecture	Class test, Exam
CLO7	Lecture and Enquiry based learning	Class test, Exam
CLO8	Lecture and Enquiry based learning	Class test, Exam
CLO9	Lecture and Enquiry based learning	Class test, Exam
CLO10	Lecture and Enquiry based learning	Class test, Exam
CLO11	Lecture and Enquiry based learning	Class test, Exam
CLO12	Lecture and Enquiry based learning	Class test, Exam
CLO13	Lecture and Enquiry based learning	Class test, Exam

Learning Materials

Recommended Readings	Aller, A. J., (2018). Fundamentals of Electrothermal Atomic Absorption Spectrometry A Look Inside the Fundamental Processes in ETAAS. Andrade-Garda, J. M., Carlosena-Zubieta, A., Gómez-Carracedo, M. P., Maestro-Saavedra, M. A., Prieto-Blanco, M. C. and Soto-Ferreiro, R. M. (2017). Problems of Instrumental Analytical Chemistry Hands-On Guide Bestseller. World Scientific Publishing Europe Ltd. 1st edition. Andreas Manz, A., Petra S Dittrich, P. S., Pamme, N. and Iossifidis, D. (2015). Bioanalytical Chemistry. Imperial College Press; 2nd Revised edition. Chatel, G., (2016). Sonochemistry: New Opportunities for Green Chemistry. WSPC, 1st edition.
Supplementary Readings	Li, N., John J Hefferren J. J. and Ke'an Li, K. (2013). Quantitative Chemical Analysis. World Scientific Pub Co Inc Thompson, M. and Lowthian, P. J., (2011). Notes on Statistics and Data Quality for Analytical Chemists.

Course Code: 0531 06 Chem 1152		Year: First	Term: First
Course Title	Chemistry Sessional		
Course Status	Core		
Credit	1.0		
Prerequisite(s)	None		
Rationale	This course will provide the practical demonstration of experimental techniques of detection of elements and functional groups of organic compounds as well as know the volumetric analysis and redox titration.		

	Course Contents/Tasks	CLOs
1	Acidimetry and Alkalimetry, Preparation of different acid and base solutions and standard solutions	1
2	Oxidation reduction titrations, iron, copper, etc. determination in water solution	2

	Upon successful completion of the course, the students will be able to:		Mapping with PLOs
Course Learning Outcomes (CLOs)	CLO1	Volumetric Analysis: Acidimetry and Alkalimetry (Neutralization titration): (i) Preparation of approx (N/10) HCl, H2SO4 and CH3COOH Solution. (ii) Preparation of standard solution. (iii) Determination of the strength of acid/base by using standard base/acid solution respectively	7, 8
	CLO2	Oxidation- Reduction Titration: (i) Determination of the amount of iron in grams per litre of the given ferrous sulphate solution by standard KMnO4 solution. (ii) Determination of the amount of copper in grams per litre in a given copper sulphate solution by using standard $Na_2S_2O_3$ solution.	7, 8

Mapping CLOs with the Teaching-Learning and Assessment Strategy

CLOs	Teaching-Learning Strategy	Assessment Strategy
CLO1	Lecture, demonstration and cooperative learning	Assignment, Presentation, Practical book assessment, Quiz, Viva
CLO2	Lecture, demonstration and cooperative learning	Assignment, Presentation, Practical book assessment, Quiz, Viva

Learning Materials

Recommended Readings	Aller, A. J., (2018). Fundamentals of Electrothermal Atomic Absorption Spectrometry A Look Inside the Fundamental Processes in ETAAS. Andrade-Garda, J. M., Carlosena-Zubieta, A., Gómez-Carracedo, M. P., Maestro-Saavedra, M. A., Prieto-Blanco, M. C. and Soto-Ferreiro, R. M. (2017). Problems of Instrumental Analytical Chemistry Hands-On Guide Bestseller. World Scientific Publishing Europe Ltd. 1st edition. Andreas Manz, A., Petra S Dittrich, P. S., Pamme, N. and Iossifidis, D. (2015). Bioanalytical Chemistry. Imperial College Press; 2nd Revised edition. Chatel, G., (2016). Sonochemistry: New Opportunities for Green Chemistry. WSPC, 1st edition.

Course Code: 0231 06 Eng 1153		Year: First	Term: First
Course Title	Communicative English		
Course Status	Core		
Credit	3.0		
Prerequisite(s)	None		
Rationale	Competence in language skills is essential for effective communication. The course offers the students an opportunity to know the skills of English Language and their proper uses.		

	Course Contents	CLOs
	Section A	
1	Development of Vocabulary: Processes of Word Formation and Transformation; Proper use of parts of speech	1
2	Sentence Structure: Structures of Basic Sentences, Identification of Clauses and Phrases, Joining sentences, Transformation of Sentences, Framing W/H Questions	2
3	Reading and Understanding: Perspectives on reading Comprehension; Elements of reading: vocabulary, syntax and meaning; Reading strategies: intensive and extensive reading; scanning and skimming; prediction and inference; reader's expectation and interpretation; contextual understanding and understanding the whole text; effective note-taking.	3
	Section B	CLOs
4	Development of Speaking Skills: Art of Good Speaking, Notions and Functions, Speaker-listener Rapport, Intonation and Stress	4
5	Development of Writing Skills: Process of writing, Understanding Academic Writing: features and elements, Mechanics in Writing: Capitalization and Punctuation; Generating ideas for a writing task; Drafting and Supporting ideas with evidence; Integrating data and graphics in texts; Modes of writing, Writing tasks: Paragraph, Essay, Summary, Précis, Report, Abstract, Letter of Application, Assignment, Examination Paper	5
6	Development of Listening Skills: Guide Lines for Developing Listening Skills, Role of a Good Listener, Listening Comprehension.	6

	Upon successful completion of the course, the students will be able to:		Mapping with PLOs
Course Learning Outcomes (CLOs)	CLO1	Know how to develop vocabulary scientifically	1, 2
	CLO2	How to transform sentences from one structure into another one, and to frame w/h questions	1, 2, 7
	CLO3	Learn about the elements of reading and reading strategies	1, 2
	CLO4	Understand the art of good speaking and apply practically different notions of speaking	1, 6, 8
	CLO5	Differentiate between academic writing and non-academic writing, learn how to generate ideas for a writing task and the modes of writing	1, 2, 6
	CLO6	How to develop listening skill and learn about the role of a good listener	1, 6, 8

Mapping CLOs with the Teaching-Learning and Assessment Strategy

CLOs	Teaching-Learning Strategy	Assessment Strategy
CLO1	Lecture	Class Test
CLO2	Lecture and Enquiry based learning	Assignment
CLO3	Lecture and Group Discussion	Assignment
CLO4	Audio-visual Lecture and Group Discussion	Oral demonstration
CLO5	Lecture	Report writing
CLO6	Audio-visual Lecture and Group Discussion	Oral Presentation

Learning Materials

Recommended Readings	Nelson, G., 2019. English: An essential grammar. Routledge. Thomson, A. J., Martinet, A. V., and Draycott, E., 1986. A practical English grammar (Vol. 332). Oxford: Oxford university press. Pyle, M. A., and Page, M. E. M., 1995. TOEFL preparation guide. Nebraska: Cliffs Notes.
Supplementary Readings	Mn, T., and Taylor, G., 1975. English conversation practice. Tata McGraw-Hill Education. Thurstun, J., and Christopher, C., 1997. Exploring academic English: A workbook for student essay writing.

Course Code: 0541 06 Math 1155		Year: First	Term: First
Course Title	Mathematics		
Course Status	Optional		
Credit	3.0		
Prerequisite(s)	None		
Rationale	This course is designed to provide the concept of formation and solution of ordinary and partial differential equations and know the solution procedure of different mathematical problems involving it.		

	Course Contents	CLOs
	Section A	
1	Functions, Domain, Range, graphs of standard functions, Limits, Continuity, Techniques of differentiation.	1
2	Higher order derivatives, Leibnitz's theorem, Partial Differentiation, Applications to physical problem, maximum and minimum values	2
3	Indefinite integral, Methods of substitution, Integration by parts, Trigonometric functions & rational fractions.	3
4	Definite integrals, Fundamental theorem of calculus, Properties of definite integrals, Evaluation of definite integrals, Beta and Gamma functions.	4
	Section B	CLOs
5	Definition and classifications of differential equations, Formation of ordinary and partial differential equation. Solutions of first order first degree equations: Exact equation, Homogeneous equation, Linear and Bernoulli's equation.	5
6	Higher order linear homogeneous and non-homogeneous equations with constants coefficients, Method of undetermined coefficients, Method of Variation of parameters.	6
7	Linear equation with variable coefficients, Cauchy-Euler equation, initial and boundary value problem.	7
8	Solution of linear autonomous system, applications to boundary value problems related to PDE (method of separation of variables).	8

	Upon successful completion of the course, the students will be able to:		Mapping with PLOs
Course Learning Outcomes (CLOs)	CLO1	Distinguish different function and graphs also know the technique of differentiations	4, 7, 9
	CLO2	Find the nth derivatives of different function and construct different models.	7, 9
	CLO3	Apply different techniques to evaluate different integral functions	7, 9
	CLO4	Calculate the value of definite integral functions	7, 9
	CLO5	Formulate different types differential equations, distinguish between ordinary and partial des and solution linear ordinary differential equations	7, 9
	CLO6	Describe the higher order differential equations and solution procedure and applications	7, 9
	CLO7	Convert a differential equation with variable coefficient to constant coefficients	7, 9
	CLO8	Find the solution procedure of linear autonomous system, applications to boundary value problems related to PDE	4, 7, 9

Mapping CLOs with the Teaching-Learning and Assessment Strategy

CLOs	Teaching-Learning Strategy	Assessment Strategy
CLO1	Lecture	Quiz
CLO2	Lecture and Problem Based Learning	Assignment
CLO3	Lecture and Group Discussion	Class test
CLO4	Lecture	Quiz
CLO5	Lecture and simulation game	Quiz
CLO6	Group discussion	Presentation, Final Exam
CLO7	Lecture	Class test
CLO8	Lecture	Final Exam

Learning Materials

Recommended Readings	Bell, R. J. 1963. An elementary treatise on coordinate geometry of three dimensions. Macmillan. Stewart, J., Clegg, D. K., & Watson, S. 2020. Calculus: early transcendentals. Cengage Learning. Avez, A. 2020. Differential calculus. Courier Dover Publications. De Morgan, A. 1836. The differential and integral calculus. Baldwin and Cradock.

First Year Second Term			
Course Code: 0831 06 FMRT 1201		Year: First	Term: Second
Course Title	Estuarine and Marine Ecology		
Course Status	Core		
Credit	3.0		
Prerequisite(s)	None		
Rationale	This course is designed to make familiar the students with the concept of estuarine and marine ecology for exploring the necessary ecological services from this area.		

	Course Contents	CLOs
	Section A	
1	Ecology and environment, development of ecology, scope and approach to the study of estuarine ecology.	1
2	Major ecological factors and interaction of multiple factors in marine ecosystem.	2
3	Ecological dynamics: Basic concept on the components of marine ecosystem, habitat and ecological niche, trophic level, food chain and food web, trophic structure and ecological pyramids, production, decomposition and transformation of organic matter.	3
4	Marine habitat: Abyssal, mid depth pelagic, upper oceanic, inshore pelagic and sub littoral zone. Sea bottom, continental shelf, the intertidal zone, rocky, sandy and muddy shores. Coral reefs- environmental factors responsible for reef formation, process of reef formation, types of reefs and coral reef communities	4
5	Ecosystem services: Definition and types, examples of key services provided by marine ecosystem	5
	Section B	CLOs
6	Estuarine Ecology: Definition and classification of estuary based on salinity range, speciation and colonization. Formation and components of estuary.	6
7	Estuarine environment	7
8	Estuarine communities: Faunal composition, vegetation, plankton; Adaptation of estuarine organisms.	7
9	Zoogeography: General Principles, theories and patterns.	7
10	Geological time scale and continental drift; Clues for the origin and dispersal of organisms.	8
11	Biogeography: Geographical range; Latitudinal gradients of species diversity; Oceanic differences in species diversity.	8
12	Geographical barrier; Latitudinal zonation; Plate tectonics and provincialization; Effect of human.	8
13	Marine communities: Types of marine communities, Sandy shore community, Muddy shore community	9

	Upon successful completion of the course, the students will be able to:		Mapping with PLOs
Course Learning Outcomes (CLOs)	CLO1	Fundamental concept of brackishwater and marine water ecology.	1, 2
	CLO2	Various ecological factors and their interaction in marine environment	1, 2, 4
	CLO3	Details about marine ecosystem, production and energy and nutrient dynamics.	2, 4, 7
	CLO4	Recognize the marine habitat in detail.	1, 2, 4
	CLO5	Explore the estuarine and marine ecosystem services.	2, 7
	CLO6	Types and nature of estuary.	1, 2,
	CLO7	Identification of the major components of estuary	2, 4
	CLO8	Comparison of the physico-chemical aspects of estuary	2, 3, 7
	CLO9	Community composition, their adaptation and distribution process in estuarine and marine environment.	2, 4, 5

Mapping CLOs with the Teaching-Learning and Assessment Strategy

CLOs	Teaching-Learning Strategy	Assessment Strategy
CLO1	Lecture	Written Exam
CLO2	Lecture	Assignment, Quiz
CLO3	Lecture, Audio-visual material	Written Exam
CLO4	Lecture, Audio-visual material	Oral Presentation
CLO5	Lecture	Written Exam
CLO6	Lecture, Audio-visual material	Assignment, Quiz
CLO7	Lecture	Written Exam
CLO8	Lecture, Audio-visual materials	Report writing
CLO9	Lecture, Audio-visual materials	Oral Presentation

Learning Materials

Recommended Readings	Nybakken, J.W., 1997. Marine Biology: An ecological approach. Addison-Wesley Educational publishers Inc., USA. Barnes, R.S.K. and Hughes, R.N., 1999. An introduction to Marine Ecology. Blackwell Science Ltd., Australia.

Course Code: 0831 06 FMRT 1202		Year: First	Term: Second
Course Title	Estuarine and Marine Ecology Sessional and Field Work		
Course Status	Core		
Credit	1.0		
Prerequisite(s)	None		
Rationale	This course is designed to provide practical knowledge on different aspects of Estuarine and marine ecology		

	Course Contents/Tasks	CLOs
1	Preparation of field trip report on shore communities: i) The stand line ii) The splash zone iii) Intertidal zone iv) Sand dune.	1
2	Determination of following ecological factors from the field trip area: Air and water temperature; humidity; rainfall; dissolved oxygen; BOD, COD, CO2 and organic matter etc.	2
3	Preparation of zonation model of estuarine and marine environment.	3

	Upon successful completion of the course, the students will be able to:		Mapping with PLOs
Course Learning Outcomes (CLOs)	CLO1	Determine and narrate the marine and/ or shore communities;	1, 2, 3
	CLO2	Determine various ecological parameters eg. DO, BOD, COD, CO2 etc.	1, 2, 3
	CLO3	Prepare zonation model of estuarine and marine environment.	2, 4

Mapping CLOs with the Teaching-Learning and Assessment Strategy

CLOs	Teaching-Learning Strategy	Assessment Strategy
CLO1	Field visit, Laboratory work	Oral presentation, viva
CLO2	Field visit, Laboratory work	Assignment, viva
CLO3	Field visit, Group work	Assignment, viva

Learning Materials

Recommended Readings	Day, J.W. Estuarine ecology. A wileyintersince publication. John wiley and sons. New York, 1989. Leivinton, J.S. Marine Ecology. John wiley and sons Inc. New York. 1966. Longhurst, A.R. Analysis of marine ecosystems. Academic press, London, 1981.
Supplementary Readings	Mac Arthur, R.I. Geographical ecology: Patterns in the distribution of species Odum, E.P. Fundamental of ecology. Philadelphia, sunders college publishing house, New Delhi.

Course Code: 0831 06 FMRT 1203		Year: First	Term: Second
Course Title	Planktology		
Course Status	Core		
Credit	3.0		
Prerequisite(s)	None		
Rationale	The growth of fish and other aquatic animal in any water body is directly related to the abundance and biomass of plankton. Plankton is important as live food in aquaculture and biofuel. This course is designed to provide students fundamental concepts on planktology and primary productivity.		

	Course Contents	CLOs
	Section A	
1	Definition, general division and importance of plankton.	1, 2
2	Taxonomy, morphology and reproduction of phytoplankton.	1, 2
3	Microbial growth, photosynthesis and its substrates; Phytoplankton productivity in different aquatic habitats in sea and its measurement. Factors affecting primary productivity and seasonal succession of phytoplankton.	2
4	Distribution: Latitudinal variations, local variations, vertical distribution and seasonal variation, and factors affecting distribution of phytoplankton.	3
5	Phytoplankton blooms: Seasonal and non-seasonal bloom, causes of phytoplankton bloom, the problems of bloom and its control.	3, 4
6	Microalgal biotechnology and microalgae for oil-strain selection and outdoor mass cultivation	4
	Section B	CLOs
7	Taxonomy and morphology of zooplankton.	5
8	Food and feeding habit, habitat and reproduction of some commercially important zooplankton: Daphnia, Moina, Rotifer, Artemia.	6
9	Phytoplankton-zooplankton relationship.	7
10	Fish plankton relationship	7
11	Distribution, abundance and biomass of zooplankton	8
12	Determination of zooplankton productivity: volumetric, gravimetric and chemical method.	8

	Upon successful completion of the course, the students will be able to:		Mapping with PLOs
Course Learning Outcomes (CLOs)	CLO1	Describe and classify phytoplankton.	1, 2, 7
	CLO2	State the concept of primary productivity and know the factors affecting primary productivity.	1, 2, 7
	CLO3	Describe the distribution and seasonal succession of phytoplankton.	1, 2, 7
	CLO4	State the concept of phytoplankton bloom, the problems of bloom and its control.	1, 2, 7
	CLO5	Describe and classify zooplankton.	1, 2, 7
	CLO6	Write the food and feeding habit, habitat and reproduction of zooplankton.	1, 2, 7
	CLO7	State the concept and process of phytoplankton-zooplankton relationship, fish plankton relationship.	1, 2, 7
	CLO8	Define the distribution of zooplankton and determine the methods of zooplankton productivity.	1, 2, 7

Mapping CLOs with the Teaching-Learning and Assessment Strategy

CLOs	Teaching-Learning Strategy	Assessment Strategy
CLO1	Lecture	Quiz
CLO2	Lecture and Enquiry based learning	Assignment
CLO3	Lecture and Group Discussion	Class test
CLO4	Lecture	Quiz
CLO5	Lecture and video tape	Quiz
CLO6	Lecture and Group Discussion	Presentation, Class test, Final Exam
CLO7	Lecture and interactive learning	Presentation, Class test, Final Exam
CLO8	Lecture and Group Discussion	Presentation, Class test, Final Exam

Learning Materials

Recommended Readings/ Materials	Pennak, R.W., 1953. Fresh-water invertebrates of the United States. In Fresh-water invertebrates of the United States. Ronald Press. Edmondson, W.T., 1959. Freshwater Biology. John Wiley & Sons. Inc. Nurul Islam, A.K.M., 1976. Contribution to the study of the marine algae of Bangladesh. J. Cramer, Germany. Moniruzzaman, K., 1997. Practical limnology and systematics of freshwater hydrophytes. In Proceedings of 3rd National Zoological conference. Dhaka University, Dhaka, Bangladesh (pp. 215-323). Vollenweider, R.A., Talling, J.F. and Westlake, D.F., 1974. A manual on methods for measuring primary production in aquatic environments. Blackwell Scientific Pub.
Supplementary Readings	Neslen, J. ed., 2004. Plankton culture manual (Vol. 183). Florida Aqua Farms. Davis, C.C., 1955. Marine and fresh-water plankton. Michigan State University Press Lavens, P. and Sorgeloos, P., 1996. Manual on the production and use of live food for aquaculture (No. 361). Food and Agriculture Organization (FAO).

Course Code: 0831 06 FMRT 1204	Year: First	Term: Second
Course Title	Planktology Sessional and Field Work	
Course Status	Core	
Credit	1.0	
Prerequisite(s)	None	
Rationale	This course is designed to disseminate various techniques of collection, preservation and identification of planktons; estimation of plankton population and measurement of primary productivity.	

	Course Contents	CLOs
	Section A	
1	Collection, preservation and identification of phytoplankton (freshwater and marine water).	1, 2
2	Estimation of phytoplankton population. Measurement of primary productivity: Light and dark bottle method, spectrophotometric method.	1, 2
	Section B	CLOs
3	Collection, preservation and identification of zooplankton (freshwater and marine water).	3, 4
4	Estimation of zooplankton population.	3, 4
5	Preparation of permanent slide of plankton.	3, 4

	Upon successful completion of the course, the students will be able to:		Mapping with PLOs
Course Learning Outcomes (CLOs)	CLO1	Collect, preserve and identify phytoplankton and estimate phytoplankton population.	1, 2, 3, 7
	CLO2	Measure primary productivity by light and dark bottle method, spectrophotometric method.	1, 2, 3, 7
	CLO3	Collect, preserve and identify zooplankton and estimate phytoplankton population.	1, 2, 3, 7, 9
	CLO4	Prepare of permanent slide of a plankton.	1, 2, 3, 7

Mapping CLOs with the Teaching-Learning and Assessment Strategy

CLOs	Teaching-Learning Strategy	Assessment Strategy
CLO1	Field visit, interactive learning, lab work	Assignment, presentation
CLO2	Demonstration, enquiry based learning	Quiz, Viva
CLO3	Demonstration, interactive learning, lab work	Data analysis and presentation, Quiz, Viva
CLO4	Demonstration, interactive learning, lab work	Quiz, Viva

Learning Materials

Recommended Readings	Edmondson, W.T., 1959. Freshwater biology. John Willey and Sons Inc. Nurul Islam, A.K.M., 1976. Contribution to the study of the marine algae of Bangladesh. J. Cramer, Germany. Pennak, R.W., 1953. Fresh-water invertebrates of the United States. In Fresh-water invertebrates of the United States. Ronald Press. Vollenweider, R.A., Talling, J.F. and Westlake, D.F., 1974. A manual on methods for measuring primary production in aquatic environments. Blackwell Scientific Pub.
Supplementary Readings	Moniruzzaman, K., 1997. Practical limnology and systematics of freshwater hydrophytes. In Proceedings of 3rd National Zoological conference. Dhaka University, Dhaka, Bangladesh (pp. 215-323).

Course Code: 0831 06 FMRT 1205		Year: First	Term: Second
Course Title	Fish Biochemistry		
Course Status	Core		
Credit	3.0		
Prerequisite(s)	None		
Rationale	This course is designed to provide basic concept of biochemistry involved in fish.		

Course Contents		CLOs
	Section A	
1	Water: Definition, weak interactions in aqueous systems, ionization of water, weak acids, and weak bases; buffering against pH changes in biological systems; water as a reactant.	1
2	Amino acids and protein: Definition, classification and biological significance of proteins; structure, classification, acid-base properties, stereoisomerisms and chemical reactions of amino acids; structure of proteins; protein metabolism.	2
3	Lipid and fatty acids: Definition, classification and biological significance of lipids, fatty acids; structure, properties and functions of phospholipids, prostaglandins, polyunsaturated fatty acids and steroids; lipid metabolism.	3
4	Carbohydrates: Definition, classification and biological significance of carbohydrates; chemical reactions; stereoisomerisms and mutarotation, structure and properties of monosaccharides, disaccharides, polysaccharides and mucopolysaccharides; carbohydrates metabolism.	4
5	Biochemical composition of fish: Introduction; importance of fish composition; structure of fish muscle; the principal components of fish muscle; the minor components of fish muscle; factors affecting the composition of fish.	5
	Section B	CLOs
6	Biological Membranes and Transport: The composition and architecture of membranes; membrane dynamics; solute transport across membranes.	6
7	Enzymes and enzyme kinetics: An introduction to enzymes; how enzymes work; enzyme kinetics as an approach to understanding mechanism; examples of enzymatic reactions; regulatory enzymes; metabolism network	7
8	Bioactive compounds in aquatic organisms: Definition, biological properties of bioactive compounds, bioactive compounds from aquatic plants and microorganisms, bioactive peptides derived from marine organisms.	8
9	Taste active compounds of fish: Taste active components in fish; Taste of delicious peptides and fragments; fish for human consumption.	9
10	Hydrocarbon from aquatic organisms: Definition, classification and biological significance of carbohydrates, biosynthesis and accumulation of hydrocarbons, sustainability of energy from algae.	10

Course Learning Outcomes (CLOs)	Upon successful completion of the course, the students will be able to:		Mapping with PLOs
	CLO1	Explain the chemical and physical properties of water and its interaction with other molecules.	1, 2, 3
	CLO2	Illustrate the biological significance of amino acids and its metabolism.	3, 4, 7
	CLO3	Describe the properties of fatty acids and its biological role in life as well as its metabolisms.	3, 4, 7
	CLO4	Elucidate chemical reaction and biological role of carbohydrates and its metabolism.	4, 5, 7
	CLO5	Describe the importance of fish biochemical composition and its relatives abundance in fish.	3, 4, 7
	CLO6	Illustrate membrane dynamics, channel, pump and its mechanisms in cell.	1, 5, 7
	CLO7	Explain the specificity of enzymes in biochemical catalysts, and the chemistry involved in enzyme action.	1, 6, 7
	CLO8	Elucidate role of bioactive compounds in biological system and extraction mechanisms from aquatic sources.	2, 3, 4
	CLO9	Describe the nature and composition of five basic tastes in aquatic products.	1, 2, 7
	CLO10	Explain how hydrocarbon synthesis in micro algae through atmospheric carbon dioxide fixation and its application in fuels.	3, 4,

Mapping CLOs with the Teaching-Learning and Assessment Strategy

CLOs	Teaching-Learning Strategy	Assessment Strategy
CLO1	Lecture, demonstration, discussion	Class test
CLO2	Lecture, demonstration, discussion	Class test
CLO3	Lecture, demonstration, discussion	Class test
CLO4	Lecture, demonstration, discussion	Class test
CLO5	Lecture, demonstration, discussion	Class test
CLO6	Lecture, demonstration, discussion	Class test
CLO7	Lecture, demonstration, discussion	Class test
CLO8	Lecture, demonstration, discussion	Class test
CLO9	Lecture, demonstration, discussion	Class test
CLO10	Lecture, demonstration, discussion	Class test

Learning Materials

Recommended Readings	Nelson, D.L., Lehninger, A.L. and Cox, M.M., 2008. Lehninger principles of biochemistry. Macmillan. Koolman, J., Röhm, K.H., Wirth, J. and Robertson, M., 2005. Color atlas of biochemistry (Vol. 2). Stuttgart: Thieme. Wilson, K. and Walker, J. eds., 2010. Principles and techniques of biochemistry and molecular biology. Cambridge university press.
Supplementary Readings	Tringali, C., 2003. Bioactive compounds from natural sources: isolation, Characterization and biological properties. CRC Press. Banerjee, A., Sharma, R., Chisti, Y. and Banerjee, U.C., 2002. Botryococcusbraunii: a renewable source of hydrocarbons and other chemicals. Critical reviews in biotechnology, 22(3), pp.245-279.

Course Code: 0831 06 FMRT 1206	Year: First	Term: Second
Course Title	Fish Biochemistry Sessional	
Course Status	Core	
Credit	1.0	
Prerequisite(s)	None	
Rationale	This course is designed to provide tried and trusted laboratory experiments in the field of fish biochemistry	

	Course Contents/Tasks	CLOs
1	Qualitative analysis of certain protein preparation.	1
2	Quantitative determination of protein, lipid and carbohydrate from fish/shell fish muscles.	2
3	Determination of glucose concentration in fish/shell fish blood.	3
4	Qualitative and quantitative analysis of fish digestive protein.	4
5	Determination of enzyme activity and metabolites in fish.	5
6	Identification of basic taste in fish products.	6

	Upon successful completion of the course, the students will be able to:		Mapping with PLOs
Course Learning Outcomes (CLOs)	CLO1	Determine protein concentration in aquatic products and fish feed.	7, 8
	CLO2	Analyze principal compound of fish/shell fish muscle	7, 8
	CLO3	Determine glucose content in fish blood.	7, 8
	CLO4	Verify taste active compounds in fish	7, 8
	CLO5	Determination of metabolites in fish.	7, 8
	CLO6	Identification of basic taste in fish products.	7, 8

Mapping CLOs with the Teaching-Learning and Assessment Strategy

CLOs	Teaching-Learning Strategy	Assessment Strategy
CLO1	Lecture, demonstration and field visit	Assignment, Presentation, Practical book assessment, Quiz, Viva
CLO2	Lecture, demonstration and field visit	Assignment, Presentation, Practical book assessment, Quiz, Viva
CLO3	Lecture, demonstration and field visit	Assignment, Presentation, Practical book assessment, Quiz, Viva
CLO4	Lecture, demonstration and field visit	Assignment, Presentation, Practical book assessment, Quiz, Viva
CLO5	Lecture, demonstration and field visit	Assignment, Presentation, Practical book assessment, Quiz, Viva
CLO6	Lecture, demonstration and field visit	Assignment, Presentation, Practical book assessment, Quiz, Viva

Learning Materials

Recommended Readings	Blackstock, J.C., 1998. Principles of biochemistry (pp.307). Butterworth Heinemann. Meyer, L.H., 1960. Food chemistry. Reinhold Pub. Corp.
Supplementary Readings	Nelson, D.L., Lehninger, A.L. and Cox, M.M., 2008. Lehninger Principles of biochemistry. Macmillan.

Course Code: 0831 06 FMRT 1207		Year: First	Term: Second
Course Title	Ichthyology		
Course Status	Core		
Credit	3.0		
Prerequisite(s)	None		
Rationale	This course is designed to provide the knowledge and skill necessary for classification and identification of major groups of fishes and to understand the external and internal anatomical features of various organs of different groups of fishes.		

	Course Contents	CLOs
	Section A	
1	Introduction: General concept of ichthyology. Factors affecting life of fishes in aquatic environment.	1, 2
2	Diversity of fishes: Diversity of fishes with special reference to those available in Bangladesh.	1, 2
3	Gross external morphology of fishes: Body form, body covering appendages, openings, lateral line, eyes.	2
4	Basic fish anatomy: Structure of gill, heart, gas bladder, kidney, brain, endocrine organs, reproductive organs etc.	3
5	Adaptive radiation in fish: Various behavior and role of behavior for adaptation in fish.	1, 4
	Section B	CLOs
6	Integumentary system: Function and section of fish skin, otolith, types of scale, derivatives of scale, usage of scale, derivatives of fish skin.	1, 5
7	Food & feeding: Food habit, feeding habit, feeding adaptation found in various groups of fishes, digestive system of fishes.	1, 6
8	Muscular features: Major kinds of muscles, skeletal musculature of trunk, head region & fin of fishes.	1, 7
9	Skeletal features: Exo-skeleton, endo-skeleton, axial firm skeleton, appendicular firm skeleton of various groups of fishes.	1, 7

	Upon successful completion of the course, the students will be able to:		Mapping with PLOs
Course Learning Outcomes (CLOs)	CLO1	Learn the basic structural concepts of fish.	1, 2, 7
	CLO2	Write about the fishes that are found in our country	1, 2, 7
	CLO3	Recognize the external and internal morphological features of fishes.	1, 2
	CLO4	State the adaptive radiation of fishes in various environments in the world.	1, 2
	CLO5	Discuss the main concept of fish skin, scale, derivatives of scale	1, 2, 7
	CLO6	Acquire technical knowledge about food for culturing fish, recognizing fish according to food and feeding habit	1, 2, 7
	CLO7	Describe the concept of muscular and skeletal features of various groups of fishes	1, 2, 7

Mapping CLOs with the Teaching-Learning and Assessment Strategy

CLOs	Teaching-Learning Strategy	Assessment Strategy
CLO1	Lecture	Quiz
CLO2	Lecture	Assignment
CLO3	Lecture	Class test
CLO4	Lecture	Quiz
CLO5	Lecture	Quiz
CLO6	Lecture	Class test
CLO7	Lecture	Class test

Learning Materials

Recommended Readings	Lagler, K.F., 1966. Studies in freshwater fishery biology (3rd rev. ed.). Lagler, K.F., 1966. Freshwater fishery biology. IOWA Press Inc. Lagler, K.F., Bardach, J.E., Miller, R.R. and Passino, D.R., M. 1977. Ichthyology. John Wiley & Sons Inc. Love, M.S. and Cailliet, G.M., 1979. Readings in ichthyology. Goodyear Publishing Company. Marshall, N.B., 2013. The life of fishes. London
Supplementary Readings	Rahman, A.A., 1989. Freshwater fishes of Bangladesh. Zoological Soc. of Bangladesh. Day, F., 1971. The Fishes of India. Today and Tomorrow Book Agency, New Delhi. Gunther, A.C.L.G., 1963. An introduction to the studies of fishes. Today and tomorrows Books Agency, New Delhi. Jhingran, V.G., 1988. Fish and Fisheries of India. Hindustan Publishing Corporation (India), Delhi.

Course Code: 0831 06 FMRT 1208		Year: First	Term: Second
Course Title	Ichthyology Sessional and Field Work		
Course Status	Core		
Credit	1.0		
Prerequisite(s)	None		
Rationale	This course is designed to provide practical knowledge and skill necessary to understand the external and internal anatomical features of various organs of different groups of fishes.		

	Course Contents/Tasks	CLOs
1	Study of museum specimens.	1
2	Study of external morphology and internal anatomy of fishes polluted from different water body : fresh water brackish water, marin water.	2
3	Preparation and study of different types of fish scales.	2
4	Fish dissection and study of different organs and systems of different types of fishes.	3
5	Comparative study of digestive systems of fishes with different food and feeding habits.	3
6	Preparation and study of muscular and skeletal system of fish.	3

	Upon successful completion of the course, the students will be able to:		Mapping with PLOs
Course Learning Outcomes (CLOs)	CLO1	Characterize and identify the major groups of fishes.	1, 2, 6
	CLO2	Recognize various organs of different groups of fishes.	1, 2, 6
	CLO3	Identify the morphological and anatomical features of fishes.	1, 6

Mapping CLOs with the Teaching-Learning and Assessment Strategy

CLOs	Teaching-Learning Strategy	Assessment Strategy
CLO1	Lecture, demonstration	laboratory assessment, assignment
CLO2	Lecture, demonstration	laboratory assessment, assignment
CLO3	Lecture, demonstration	laboratory assessment, assignment class test, quiz, viva

Learning Materials

Recommended Readings	Day, F., 1971. The Fishes of India. Today and Tomorrow Book Agency, New Delhi. Gunther, A.C.L.G., 1963. An introduction to the studies of fishes. Today and tomorrows Books Agency, New Delhi. Jhingran, V.G., 1988. Fish and Fisheries of India. Hindustan Publishing Corporation (India), Delhi.
Supplementary Readings	Lagler, K.F., Bardach, J.E., Miller, R.R. and Passino, D.R., M. 1977. Ichthyology. John Wiley & Sons Inc.

Course Code: 0811 06 Soil 1251		Year: First	Term: Second
Course Title	Soil Science		
Course Status	Optional		
Credit	3.0		
Prerequisite(s)	None		
Rationale	This course is designed to familiarize students with different aspects of soil science focusing on soil-water interaction for aquaculture.		

	Course Contents	CLOs
	Section A	
1	Soil and its characteristics: Definition, Origin and nature of soil, composition of soil, soil formation, soil type of Bangladesh, Significance in fisheries, soil forming processes and factors, soil profile and classes for fish culture, pond construction and management.	1
2	Physical properties of soil: Soil color, Soil texture, soil structure, types of soil structure, Aggregate stability, soil porosity, measuring soil porosity, bulk density, water holding capacity, soil types and their distribution, sandy soils properties and problems in pond construction, fish culture.	2
3	Soil organic matters: Organic Carbon, Organic material in the soil, Carbon – Nitrogen ratio, soil fertility, humus, characteristics of humus, function of humus, importance of organic matter.	3
	Section B	CLOs
4	Soil chemistry: Soil pH, raising soil pH, acidifying soil, types of acidifying soil, causes of acid formation in the soil, treatment of acidifying soil. Alkaline soil: Type of alkaline soil, problem with alkaline soil, causes of alkalinity in the soil, treatment of alkaline soil.	4
5	Soil water interactions: Types of soil water, water movement in the soil, factors affecting the available water holding capacity of soil. Soil water interactions: Types of soil water interaction, causes of soil water interactions, importance of soil water interactions.	5
6	Soil microbiology: Microbial community in soil, role of soil microbes in productivity of waterbody.	6
7	Soil quality criteria for aquaculture: Soil and water amendments: lime manures and application of liming, fertilizers, micronutrients, zeolites, alum, and gypsum etc.	7

	Upon successful completion of the course, the students will be able to:		Mapping with PLOs
Course Learning Outcomes (CLOs)	CLO1	State soil types and its characteristics	1, 2, 3
	CLO2	Write physical properties of soil	3, 4, 7
	CLO3	Describe organic material and soil fertility	3, 4, 7
	CLO4	Discuss soil chemistry, soil ph, acid soil, alkaline soil, liming	4, 5, 7
	CLO5	Describe soil-water interaction, causes and importance	3, 4, 7
	CLO6	Recognize the microbial community in soil	1, 5, 7
	CLO7	Distinguish soil quality for aquaculture	1, 6, 7

Mapping CLOs with the Teaching-Learning and Assessment Strategy

CLOs	Teaching-Learning Strategy	Assessment Strategy
CLO1	Lecture, demonstration, discussion	Class test and final exam
CLO2	Lecture, demonstration, discussion	Class test and final exam
CLO3	Lecture, demonstration, discussion	Class test and final exam
CLO4	Lecture, demonstration, discussion	Class test and final exam
CLO5	Lecture, demonstration, discussion	Class test and final exam
CLO6	Lecture, demonstration, discussion	Class test and final exam
CLO7	Lecture, demonstration, discussion	Class test and final exam

Learning Materials

Recommended Readings	Huheey, J.E., Keiter, E.A., Keiter, R.L. and Medhi, O.K., 2006. Inorganic chemistry: principles of structure and reactivity. Pearson Education India. Thompson, L.M., 1952. Soils and soil fertility. Soil Science, 74(3), p.264. Scheffer, F. and Schachtschabel, P., 1982. Textbook of soil science. Ferdinand Enke.
Supplementary Readings	Mukherjee, S.K. and Biswas, T.D., 1987. Textbook of Soil Science. Tata McGraw Hill. Brady, N.C. and Weil, R.R., 1996. The nature and properties of soils (No. Ed. 11). Prentice-Hall Inc.

Course Code: 0811 06 Soil 1252	Year: First	Term: Second
Course Title	Soil Science Sessional and Field Work	
Course Status	Optional	
Credit	1.0	
Prerequisite(s)	None	
Rationale	This course is designed to provide knowledge to the students on practical aspects of soil chemistry.	

	Course Contents/Tasks	CLOs
1	Measurement of moisture content in soil	1, 2
2	Measurement of soil pH	3, 4
3	Measurement of soil organic matter, available nitrogen, total phosphorus	5, 6

	Upon successful completion of the course, the students will be able to:		Mapping with PLOs
Course Learning Outcomes (CLOs)	CLO1	Explain soil sampling procedure	7, 8
	CLO2	Measure soil texture	7, 8
	CLO3	Measure moisture content in soil	7, 8
	CLO4	Measure pH content in soil	7, 8
	CLO5	Measure EC in soil	7, 8
	CLO6	Measure soil organic carbon, phosphorus, ammonium nitrogen	7, 8

Mapping CLOs with the Teaching-Learning and Assessment Strategy

CLOs	Teaching-Learning Strategy	Assessment Strategy
CLO1	Lecture, demonstration and field visit	Practical book assessment, Report
CLO2	Lecture and demonstration	Practical book assessment
CLO3	Lecture and demonstration	Practical book assessment, Quiz
CLO4	Lecture and demonstration	Practical book assessment,
CLO5	Lecture and demonstration	Practical book assessment, Quiz,
CLO6	Lecture and demonstration	Presentation, Practical book assessment, Viva

Learning Materials

Recommended Readings	Huheey, J.E., Keiter, E.A., Keiter, R.L. and Medhi, O.K., 2006. Inorganic chemistry: principles of structure and reactivity. Pearson Education India. Thompson, L.M., 1952. Soils and soil fertility. Soil Science, 74(3), p.264. Scheffer, F. and Schachtschabel, P., 1982. Textbook of soil science. Ferdinand Enke. Mukherjee, S.K. and Biswas, T.D., 1987. Textbook of Soil Science. Tata McGraw Hill. Brady, N.C. and Weil, R.R., 1996. The nature and properties of soils (No. Ed. 11). Prentice-Hall Inc..
Supplementary Readings	FAO, 1971. Bangladesh: Soil resource. AGL: SF/ PAK 6. Technical Report No. 3. p.221. Fitz Patrick, E.A., 1986. An introduction to soil science (No. Second Edition). Longman Scientific & Technical Group UK.

Course Code: 0533 06 Phy 1253		Year: First	Term: Second
Course Title	Physics		
Course Status	Optional		
Credit	3.0		
Prerequisite(s)	None		
Rationale	This course in designed to provide introductory knowledge of physical science, including Newtonian mechanics, waves and oscillation, elasticity and surface tension, modern physics, kinetic theory of gasses, heat and thermodynamics, geometrical optics and basic electronics.		

	Course Contents	CLOs
	Section A	
1	Newtonian Mechanics: Conservation law of Mechanics, Circular Motion, Motion of rigid bodies, Gravity and Gravitation, Escape velocity.	1
2	Waves and Oscillation; Simple Harmonic Motion, Differential Equation of SHM and its Solution, Graphical Representation of SHM, Lissajous Figures.	2
3	Elasticity, Fluid Statics and Dynamics: Elasticity, Young's Modulus, Bulk Modulus and Modulus of Rigidity, Poisson's Ratio, Equation of continuity, Bernoulli's Theorem and its Application, Surface tension and Surface Energy; Angle of Contact, Capillarity, Excess pressure inside the Liquid Drop, Excess pressure inside the Soap Bubble, Viscosity; Coefficient of Viscosity.	3
4	Modern Physics: Photoelectric Effect, Plank's Constant and Quanta of Light Energy, Radioactivity; α, β and γ rays and their characteristics, Nuclear reaction, Binding Energy and Mass defect.	4
	Section B	CLOs
5	Kinetic Theory of Gasses: Gas laws, Fundamental assumptions of Kinetic theory of gases, Pressure Exerted by Perfect Gas, Deduction of Gas laws on the basis of kinetic theory, Equipartition of Energy, Mean free path of a molecule.	5
6	Heat Transmissions and Thermodynamics: Transfer of heat; Conduction, Convection and Radiation, Determination of thermal conductivity, Thermodynamics system, First and Second Law of Thermodynamics.	6
7	Geometrical optics: Reflection, Refraction, Total Internal Reflection, Huygens's Principle, Fermat's Principle and its application, Interference Phenomena and Newton's ring, Polarization; Malu's law, Brewster's law.	7
8	Electronics: Bonds in Semiconductors, Types of Semiconductors, Energy Band Description of Semiconductor, p-n junction, Semiconductor diode, transistor and name of transistor terminals	8

	Upon successful completion of the course, the students will be able to:		Mapping with PLOs
Course Learning Outcomes (CLOs)	CLO1	Describe various aspects of Physics. Explain various concepts in Newtonian mechanics.	1, 2
	CLO2	Explain numerous concepts related with wave and oscillations.	1, 2, 7
	CLO3	Apply fluid theories in related problem	1, 2
	CLO4	Illustrate modern physics in numerous ways.	1, 6, 8
	CLO5	Analyze and explain the components of kinetic theory of gases	1, 2, 6
	CLO6	Interpret basics concepts of heat and thermodynamics.	1, 6, 8
	CLO7	Apply the concepts of theories in different phenomenon of geometrical optics.	1, 6, 8
	CLO8	Approach and solve new problems in a range of advanced topics in electronics.	1, 2, 6

Mapping CLOs with the Teaching-Learning and Assessment Strategy

CLOs	Teaching-Learning Strategy	Assessment Strategy
CLO1	Lecture	Class Test
CLO2	Lecture	Assignment
CLO3	Lecture and Group Discussion	Assignment
CLO4	Audio-visual Lecture and Group Discussion	Class Test
CLO5	Lecture	Class Test
CLO6	Audio-visual Lecture and Group Discussion	Class Test
CLO7	Audio-visual Lecture	Class Test
CLO8	Audio-visual Lecture	Class Test

Learning Materials

Recommended Readings	Mathur, D.S., 1962. Elements of properties of matter. S. Chand and Company. Mehta, V.K. and Mehta, R., 2014. Principles of electronics. S. Chand and Company. Brij Lal and Subrahmany, N., 2001. Heat and Thermodynamics. S. Chand and Company. Subrahmany, N. and Brij Lal, 2001. Text book of optics. S. Chand and Company.

Course Code: 0533 06 Phy 1254		Year: First	Term: Second
Course Title	Physics Sessional		
Course Status	Optional		
Credit	1.0		
Prerequisite(s)	None		
Rationale	This course is to introduce one to the proper methods for conducting controlled physics experiments, including the acquisition, analysis and physical interpretation of data. The course involves experiments which illustrate the principles of mechanics. In this course students will learn to operate Searle's apparatus, fly wheel, compound pendulum, capillary tube, flat spiral spring etc and will be able to manage various sensitive instruments safely. They will able to have a practical experience in dealing experiments of Physics and develop them with their theoretical ideas.		

	Course Contents/Tasks	CLOs
1	Familiarization of Vernier calipers and screw gauge and hence determine the volume of solid sphere and measure inner diameter, depth of hollow cylinder.	1
2	Determination of the Young's modulus and rigidity modulus of a short wire by Searle's dynamic method.	2
3	Determination of the modulus of rigidity of a wire by statical method.	3
4	Determination of the value of 'g', acceleration due to gravity, by means of a compound pendulum.	4
5	Determination of the surface tension of water by capillary tube method.	5
6	Verification of the laws of transverse vibration of a stretched string using sonometer.	6
7	Determination of the velocity of sound in air by resonance column method.	7
8	Determination of focal length of a convex mirror using convex lens.	8
9	Determination of resistance per cm of a wire by plotting a graph of potential difference versus	9

	Upon successful completion of the course, the students will be able to:		Mapping with PLOs
Course Learning Outcomes (CLOs)	CLO1	Determine volume and cross sectional area of various materials.	1, 2
	CLO2	Determine the Young's modulus & rigidity modulus of a short wire by Searle's dynamic method.	1, 2
	CLO3	Determine the modulus of rigidity of a wire by statical method.	1, 2
	CLO4	Determine the value of 'g', acceleration due to gravity, by means of a compound pendulum.	1, 7, 8
	CLO5	Observe the surface tension of water and any other liquid by capillary tube method.	1, 2, 6, 8
	CLO6	Measure the spring constant and effective mass of a given spiral spring and hence will be able to calculate the rigidity modulus of the material of the spring.	1, 6, 8
	CLO7	Determine the Young's modulus by flexure of a beam.	1, 6, 8
	CLO8	Determine the length of convex and concave lens	1, 2, 6
	CLO9	Determine the resistance of wire	6, 8

Mapping CLOs with the Teaching-Learning and Assessment Strategy

CLOs	Teaching-Learning Strategy	Assessment Strategy
CLO1	Lecture and Lab work	Lab Report
CLO2	Lecture and Lab work	Lab Report
CLO3	Lecture and Lab work	Lab Report
CLO4	Lecture and Lab work	Class Test and Lab Report
CLO5	Lecture and Lab work	Lab Report
CLO6	Lecture and Lab work	Lab Report
CLO7	Lecture and Lab work	Lab Report
CLO8	Lecture and Lab work	Lab Report
CLO9	Lecture and Lab work	Final Test and Lab Report

Learning Materials

Recommended Readings	Mathur, D.S., 1962. Elements of properties of matter. S. Chand and Company. Mehta, V.K. and Mehta, R., 2014. Principles of electronics. S. Chand and Company. Brij Lal and Subrahmany, N., 2001. Heat and Thermodynamics. S. Chand and Company.
Supplementary Readings	Subrahmany, N. and Brij Lal, 2001. Text book of optics. S. Chand and Company.

Second Year First Term			
Course Code: 0831 06 FMRT 2101		Year: Second	Term: First
Course Title	Fisheries Microbiology		
Course Status	Core		
Credit	3.0		
Prerequisite(s)	None		
Rationale	This course is designed to provide information on microbial groups and their major characteristics, their growth, metabolic activity and control of their growth. This course will help the student to know food borne infections/diseases related to fish and fisheries product. They will also learn on microorganisms associated with fish and aquatic system, fish spoilage and its associated problems, and different advanced technology associated with microbial management.		

Course Contents		CLOs
	Section A	
1	Introduction: Definitions, scope, history and importance of studying microbiology; Overview of branches: bacteriology, virology, mycology, phycology, protozoology; Major characteristics of microorganisms, nomenclature and classification of microorganisms, concept of size units and size relationships;	1
2	Functional anatomy of prokaryotes and eukaryotes: Comparison among prokaryotes and eukaryotes; Basic structural features of prokaryotes and eukaryotes: size, shape, spore, flagella, pili, cell wall, cell membrane, nucleic acid, plasmid etc.	1
3	Microbial growth and cultivation: Concept of microbial growth, factors affecting microbial growth; phases of growth; laboratory cultures: pure, streak; growth media; measurements of microbial growth; quantifying microorganism;	2
4	Control of microbial growth: Key concepts of physical, chemical means, antibiotics and alternatives to antibiotics to control the growth of microbes;	2
5	Important microorganisms in fish and water: Microbial community associated with aquatic environment, fish and aquaculture, role and function of beneficial microorganisms in aquatic ecosystem, microorganisms for sustainable aquaculture development;	1, 5
	Section B	CLOs
6	Microbial metabolism: Concept, classification, metabolic diversity among organisms, metabolic pathways of energy production and use, heterotrophic and autotrophic bacterial metabolism;	4
7	Food borne diseases: Concept of 'food infection' and 'food intoxication'; food borne diseases caused by Staphylococcus aureus, Clostridium botulinum, E. coli, Vibrio cholera, Salmonella, Shigella etc.	3
8	Microbes in fish spoilage: Basic concept of fish spoilage, specific spoilage bacteria, evidence of spoiled fish, role of microbes in fish spoilage, types of microbes involved, major deteriorative changes in fishery products, factors for accelerating fish spoilage and ways for delaying/stopping fish spoilage; effect of different preservation methods on fish microflora;	6
9	Microbial community management: Probiotics and prebiotics, use and strains of probiotic in aquaculture, methods to select probiotic bacteria for use in the aquaculture, quorum sensing, r/k selection, biofloc technology.	6

Course Learning Outcomes (CLOs)	Upon successful completion of the course, the students will be able to:		Mapping with PLOs
	CLO1	Discuss the basic concepts of microbes, their branches, classification, groups, scope and importance, prokaryotes and eukaryotes.	1
	CLO2	Get clear concept about size of various microbes, their growth, factors affecting growth, and control of microbial growth.	1, 2, 3, 7
	CLO3	Describe various food borne human diseases that are relevant to fish and fishery products.	1, 2
	CLO4	Explain the metabolic pathways of major bacterial group available in fish and aquatic environment.	1, 2
	CLO5	Identify important microorganisms found in fish and aquatic system.	1, 2
	CLO6	Describe the mechanisms of microbial spoilage in fish and its control, advanced technology associated with microbial community management.	1, 2, 3, 4, 7

Mapping CLOs with the Teaching-Learning and Assessment Strategy

CLOs	Teaching-Learning Strategy	Assessment Strategy
CLO1	Lecture	Class test, final exam
CLO2	Lecture	Class test, final exam
CLO3	Lecture	Class test, final exam
CLO4	Lecture	Class test, final exam
CLO5	Lecture	Class test, final exam
CLO6	Lecture, problem based learning	Presentation, assignment, final exam

Learning Materials

Recommended Readings	Talaro, K. and Talaro, A.. 1994. Foundations in Microbiology. WCB Publishers. USA Atlas, R.M., 1994. Principles of Microbiology. Mosby Publishers, Vonhoffmann Press, USA
Supplementary Readings	Alcamo, I.E. and Warner, J.M., 2010. Schaum's Outline of Microbiology (Second Edition), McGraw- Hill, New York. Betsy, T. and Keogh, J., 2005. Microbiology Demystified. McGraw- Hill, New York.

Course Code: 0831 06 FMRT 2102		Year: Second	Term: First
Course Title	Fisheries Microbiology Sessional and Field Work		
Course Status	Core		
Credit	1.0		
Prerequisite(s)	None		
Rationale	This course is designed to provide the practical knowledge and skill necessary to understand the microbes, microscopy and culture of microbes. This course will also help the student to enumerate and isolate different microbial groups from fish & fishery products and aquatic systems.		

	Course Contents/Tasks	CLOs
1	Guidelines for using microbiological laboratory, Instruments used in study of Microbiology.	1
2	Study of different types of microscopes: principles and operation.	1
3	Study of sterilization techniques: moist heat and dry heat	1
4	Study of culture media: ingredients, types and preparation of culture media.	2
5	Culture of microorganisms: broth culture pours culture, spread-plate culture, streak-plate culture, stab culture, shake culture.	2
6	Isolation and identification of bacteria: morphological, biochemical and serological study.	3, 4
7	Quantitative estimation of bacteria: consecutive decimal dilution technique and most probable number method.	3, 4
8	Microscopic observation of bacteria: Gram's stain, spore stain, flagella stain,	3, 4
9	Field visit and sample collection from fish landing centers, fish market, processing plants and fish product stores and analysis of bacteriological quality.	2, 3, 4

	Upon successful completion of the course, the students will be able to:		Mapping with PLOs
Course Learning Outcomes (CLOs)	CLO1	Operate different scientific equipments required to conduct microbial test in laboratory.	1, 3
	CLO2	Prepare and process field samples and culture media.	1, 3
	CLO3	Enumerate bacteria from various fishery products and aquatic systems independently.	3, 2
	CLO4	Isolate and Characterize major bacterial group available in fish and culture water	3, 4, 8

Mapping CLOs with the Teaching-Learning and Assessment Strategy

CLOs	Teaching-Learning Strategy	Assessment Strategy
CLO1	Lecture and demonstration	Quiz and viva
CLO2	Demonstration	Viva
CLO3	Field visit, demonstration	Lab test and viva
CLO4	Demonstration	Assignment and viva

Learning Materials

Recommended Readings	Cowan, M. Kelly. Microbiology : a systems approach / Marjorie Kelly Cowan. — 3rd ed. Benson: Microbiological Applications Lab Manual, Eighth Edition The McGraw–Hill Companies, 2001
Supplementary Readings	Heritage, J, Evans, E.G.V. and Killington, A. (1996). Introductory Microbiology, Cambridge University, New York.

Course Code: 0831 06 FMRT 2103		Year: Second	Term: First
Course Title	Fish Physiology		
Course Status	Core		
Credit	3.0		
Prerequisite(s)	None		
Rationale	This course is designed to provide information regarding fish biology and physiology. The focus of the course is to deliver several lectures in order to teach the students about different organs of fishes, their activities, various factors that influence these functions.		

Course Contents		CLOs
	Section A	
1	Introduction: central themes in animals/ fish physiology	1, 2
2	Digestion: Definition, fish digestive tracts, accessory digestive organs, gastrointestinal secretions and their functions.	1, 2
3	Growth in fish: Definition and measurement of growth, factors affecting growth in fish, hormonal control of fish growth, manipulation of fish growth.	1, 3
4	Membrane, channel and transport: cell membrane, fluid mosaic model, channels, transmembrane transport.	1
5	Swimming and locomotion: Forces affecting movement in fish, body shape in fish.	1, 4
6	Sensory organs: Visual, chemosensory, acoustics, lateral system.	1, 5
7	Role of hormones in fish physiology: Modern concepts of hormones, types of hormone, roles of hormone, endocrine glands.	1, 6
	Section B	CLOs
8	Gas exchange: Basic concept of respiration, respiratory organs, structure and function of gills, mechanism of respiration.	1, 7
9	Blood: Blood, function, tissue fluids, fish blood circulation and blood passing organs, controlling body temperature.	1, 8
10	Osmoregulation: Definition and types of osmoregulatory fish, osmoregulation in catadromous, anadromous and diadromous fish, endocrine control of osmoregulation.	1, 9
11	Reproduction: Reproduction, types of reproduction, concept of mode of reproduction, parental care, gamete developments, gross anatomical annual reproductive cycle, hormonal control of reproduction	1, 10

	Upon successful completion of the course, the students will be able to:		Mapping with PLOs
Course Learning Outcomes (CLOs)	CLO1	Illustrate various aspects of fish physiology, scopes of this course.	1, 2, 7
	CLO2	Develop knowledge on digestion, absorption and assimilation, digestive system in fishes, digestive organs involved in fish digestion, digestive enzymes and their roles.	1, 2, 7
	CLO3	State what is growth, why is it different in fishes than mammals, how to measure and influencing variables, growth hormones and their functions, etc.	1, 2
	CLO4	Write swimming and locomotory mechanisms of fishes facilitated by their body shapes.	1, 2
	CLO5	State different sensory mechanisms of fish	1, 2, 7
	CLO6	Develop knowledge on hormonal control of the physiological activities of fishes	1, 2, 7
	CLO7	Discuss about structure and functions of fish gills, its involvement in gas exchange mechanism.	1, 2, 7
	CLO8	Explain blood, blood cells, blood circulation systems, and micro-circulation, how are body temperature.	1, 2, 3
	CLO9	Acquire knowledge on osmoregulation and other associated biological functions, types of osmoregulators depending on migrations, and osmoregulation controlling hormones in fishes	1, 2, 3
	CLO10	Acquire clear concept on fish reproduction.	1, 2, 3

Mapping CLOs with the Teaching-Learning and Assessment Strategy

CLOs	Teaching-Learning Strategy	Assessment Strategy
CLO1	Lecture	Quiz
CLO2	Lecture	Assignment
CLO3	Lecture	Class test
CLO4	Lecture	Quiz
CLO5	Lecture	Quiz
CLO6	Lecture	Class test
CLO7	Lecture	Class test
CLO8	Lecture	Assignment
CLO9	Lecture	Final Exam
CLO10	Lecture	Final Exam

Learning Materials

Recommended Readings	Lagler, K.F., 1950. Studies in freshwater fishery biology (3rd rev. Ed.). Michigan, J.W. Smith, L.S., 1990. Introduction to fish physiology. Narendra Publishing House, New Delhi.
Supplementary Readings	Kyle, H.M., 1995. The Biology of Fishes. Rishabh Publishers & Distributors. Nielsen, K.S., 1990. Animal Physicology (Fourth edition). Press syndicate of the University of Cambridge, Cambridge CB2 1RP, UK.

Course Code: 0831 06 FMRT 2104		Year: Second	Term: First
Course Title	Fish Physiology Sessional		
Course Status	Core		
Credit	1.0		
Prerequisite(s)	None		
Rationale	This course is designed to provide information regarding fish biology and physiology. The focus of the course is to deliver several lectures in order to teach the students about different organs of fishes, their functions, various factors that influence these functions.		

	Course Contents/Tasks	CLOs
1	Determine fish growth using scales, otolith and other organs.	1
2	Examination of fine structure of fish gills.	2
3	Collection of fish blood and preparation to examine of blood cells (RBC, WBC) and counting.	3
4	Determination of oxygen consumption rate, CO_2 released, ammonia excreted by fish.	4
5	Determination of effect of salinity change on fish collected from different culture area.	4

	Upon successful completion of the course, the students will be able to:		Mapping with PLOs
Course Learning Outcomes (CLOs)	CLO1	Demonstrate how to collect, preserve and prepare different structures to measure fish growth.	1, 2, 6
	CLO2	See the elements in fish gills, examine each part and associated organs, etc.	1, 2, 6
	CLO3	Recognize fish heart, which organs involved during fish blood circulation, blood cells examination and counts, etc.	1, 6
	CLO4	Acquire practical knowledge on measuring dissolved oxygen, CO_2, ammonia, salinity from tank of consumed after a certain time or activities, etc.	1, 2, 6

Mapping CLOs with the Teaching-Learning and Assessment Strategy

CLOs	Teaching-Learning Strategy	Assessment Strategy
CLO1	Lecture, demonstration	laboratory assessment, assignment
CLO2	Lecture, demonstration	laboratory assessment, assignment
CLO3	Lecture, demonstration	laboratory assessment, assignment class test, quiz, viva
CLO4	Lecture, demonstration	laboratory assessment, assignment class test, quiz, viva

Learning Materials

Recommended Readings	Lagler, K.F., 1950. Studies in freshwater fishery biology (3rd rev. ed.). Michigan, J.W. Smith, L.S., 1990. Introduction to fish physiology. Narendra Publishing House, New Delhi. M. Sharma and P, Mishra, 2014. Finfish and shellfish Physiology Practical manual, edited by G. Pandey. Int. E- Publication. India.
Supplementary Readings	Nielsen, K.S., 1990. Animal Physiology (Fourth edition). Press syndicate of the University of Cambridge, Cambridge CB2 1RP, UK. Lagler, K.F., Bardach, J.E., Miller, R.R. and Passino, D.R., M. 1977. Ichthyology. John Wiley & Sons Inc.

Course Code: 0831 06 FMRT 2105		Year: Second	Term: First
Course Title	Fish Nutrition and Feed Formulation		
Course Status	Core		
Credit	3.0		
Prerequisite(s)	None		
Rationale	The course intends to provide students an understanding of the nutritional requirements of fish. It will give ideas on the feed ingredient selection and diet formulation and manufacturing for different fish, shellfish and other aquatic species. Globally this course will endow students with the fundamental basis of nutritional science and innovative ideas in fish feed formulation and production.		

Course Contents		CLOs
Section A		
1	Introduction: background, terminologies and scopes;	1, 2
2	Type of food and feed: natural and artificial, feed ingredients, its type and source, nutrition and other components of feedstuffs;	2
3	Nutritional energetic: components, energy flow, energy partitioning, factors influencing energy requirements, nutritional requirements, lack of essential nutrients;	3
4	Feed additives: nutritional supplements, anti-nutritional agents.	3
Section B		CLOs
5	Feed type and form: dry, wet, compound feed, pellet, extruded, sinking, floating;	2, 4
6	Feed formulation: ingredient selection, composition, formulation;	4
7	Feed production: manufacturing, storage, distribution and record keeping;	5
8	Feed testing: FCR, PER, NPU, digestibility etc.	6

	Upon successful completion of the course, the students will be able to:		Mapping with PLOs
Course Learning Outcomes (CLOs)	CLO1	Understand the basic terminologies, background and scopes of fish nutrition;	1, 2
	CLO2	Recognize the source of nutrients and its potentiality to use;	2, 3, 4
	CLO3	Describe the dynamics of energy flow in fish; feed additive selection and mechanism of anti-nutritional factors in fish feed;	1, 2, 7
	CLO4	Select different feed ingredient for compound feed preparation;	3, 4, 8
	CLO5	Formulate fish feed, and understand feed production and record keeping;	1, 5, 6, 8, 9
	CLO6	Calculate testing biological value of different diet and ingredients.	1, 2, 3, 4, 9

Mapping CLOs with the Teaching-Learning and Assessment Strategy

CLOs	Teaching-Learning Strategy	Assessment Strategy
CLO1	Lecture	Quiz
CLO2	Lecture, Enquiry based learning, video tape	Assignment
CLO3	Lecture and Group Discussion	Class test
CLO4	Lecture, group-topic presentation	Quiz, group discussion responses
CLO5	Lecture and video tape	Quiz
CLO6	Lecture, problem based learning, case study	Quiz and class test

Learning Materials

Recommended Readings	Halver, J.E. (ed.), 1989. Fish Nutrition (2nd Ed.). Academic Press Inc. Halver, J.E. (ed.), 2002. Fish Nutrition (3rd Ed.). Academic Press. New, M.B., 1987. Feed and Feeding of Fish and Shrimp. Aquaculture Development and Coordination Programme, ADCP/REP/87/26. UNDP-FAO.
Supplementary Readings	NRC (National Research Council), 1993. Nutrient Requirements of Fish. National Academy Press. Hepher, B., 1990. Nutrition of Pond Fishes. Cambridge University Press.

Course Code: 0831 06 FMRT 2106	Year: Second	Term: First
Course Title	Fish Nutrition and Feed Formulation Sessional and Field Work	
Course Status	Core	
Credit	1.0	
Prerequisite(s)	None	
Rationale	The course aims to develop practical skills of the students to analyze the nutrient composition of different feed ingredients to formulate and manufacturing of feed for different fish species. It also intends to provide ideas the students how to test some biological values of feed and ingredients.	

	Course Contents/Tasks	CLOs
1	Proximate composition analysis: protein, lipid, ash, moisture, fiber and NFE of different feed and ingredients;	1
2	Feed development: formulation, preparation of diets;	1, 2
3	Testing: biological value of feed and ingredients viz. nutrient digestibility and feed digestibility.	3

	Upon successful completion of the course, the students will be able to:		Mapping with PLOs
Course Learning Outcomes (CLOs)	CLO1	Analyze the proximate composition of feed and ingredients;	1, 2
	CLO2	Formulate and manufacture diet for fish, shellfish and other aquatic species;	3, 4, 5, 7, 8
	CLO3	Estimate the biological value of feed and ingredients;	9

Mapping CLOs with the Teaching-Learning and Assessment Strategy

CLOs	Teaching-Learning Strategy	Assessment Strategy
CLO1	Laboratory demonstration and analytical works	Assignment, lab report
CLO2	Laboratory demonstration, field visit, group discussion	Practical book assessment, Quiz, Viva, lab report
CLO3	Laboratory demonstration and analytical works; enquiry based learning	Quiz, Viva

Learning Materials

Recommended Readings	Halver, J.E. (ed.), 1989. Fish Nutrition (2nd Ed.). Academic Press Inc. Halver, J.E. (ed.), 2002. Fish Nutrition (3rd Ed.). Academic Press. New, M.B., 1987. Feed and Feeding of Fish and Shrimp. Aquaculture Development and Coordination Programme, ADCP/REP/87/26. UNDP-FAO.
Supplementary Readings	NRC (National Research Council), 1993. Nutrient Requirements of Fish. National Academy Press. Hepher, B., 1990. Nutrition of Pond Fishes. Cambridge University Press

Course Code: 0831 06 FMRT 2107	Year: Second	Term: First
Course Title	Shellfish Biology	
Course Status	Core	
Credit	3.0	
Prerequisite(s)	None	
Rationale	This course is designed to disseminate information about various biological aspects of shellfish belongs to family arthropoda and mollasca.	

	Course Contents	CLOs
	Section A	
1	Penaeid shrimps: Taxonomy, identifying characters, morphology, distribution, food and feeding habit, maturation, reproductive biology, recruitment, digestive system and migration.	1
2	Carridae shrimps: Taxonomy, identifying characters, morphology, distribution, food and feeding habit, maturation, reproductive biology, recruitment, digestive system and migration.	2
	Section B	CLOs
3	Lobster: Taxonomy, identifying characters, morphology, reproductive biology, distribution and production techniques.	3
4	Crab: Taxonomy, identifying characters, morphology, reproductive biology, distribution and production techniques.	4
5	Oyster: Taxonomy, identifying characters, morphology, reproductive biology, distribution and production techniques.	5
6	Mussel: Taxonomy, identifying characters, morphology, reproductive biology, distribution and production techniques.	6
7	Abalone: Taxonomy, identifying characters, morphology, reproductive biology, distribution and production techniques.	7
8	Turtle: Taxonomy, identifying characters, morphology, reproductive biology, distribution and production techniques.	8

	Upon successful completion of the course, the students will be able to:		Mapping with PLOs
Course Learning Outcomes (CLOs)	CLO1	Describe the biology of penaeid Shrimp.	1, 2, 7
	CLO2	Describe the biology of carridae Shrimp.	1, 2, 7
	CLO3	Describe the basic biology of Lobster.	1, 2, 7
	CLO4	Describe the basic biology of crab.	1, 2, 7
	CLO5	Describe the basic biology of Oyster.	1, 2, 7
	CLO6	Describe the basic biology of Mussel.	1, 2, 7
	CLO7	Describe the basic biology of Abalone.	1, 2, 7
	CLO8	Describe the basic biology of Turtle.	1, 2, 7

Mapping CLOs with the Teaching-Learning and Assessment Strategy

CLOs	Teaching-Learning Strategy	Assessment Strategy
CLO1	Lecture and Group discussion	Quiz
CLO2	Lecture, Group discussion and video tape	Assignment
CLO3	Lecture and Group discussion	Class test
CLO4	Lecture and Group discussion	Quiz
CLO5	Lecture and Group discussion	Quiz
CLO6	Lecture, Group discussion and video tape	Presentation
CLO7	Lecture and Group discussion	Assignment
CLO8	Lecture and Group discussion	Final examination

Learning Materials

Recommended Readings	Jhingran, V.G., 1988. Fish and fisheries of India. Hindustan publishing corporaration, Delhi. Islam, M.A., 1987. MacherparibeshTathya. Bangla Academy, Dhaka.
Supplementary Readings	Lagler, K.F., 1952. Freshwater fisheries biology. IOWA press INC., USA. Kurian, C.V. and Sebastin, V.O., 1999. Prawn and prawn fisheries of India.

Course Code: 0831 06 FMRT 2108		Year: Second	Term: First
Course Title	Shellfish Biology Sessional and Field Work		
Course Status	Core		
Credit	1.0		
Prerequisite(s)	None		
Rationale	This course is designed to disseminate practical information about various biological aspects of shellfish belongs to family arthropoda and mollasca.		

	Course Contents/Tasks	CLOs
1	Study of external features and appendages of penaeid and carridae shrimp.	1
2	Study of external features and appendages of lobster, crab, oyster, mussel, abalone and turtle.	2
3	Study of digestive, reproductive and nervous system of penaeid and carridae shrimp.	3
4	Study of digestive, reproductive and nervous system of lobster, crab, oyster, mussel and abalone.	4
5	Prepare poster of different group of shellfish.	5

	Upon successful completion of the course, the students will be able to:		Mapping with PLOs
Course Learning Outcomes (CLOs)	CLO1	Gain practical knowledge about penaeid and carridae Shrimp.	1, 3
	CLO2	Gain practical knowledge about lobster, crab, oyster, mussel, abalone and turtle.	1, 3
	CLO3	Gain practical knowledge about digestive, reproductive and nervous system of penaeid and carridae shrimp.	1, 3
	CLO4	Gain practical knowledge about digestive, reproductive and nervous system of lobster, crab, oyster, mussel, abalone and turtle.	1, 3
	CLO5	Identify different morphological and anatomical features of arthropoda and mollasca.	1

Mapping CLOs with the Teaching-Learning and Assessment Strategy

CLOs	Teaching-Learning Strategy	Assessment Strategy
CLO1	Field visit	Assignment, presentation
CLO2	Lecture, Video	Practical book assessment, Quiz, Viva
CLO3	Field visit, Lecture	Quiz, Assessment
CLO4	Field visit, Lecture	Quiz, Assessment
CLO5	Field visit, Lecture	Quiz, Assessment

Learning Materials

Recommended Readings	Jhingran, V.G., 1988. Fish and fisheries of India. Hindustan publishing corporaration, Delhi. Islam, M.A., 1987. MacherparibeshTathya. Bangla Academy, Dhaka.
Supplementary Readings	Lagler, K.F., 1952. Freshwater fisheries biology. IOWA press INC., USA. Kurian, C.V. and Sebastin, V.O., 1999. Prawn and prawn fisheries of India.

Course Code: 0831 06 FMRT 2109		Year: Second	Term: First
Course Title	Fundamentals of Aquaculture		
Course Status	Core		
Credit	3.0		
Prerequisite(s)	None		
Rationale	This course imparts knowledge and background information that would enable students understands the history and evolution of aquaculture as a practice and its refinement as knowledge evolved.		

Course Contents		CLOs
Section A		
1	Introduction: Important definitions, aims and scopes of aquaculture; Origin and growth of aquaculture. Global and national context of aquaculture. Institutional and organizational set ups partnering to aquaculture sector in Bangladesh.	1
2	Aquaculture types and techniques: Scope and definition; Cultural, socio-economic, biological and technological aspects of aquaculture techniques. Monoculture, polyculture and integrated aquaculture; Pond culture, pen culture, cage culture, running water culture etc. Extensive, semi-intensive and intensive aquaculture.	2
3	Site selection: Factors to be considered for the selection of suitable culture technique. Site characteristics of an ideal aqua farm. Site selection criteria and the factors that govern them.	3
4	Species selection: Biological characteristics of aquaculture species; Economic and market considerations. Criteria for selection of candidate species for aquaculture.	4
Section B		CLOs
5	Capture vs Culture: Freshwater, brackish and marine water areas of Bangladesh. Global and national trends of wild capture vs aquaculture; Exploration and exploitation of fish and other biotic resources of Bangladesh.	5
6	Major Aquaculture Species: Introduction to major aquaculture species: finfish and shellfish. Exotic species: opportunities and threat. Introduction to non-conventional emerging aquaculture species: mud crab, sea weeds, ornamental fish etc.	6
7	Prestocking management: Pond preparation: dikes, drying, dewatering, bottom conditioning. Eradication and control of aquatic weeds and algae; Eradication of unwanted fish; Eradication of predatory insects. Fertilization of ponds. Stocking of nursery/grow-out ponds: species ratio, stocking density; Husbandry prior to stocking; Fry transportation; Time and methods of stocking	7
8	Post-stocking management: Feeding; Periodic fertilization. Understanding and maintaining water quality: Variables to measure periodically (temperature, dissolved oxygen, pH, ammonia, nitrite, salinity), Other factors (water color, turbidity). Test harvesting, final harvesting and handling, record keeping.	8

Course Learning Outcomes (CLOs)	Upon successful completion of the course, the students will be able to:		Mapping with PLOs
	CLO1	Write the history and development of aquaculture in the world and its contribution to the economic development of Bangladesh	1, 2
	CLO2	State different aquaculture types and techniques based on what is to be cultured and the management regimes being used	1, 2, 8
	CLO3	Describe the ideal characteristics of an aquaculture farm and the factors that need to be considered in selecting a suitable site for aquaculture	1, 2, 3, 4
	CLO4	Describe the biological, economic and market considerations in selecting a suitable species for aquaculture	1, 2, 4, 6
	CLO5	Comprehend the role of aquaculture towards total fish production of the world and the country.	1, 2
	CLO6	Categorize the major fish, shrimp and other aquatic species of commercial importance with special emphasis on the merits and demerits of introduced species	2, 3, 5,7
	CLO7	Describe the basic steps involved in preparation of a farm suitable for aquaculture	1, 3
	CLO8	Describe the basic steps involved in maintaining fish growth until final harvest through following appropriate management criteria.	1, 5

Mapping CLOs with the Teaching-Learning and Assessment Strategy

CLOs	Teaching-Learning Strategy	Assessment Strategy
CLO1	Lecture and Group Discussion	Quiz
CLO2	Lecture, Video Tape and Seminar	Assignment
CLO3	Lecture, Video Tape and Group Discussion	Class test
CLO4	Lecture, Video Tape and Enquiry based learning	Quiz
CLO5	Lecture, Discussion and Seminar	Written Exam
CLO6	Lecture, Group Discussion and Case Study	Assignment
CLO7	Lecture and Group Discussion	Presentation
CLO8	Lecture, Case Study and Group Discussion	Assignment, Final Exam

Learning Materials

Recommended Readings	Bardach, J.E., Ryther, J.H. and Mclarney, W.O., 1972. Aquaculture (pp.868). John willey & Sons Inc., New York. Jhingran, V.G., 1991. Fish and Fisheries in India (3rd Edition) (pp.727). Hindustan Publishing, Delhi. Pillay, T.V.R., 1990. Aquaculture Principles and Practices (pp.575). Fishing News Books, University Press.
Supplementary Readings	Huet, M., 1979. Textbook of Fish Culture: Breeding and Cultivation of Fish. Fishing News Books Ltd. Landau, M., 1992. Introduction to Aquaculture. John Wiley & Sons Inc.

Course Code: 0831 06 FMRT 2110	Year: Second	Term: First
Course Title	Fundamentals of Aquaculture Sessional and Field Work	
Course Status	Core	
Credit	1.0	
Prerequisite(s)	None	
Rationale	The course is designed to provide knowledge and background information that would enable students of aquaculture as a practice and its refinement as knowledge evolved.	

	Course Contents/Tasks	CLOs
1	Site observation and feasibility study for aquaculture.	1, 2
2	Designing for different types of farms and hatcheries.	1, 3
3	Economical estimation in selecting suitable species for aquaculture.	1, 2, 3
4	Preparation of checklist and photographic album of cultivable species.	1, 3

	Upon successful completion of the course, the students will be able to:		Mapping with PLOs
Course Learning Outcomes (CLOs)	CLO1	Observe different culture systems of different marine and freshwater fishes of Bangladesh	1, 2, 4, 8, 9
	CLO2	Design different types of farms and hatcheries.	3, 4, 7, 8, 9
	CLO3	Estimate suitable species for culture	3, 5, 7,

Mapping CLOs with the Teaching-Learning and Assessment Strategy

CLOs	Teaching-Learning Strategy	Assessment Strategy
CLO1	Field visit, video tape, cooperative learning	Assignment, presentation
CLO2	Workshop, Demonstration, enquiry based learning	Practical book assessment, Quiz, Viva
CLO3	Field visit, Demonstration	Final Exam

Learning Materials

Recommended Readings	Huet, M., 1979. Textbook of Fish Culture: Breeding and Cultivation of Fish. Fishing News Books Ltd. Landau, M., 1992. Introduction to Aquaculture. John Wiley & Sons Inc.

Course Code: 0831 06 FMRT 2111		Year: Second	Term: First
Course Title	Fisheries Systematics and Evolution		
Course Status	Optional		
Credit	2.0		
Prerequisite(s)	None		
Rationale	Systematics being dealt with classification and being cornerstone of growth and understanding of biology as a whole, the course is designed to provide the students an understanding about the theoretical basis and methods and principles of biological systematics and classification. The course will also highlight the evolutionary paradigm and relationship among different groups of organisms.		

Course Contents		CLOs
	Section A	
1	Introduction: General principles and history of systematics and evolution, and scope; relations with and contribution to other branches of biology.	1
2	Taxonomic Characters: Taxonomic characters in fishes, criteria for taxonomic categories as applied in ichthyology.	1, 2, 3
3	Methods and techniques of classifying fishes: Methods and techniques of classification and external morphology of fishes with special reference to commercially important groups.	1, 2, 3
4	Theories and patterns of organic evolution: The process and patterns of evolution in fishes; evolution at the molecular level, natural selection.	4
	Section B	CLOs
5	Methods and techniques of classifying crustaceans: Methods and techniques of classification and external morphology of crustaceans with reference of commercially important groups.	1, 2, 5
6	Species concept and speciation: Different concepts, isolation mechanisms, speciation, population systematics, allopatry-sympatry, polytypic species and infra-specific categories.	1, 6
7	Phylogeny: Concepts, history, cladistics, missing link in taxonomic lineage, phylogenetic tree.	1, 7
8	Zoological nomenclature: Law of priority, synonyms, homonyms, types and type method, zoogeography of fishes.	8

	Upon successful completion of the course, the students will be able to:		Mapping with PLOs
Course Learning Outcomes (CLOs)	CLO1	Write basic and overview of the subject with history, scope and relation and contributions to other branches of biology	1, 2
	CLO2	State Taxonomic character, categories and hierarchy of the categories	1, 2
	CLO3	Describe methods and techniques of classification of fishes with external morphology	1, 2, 3, 7
	CLO4	Discuss organic evolution in fishes, evolution in molecular level and natural selection.	1, 2
	CLO5	Discuss the methods and techniques of classification of crustaceans with external morphology.	1, 2, 3, 4
	CLO6	State species concept and species isolating mechanisms, sympatry-allopatry in populations.	1, 2
	CLO7	Write the history and concept of phylogeny.	1, 2
	CLO8	Describe ICZN laws and zoogeography of fishes	5, 6

Mapping CLOs with the Teaching-Learning and Assessment Strategy		
CLOs	Teaching-Learning Strategy	Assessment Strategy
CLO1	Lecture	Quiz
CLO2	Lecture and Group Discussion	Assignment
CLO3	Lecture, Video Tape and Group Discussion	Class test
CLO4	Lecture and Enquiry based learning	Quiz
CLO5	Lecture, Video Tape and Co-operative Learning	Written Exam
CLO6	Lecture and Case Study	Assignment
CLO7	Lecture and Group Discussion	Presentation
CLO8	Lecture, Case Study and Group Discussion	Final Exam

Learning Materials

Recommended Readings	Mayr, E. and Ashlock, P.D., 1992. Principles of Systematic Zoology (2nd edition) (pp.416). McGraw Hill College. Mayr, E., 1966. Animal Species and Evolution. Verma, P.S. and Agarwal V.K., 2004. Cell Biology, Genetics, Molecular Biology, Evolution and Ecology. S. Chand & Company PVT. LTD. Hillis, D.M., Morizot, C. and Mable, B.K.(Eds.), 1996. Molecular Systematics. Sinauer Associates, Inc. Jordan, D.S., 1963. The Genera of Fishes and Classification of Fishes. Stanford University Press.
Supplementary Readings	Mayr, E., 1966. Animal Species and Evolution. Misra, K.S., 1962. An Aid to the Identification of the Common Commercial Fishes of India and Pakistan. In Rec. Indian Mus. (volume 57), pp.1-320

Course Code: 0831 06 FMRT 2112	Year: Second	Term: First
Course Title	Fisheries Systematics and Evolution Sessional and Field Work	
Course Status	Optional	
Credit	1.0	
Prerequisite(s)	None	
Rationale	The course is designed to provide knowledge on the collection, identification of commercially important fishes and non-fishes specimen.	

	Course Contents/Tasks	CLOs
1	Collection of fish samples and species identification: Collection and identification of commercially important freshwater and marine fishes of Bangladesh. Study of their morphology and classification. Identification of preserved specimens of fishes.	1
2	Identification of crustaceans and mollusks: Collection and identification of crustaceans and mollusks of commercially important groups.	2
3	Preparing Checklist: Preparation and study of checklist of marine and freshwater fishes of Bangladesh and the region – SARRC countries.	3

	Upon successful completion of the course, the students will be able to:		Mapping with PLOs
Course Learning Outcomes (CLOs)	CLO1	Collect and identify marine and freshwater fishes of Bangladesh, identify preserved specimen in the laboratory	3, 4, 7, 8
	CLO2	Collect and identify commercially important crustaceans and mollusks	3, 4, 7, 8
	CLO3	Prepare checklist for important fishes in SARRC countries	6, 9

Mapping CLOs with the Teaching-Learning and Assessment Strategy		
CLOs	Teaching-Learning Strategy	Assessment Strategy
CLO1	Field visit, video tape, cooperative learning	Assignment, presentation
CLO2	Workshop, Demonstration, enquiry based learning	Practical book assessment, Quiz, Viva
CLO3	Demonstration, group discussion, seminar	Presentation

Learning Materials

Recommended Readings	Mayr, E., 1969. Principles of Systematic Zoology. McGraw Hill Book Co. New York. Day, F., 1971. The Fishes of India. Today and Tomorrows Book Agency, New Delhi.
Supplementary Readings	Mayr, E., 1966. Animal Species and Evolution.

Course Code: 0610 06 CSE 2150		Year: Second	Term: First
Course Title	Database and Statistical Analysis Lab		
Course Status	Optional		
Credit	2.0		
Prerequisite(s)	None		
Rationale	This course is designed to provide basic knowledge on database, input and output designs, data query and analysis of data using statistical package.		

	Course Contents/Tasks	CLOs
1	Concept on database	1
2	Input and output designs	1
3	Data query	2
4	Analysis of data using statistical packages	2

Course Learning Outcomes (CLOs)	Upon successful completion of the course, the students will be able to:		Mapping with PLOs
	CLO1	Apply the principles of data base and statistical Package	9
	CLO2	Demonstrate ICT skill and data analytic capability	9

Mapping CLOs with the Teaching-Learning and Assessment Strategy

CLOs	Teaching-Learning Strategy	Assessment Strategy
CLO1	Lecture, presentation, software practice	Assignment, presentation
CLO2	Demonstration, interactive learning, software practice	Practical assessment, Quiz, Viva

Learning Materials

Recommended Readings	Bhijel, R.C., 2008. Statistics for aquaculture. Wiley-Blackwell. Hanck, C., Arnold, M., and Gerber, A., 2021. Introduction to Econometricss with R. James, G., Witten, D., Hastie, T., and Tibshirani, R., 2021. An Introduction to Statistical Learning: with Applications in R. SalKind, N. J., 2014. Statistics for People Who (Think They) Hate Statistics. SAGE Publications, Inc. Zar, H. J., 1999. Biostatistical Analysis. Pretice-Hall Inc., USA.

Second Year Second Term			
Course Code: 0831 06 FMRT 2201		Year: Second	Term: Second
Course Title	Freshwater Aquaculture		
Course Status	Core		
Credit	3.0		
Prerequisite(s)	None		
Rationale	The course is designed to provide knowledge on freshwater aquaculture system and apply the knowledge of various aquaculture systems to raise production of different freshwater species at commercial level.		

Course Contents		CLOs
Section A		
1	Introduction: Definition, Scope, prospects, problems, present status, On-going national program in Bangladesh	1
2	Preparation before stocking fish: Properties of a good pond, Pond preparation in dry and wet condition, control of undesirable species, Liming and fertilization, Biodiversity concern in aquaculture.	2
3	Nursery rearing: Nursery management before stocking in grow out pond, Importance of over wintering nursing	3
4	Farming technique of fish: Culture techniques of indigenous and exotic carps (poly, integrated), catfishes (Pangus, Magur, Shing, Pabda, Tengra etc.)	4
5	Farming of crustaceans: Culture techniques freshwater prawn (mono, poly and integrated and all male).	5
6	Exotic Fish Farming: Culture technique of Tilapia (pond, monosex), Thai and Vietnam koi, Indigenous koi, predatory fishes (Shol, Taki, Boal, Aor, Chital etc.) and Eel, Kuchia	6
Section B		CLOs
7	Water and soil quality parameters in aquaculture system: Meaning of water and soil quality parameters, optimum level, causes, effects and control measures of water and soil quality parameters.	7
8	Culture technique of SIS (Mola, Dhela,Puti, Khalisa), Flood plain and open water based culture system.	8
9	Culture of commercially important non piscine organisms (Crocodile, turtle, frog, freshwater mussel). Pearl culture procedure in freshwater mussel.	9
10	Conception and application of new technology: Organic aquaculture, Probiotic, Biofloc technology and others.	10
11	Cage, pen floating pond aquaculture practice Cultivable species, Stocking-size, density, feed management, Risk and hazard, harvesting, cost-benefit.	11
12	Good Aquaculture Practices:Environmental and social issues, HACCP in Aquaculture, Food security, Medicine and reagent used in aquaculture.	12

Course Learning Outcomes (CLOs)	Upon successful completion of the course, the students will be able to:		Mapping with PLOs
	CLO1	Write definition, scope, problems and prospect of freshwater aquaculture system	1, 2
	CLO2	Discuss scientific preparation before stocking fish to prevent pollution and disease problem for getting faster growth and higher production.	1, 2, 8
	CLO3	Acquire knowledge on nursing procedure of cultivable species.	1, 2, 3, 4
	CLO4	Describe culture techniques of indigenous and exotic carps and catfishes	1, 2, 4, 6
	CLO5	State the culture procedure of freshwater prawn.	1, 2
	CLO6	Discuss mono sex tilapia culture, culture system of exotic and indigenous koi and some predator fishes and eel fishes.	2, 3, 5, 7
	CLO7	State water and soil quality parameters, their effects and control measures	1, 3
	CLO8	Get knowledge on culture technique of SIS and open water culture system	1, 5
	CLO9	Discuss the importance and culture techniques of some commercially important nonpiscine species.	5, 8
	CLO10	Think about new aquaculture approaches.	9
	CLO11	Discuss cage, pen and floating aquaculture system.	1, 6
	CLO12	Obtain knowledge on good aquaculture practices, different hazards in aquaculture, food safety etc.	1, 2, 5

Mapping CLOs with the Teaching-Learning and Assessment Strategy

CLOs	Teaching-Learning Strategy	Assessment Strategy
CLO1	Lecture and Group Discussion	Quiz
CLO2	Lecture and Group Discussion	Quiz
CLO3	Lecture, Video Tape and Seminar	Assignment
CLO4	Lecture, Video Tape and Seminar	Assignment
CLO5	Lecture, Video Tape and Group Discussion	Class test
CLO6	Lecture, Video Tape and Group Discussion	Class test
CLO7	Lecture, Video Tape and Enquiry based learning	Quiz
CLO8	Lecture, Video Tape and Enquiry based learning	Quiz
CLO9	Lecture, Discussion and Seminar	Written Exam
CLO10	Lecture, Group Discussion and Case Study	Assignment
CLO11	Lecture and Group Discussion	Presentation
CLO12	Lecture, Case Study and Group Discussion	Assignment, Final Exam

Learning Materials

Recommended Readings	Bardach, J.E., Ryther, J.H. and Mclarney, W.O., 1972. Aquaculture (pp.868). John willey & Sons Inc. Jhingran, V.G., 1991. Fish and Fisheries in India (3rd Edition) (pp.727). Hindustan Publishing Delhi.
Recommended Readings	Pillay, T.V.R., 1990. Aquaculture Principles and Practices (pp.575). Fishing News Books, University Press, Cambridge. Huet, M., 1979. Textbook of Fish Culture: Breeding and Cultivation of Fish. Fishing News Books Ltd.

Course Code: 0831 06 FMRT 2202		Year: Second	Term: Second
Course Title	Freshwater Aquaculture Sessional and Field Work		
Course Status	Core		
Credit	1.0		
Prerequisite(s)	None		
Rationale	The course is designed to provide knowledge on estimation of area and water body to apply lime and fertilizers and also for visiting farms.		

	Course Contents/Tasks	CLOs
1	Determination of effective area of pond.	1, 2
2	Estimation of volume of water body.	1, 2
3	Determination of quantity of lime, fertilizer and biocides.	1, 2
4	Water and bottom mud quality monitoring	1, 2
5	Test for natural food production	1, 2
6	Method demonstration of liming, fertilization, stocking and supplementary feeding	1, 2
7	Visit to freshwater fish and prawn farms and report writing.	1, 2

	Upon successful completion of the course, the students will be able to:		Mapping with PLOs
Course Learning Outcomes (CLOs)	CLO1	Estimate pond area and water body	1, 2, 5, 4, 8, 9
	CLO2	Estimate amount of lime and fertilizer	3, 4, 6, 7, 8, 9

Mapping CLOs with the Teaching-Learning and Assessment Strategy

CLOs	Teaching-Learning Strategy	Assessment Strategy
CLO1	Field visit, video tape, cooperative learning	Assignment, presentation
CLO2	Workshop, Demonstration, enquiry based learning	Practical book assessment, Quiz, Viva

Learning Materials

Recommended Readings	Pillay T.V.R., 1990. Aquaculture: Principles and practices. Fishing New Books, London. Fast, A. and Lester, L.J., 1992. Marine Shrimp Culture: Principles and practices. Elsevier Amsterdam, London, New York. Chen, T.P., 1976. Aquaculture practices in Taiwan. Fishing New Books, London.
Recommended Readings	Hepher, B. and Pruginin, Y., 1981. Commercial Fish Farming.

Course Code: 0831 06 FMRT 2203		Year: Second	Term: Second
Course Title	Live Food Culture		
Course Status	Core		
Credit	2.0		
Prerequisite(s)	None		
Rationale	This course is designed to provide information regarding the culture of primary food of fish and shellfish. The focus of the course is to deliver several lectures in order to teach the students about different types of live feed of fish, their culture and management, various factors that can affect live feed production.		

	Course Contents	CLOs
	Section A	
1	General introduction: Live feeds and their importance.	1
2	Micro-algae: Major classes and genera of cultured micro-algae, algal production, nutritional value of micro-algae, use of micro-algae in aquaculture, replacement diets for live algae.	2
3	Micro-algae culture: culture types, culture media, maintaining and upscalling stock cultures and immobilization.	3
	Section B	CLOs
4	Rotifers: Morphology, strain differences, general culture conditions, nutritional value of cultured rotifers, production and use of resting eggs.	4
5	Artemia: Ecology of Artemia, use of cysts, use ofnauplii and meta-nauplii for culture, tanks production and use of ongrown Artemia, pond production, etc. for aquaculture.	5
6	Zooplankton: Wild zooplankton, production of copepods, mesocosm system.	6
7	Cladocerans, nematodes and tochophora larvae:Daphnia and Moina, nematodes, tochophora larvae.	7

	Upon successful completion of the course, the students will be able to:		Mapping with PLOs
Course Learning Outcomes (CLOs)	CLO1	Develop knowledge on live feed, their types and importance in aquaculture.	1, 2
	CLO2	List commercially cultured micro-algae and write their production and usages in aquaculture, their nutrient contents, etc.	1, 2, 5
	CLO3	Discuss the culture techniques of microalgae	1, 2
	CLO4	Acquire information on rotifers as live food, their biology and other traits, their nutritional value and culture techniques	1, 2
	CLO5	Describe the best live food Artemia, their reproduction, cyst collection and nauplii production, their nutritional value and usages of Artemia in aquaculture.	1, 2, 3
	CLO6	Categorize other types of zooplanktons and discuss their collection, culture and usages in aquaculture.	1, 2, 7
	CLO7	State the biology of Daphnia, Moina, nematodes and trochophore larvae, their culture and usages in aquaculture.	2, 4, 7

Mapping CLOs with the Teaching-Learning and Assessment Strategy

CLOs	Teaching-Learning Strategy	Assessment Strategy
CLO1	Lecture	Quiz
CLO2	Lecture and video tape	Assignment
CLO3	Lecture and group Discussion	Class test
CLO4	Lecture	Quiz
CLO5	Lecture and video tape	Quiz
CLO6	Lecture and group discussion	Presentation, Class test

Learning Materials

Recommended Readings	Lavens, P. and Sorgeloos, P., 1996. Manual on the production and use of live food for aquaculture (No. 361). Food and Agriculture Organization (FAO). De Pauw, N. and Persoone, G., 1988. Micro-algae for aquaculture. In Micro-algal Biotechnology. Borowitzka, M.A. and Borowitzka, L.J. (Eds.). Cambridge University Press, Cambridge. pp 197-221. Fukusho, K., 1989. Biology and mass production of the rotifer Brachionusplicatilis. Int. J. Aq. Fish. Technol, 1(232-240), pp.68-76. Dhont, J., Lavens, P. and Sorgeloos, P., 1993. Preparation and use of Artemia as food for shrimp and prawn larvae. CRC Handbook of Mariculture: Crustacean Aquaculture, 1, p.61. Lavens, P., Sorgeloos, P., Dhert, P. and Devresse, B., 1995. Larval foods. Broodstock management and egg and larval quality, 99, pp.373-397.
Supplementary Readings	Sorgeloos, P. and Léger, P., 1992. Improved larviculture outputs of marine fish, shrimp and prawn. Journal of the World Aquaculture Society, 23(4), pp.251-264. Fukusho, K., 1980. Mass production of a copepod, Tigriopus japonicus in combination culture with a rotifer Brachionusplicatilis, fed omega-yeast as a food source. Bulletin of the Japanese Society of Scientific Fisheries46 (5), 625-629. Kuroshima, R., Yoshinaka, R. and Ikeda, S., 1987. Nutritional quality of the wild zooplankton as a living feed for fish larvae. Aquaculture Science, 35(2), pp.113-117. De Pauw, N., Laureys, P. and Morales, J., 1981. Mass cultivation of Daphnia magna Straus on ricebran. Aquaculture, 25(2), pp.141-152. Alam, J., 1992. Moinamicrura (Kurz) as a live substitute for Artemia spp. in larval rearing of Macrobrachiumrosenbergii (De Man) (Doctoral dissertation, Doctoral thesis, Faculty of Fisheries and Marine Science, UniversitiPertanian Malaysia).

Course Code: 0831 06 FMRT 2204	Year: Second	Term: Second
Course Title	Live Food Culture Sessional	
Course Status	Core	
Credit	1.0	
Prerequisite(s)	None	
Rationale	This course is designed to provide information regarding the culture of primary food of fish and shellfish. The focus of the course is to deliver several lectures in order to teach the students about different types of live feed of fish, their culture and management, various factors that can affect live feed production.	

	Course Contents/Tasks	CLOs
1	Preparation of phytoplankton culture media and isolation of phytoplankton for culture.	1
2	Artemia cysts hatching and enrichment	2
3	Procedure for the decapsulation of Artemia cysts	3
4	Collection and culture of Daphnia and Moina	4

	Upon successful completion of the course, the students will be able to:		Mapping with PLOs
Course Learning Outcomes (CLOs)	CLO1	Prepare culture media for different types of phytoplankton, collect and isolate them, and demonstrate how to culture them, etc.	1, 2, 3
	CLO2	Estimate the water content of Artemia cysts, disinfection of cysts with liquid bleach, finally hatching of cysts.	1, 7
	CLO3	Discuss and demonstrate to the procedures of decapsulating cysts.	3, 4
	CLO4	Collect Daphnia and Moina, rear and culture them in the laboratory conditions, prepare them as food for fish larvae, etc.	3, 7

Mapping CLOs with the Teaching-Learning and Assessment Strategy

CLOs	Teaching-Learning Strategy	Assessment Strategy
CLO1	Field visit, cooperative learning	Assignment, presentation
CLO2	Demonstration, enquiry based learning	Practical book assessment, Quiz, Viva
CLO3	Field visit, demonstration, video tape	Presentation
CLO4	Field visit, video tape	Written exam, viva,

Learning Materials

Recommended Readings	Lavens, P. and Sorgeloos, P., 1996. Manual on the production and use of live food for aquaculture (No. 361). Food and Agriculture Organization (FAO). De Pauw, N. and Persoone, G., 1988. Micro-algae for aquaculture. In Micro-algal Biotechnology. Borowitzka, M.A. and Borowitzka, L.J. (Eds.). Cambridge University Press, Cambridge. pp 197-221. Fukusho, K., 1989. Biology and mass production of the rotifer Brachionusplicatilis. Int. J. Aq. Fish. Technol, 1(232-240), pp.68-76. Dhont, J., Lavens, P. and Sorgeloos, P., 1993. Preparation and use of Artemia as food for shrimp and prawn larvae. CRC Handbook of Mariculture: Crustacean Aquaculture, 1, p.61. Lavens, P., Sorgeloos, P., Dhert, P. and Devresse, B., 1995. Larval foods. Broodstock management and egg and larval quality, 99, pp.373-397.
Supplementary Readings	Sorgeloos, P. and Léger, P., 1992. Improved larviculture outputs of marine fish, shrimp and prawn. Journal of the World Aquaculture Society, 23(4), pp.251-264. Fukusho, K., 1980. Mass production of a copepod, Tigriopus japonicus in combination culture with a rotifer Brachionusplicatilis, fed omega-yeast as a food source. Bulletin of the Japanese Society of Scientific Fisheries46 (5), 625-629. Kuroshima, R., Yoshinaka, R. and Ikeda, S., 1987. Nutritional quality of the wild zooplankton as a living feed for fish larvae. Aquaculture Science, 35(2), pp.113-117. De Pauw, N., Laureys, P. and Morales, J., 1981. Mass cultivation of Daphnia magna Straus on ricebran. Aquaculture, 25(2), pp.141-152. Alam, J., 1992. Moinamicrura (Kurz) as a live substitute for Artemia spp. in larval rearing of Macrobrachiumrosenbergii (De Man) (Doctoral dissertation, Doctoral thesis, Faculty of Fisheries and Marine Science, UniversitiPertanian Malaysia).

Course Code: 0831 06 FMRT 2205		Year: Second	Term: Second
Course Title	Physical Oceanography		
Course Status	Core		
Credit	3.0		
Prerequisite(s)	None		
Rationale	The students are expected to be learned about the overall dynamism of the physical components of the ocean. The approach of the course will help the learners to perform as a professional graduate in any fields of ocean related events; related higher study or academic research In future.		

	Course Contents	CLOs
	Section A	
1	Introduction: Course concept, water on earth surface, History of oceanography	1, 2
2	Physical properties of sea water: Solvent properties Salinity, Temperature and density, Surface tension, Light and Colour, Sound, Residence time	1, 2
3	Oceanic circulation: Surface currents/horizontal circulation, vertical circulation, Water mass movements, Surface currents in major oceans	2, 3
	Section B	CLOs
4	Wave: Review of undergraduate level understanding, Classification of wave, Wave formation and development of sea, Internal wave; Tsunami, Large & catastrophic surface waves, Wave generated currents	1, 4
5	Tides: Review of undergraduate level understanding, Centrifugal, centripetal, gravitational and Tide generating force, tide level, tide pattern, Equilibrium theory of tides, Dynamic theory of tides, Tidal bore and tidal constituents	4, 6
6	Air-sea interaction: Responsible parameters- Light, density, solar energy Heat balance in the earth, Heat budget of the world ocean	1, 5

	Upon successful completion of the course, the students will be able to:		Mapping with PLOs
Course Learning Outcomes (CLOs)	CLO1	Share ideas and keyword definitions regarding the course distribution of land and water on earth surface, Important voyages, events and achievements in the history	1, 4
	CLO2	State the concept, water molecule, its bonding pattern and characteristics, causes and distribution of salinity, distribution of temperature and density, application	1, 4
	CLO3	Discuss the causes and the process of occurrence, water mass movements, and the pattern of surface currents in the Atlantic, Pacific and Indian oceans	1, 4
	CLO4	State the concept and explain the processes related to wave	1, 4
	CLO5	Recall the previous knowledge, describe the concept and generation process of tide	1, 4
	CLO6	Describe the concept and mechanism of air-sea interactions	1, 4

Mapping CLOs with the Teaching-Learning and Assessment Strategy

CLOs	Teaching-Learning Strategy	Assessment Strategy
CLO1	Lecture	Quiz
CLO2	Lecture and video tape	Class test
CLO3	Lecture and Group Discussion	Assignment
CLO4	Lecture and video tape	Quiz
CLO5	Lecture and video tape	Quiz
CLO6	Group discussion and video tape	Presentation, Final Exam

Learning Materials

Recommended Readings	Thurman, H.V., 1983. Essentials of oceanography. Charles E. Merrill Publishing Company. Stewart, R.H., 2008. Introduction to physical oceanography (pp. 133-147). Texas: Texas A & M University.
Supplementary Readings	Open University. Oceanography Course Team, 1989. Ocean circulation (Vol. 3). Pergamon. Ingmanson, D.E. and Wallace, W.J., 1989. Oceanography: an introduction. Wadsworth.

Course Code: 0831 06 FMRT 2206		Year: Second	Term: Second
Course Title	Physical Oceanography Sessional and Field Work		
Course Status	Core		
Credit	1.0		
Prerequisite(s)	None		
Rationale	Bangladesh has vast area with ample of resources in Bay of Bengal. Sustainable utilization and management of ocean resources requires understanding of basic measures in the field of Physical Oceanography.		

	Course Contents/Tasks	CLOs
1	Contour lines-Basic rules	1
2	Determining position on the earth's surface	2
3	Construction of a bathymetric profiles	3
4	Measurements of current, wave, tide, transparency, turbidity, density, TS and TDS	4
5	Representation of tidal fluctuation by graphical methods	5
6	Calibration of reversible thermometer	6

	Upon successful completion of the course, the students will be able to:		Mapping with PLOs
Course Learning Outcomes (CLOs)	CLO1	Read a contour map	4, 7
	CLO2	Determine geographical position	4, 7
	CLO3	Construct a bathymetric profile	4, 7
	CLO4	Measure tide, wave, current, turbidity, density, TS and TDS	4, 7
	CLO5	Prepare graphical presentation of tidal fluctuation	4, 7, 9
	CLO6	State the process of calibrating reversible thermometer	4, 7

Mapping CLOs with the Teaching-Learning and Assessment Strategy

CLOs	Teaching-Learning Strategy	Assessment Strategy
CLO1	Demonstration,	Practical book assessment
CLO2	Demonstration, enquiry based learning	Practical book assessment
CLO3	Demonstration, enquiry based learning	Quiz,
CLO4	Demonstration and field visit	Presentation
CLO5	Demonstration	Presentation
CLO6	Cooperative learning	Viva

Learning Materials

Recommended Readings	Thurman, H.V., 1983. Essentials of Oceanography. Charles E. Merrill Publishing Company. Stewart, R.H., 2008. Introduction to physical oceanography (pp. 133-147). Texas: Texas A & M University.
Supplementary Readings	Open University. Oceanography Course Team, 1989. Ocean circulation (Vol. 3). Pergamon Ingmanson, D.E. and Wallace, W.J., 1989. Oceanography: an introduction. Wadsworth

Course Code: 0731 06 URP 2250		Year: Second	Term: Second
Course Title	GIS and Remote Sensing Sessional and Field Work		
Course Status	Optional		
Credit	2.0		
Prerequisite(s)	None		
Rationale	This course is designed to provide hands on training on data presentation and analysis, sampling, correlation and regression analysis, and normality test, and development of any sector.		

	Course Contents/Tasks	CLOs
1	Spatial Database Development: Digitizing; Digitizing Considerations: format, ID, error reduction in digitizing; on-screen digitizing, importing data from other sources	1
2	Topology creation and map Editing: Error identification and editing.	2
3	Coordinate System and map projection: map projection, transformation, coordinate system, Geo-referencing	3
4	Map Composition and Cosmetic: map elements, color, legend, scale, inset map	4
5	GIS Map and Database: Joining database with map.	4
6	Attribute Query: SELECT, ASELECT, NSELECT, switch select, use of wild card, summarization.	5
7	Spatial Query: select by location, base on single feature or multiple feature	6
8	Table Manipulations: editing, adding field, field calculation, geometry calculation, switch selection,	6
9	Overlay: BUFFER, INTERSECT, UNION, IDENTITY, CLIP, ERASE	6
10	Raster GIS: conversion to and from vector, raster calculator, reclassification, weighted sum, use of multi-criteria evaluation (MCE) in GIS	6

	Upon successful completion of the course, the students will be able to:		Mapping with PLOs
Course Learning Outcomes (CLOs)	CLO1	Present data, including spatial data base information, table and graph making using software.	4, 7, 8, 9
	CLO2	Calculate parameters of measures of location using software.	4, 7, 8, 9
	CLO3	Apply different sampling area map, geological information in Fisheries sector.	4, 7, 8, 9
	CLO4	Demonstrate ability to geo reference scanned maps. Digitize and correct errors; project maps.	4, 7, 8, 9
	CLO5	Demonstrate familiarity with the tools available within different software.	4, 7, 8, 9
	CLO6	Prepare professional map layout for printing. Use multi-criteria analysis (MCA) for different problems using both vector and raster data; Show proficiency in using GIS for network data	4, 7, 8, 9

Mapping CLOs with the Teaching-Learning and Assessment Strategy

CLOs	Teaching-Learning Strategy	Assessment Strategy
CLO1	Demonstration, enquiry based learning	Quiz
CLO2	Demonstration and enquiry based learning	Lab test
CLO3	Demonstration problem based learning	Lab test
CLO4	Lecture, case study, problem based learning	Assignment, Lab test

Learning Materials

Recommended Readings	Qihao, W., 2010. Remote Sensing and GIS Integration – Theories, methods and applications. Publisher: McGraw-Hill, ISBN: 9780071625463. Martin, S., 2014. An Introduction to Ocean Remote Sensing, (Second edition), Cambridge University Press. Gobbi, G. P., and Barnaba, F., 2002. Remote Sensing of Atmosphere and Ocean from Space: Models, Instruments and Techniques, Frank S. Marzano, Guido Visconti (eds.), Springer Netherlands, ISBN: 978-1-4020-0943-3,978-0-306-48150-5 Wright, D. J., Blongewicz, M. J., Halpin, P. N., & Breman, J. 2007. Arc Marine: GIS for a blue planet, ESRI, Inc. Konecny, G., 2003. Geoinformation: Remote Sensing, Photogrammetry and Geographic Information System, Taylor & Francis, London and New York.
Supplementary Readings	DeMers, M.N., 1997. Fundamentals of Geographical Information System. Willy & Sons Schwengerdt, R.A., 1983. Techniques for Image Processing and Classification in Remote Sensing, Academic Press.

Course Code: 0542 06 Stat 2251		Year: Second	Term: Second
Course Title	Principles of Statistics		
Course Status	Core		
Credit	3.0		
Prerequisite(s)	None		
Rationale	This course is designed to provide fundamental concepts of data collection, arrangement, process, analysis, presentation and interpretation for understanding and development of any sector.		

Course Contents		CLOs
Section A		
1	Introduction to Statistics: Definition, importance of Statistics in Biological Sciences (FMRT), scope, limitation.	1, 2
2	Statistical data: Experimental units in aquaculture, Concept of data (statistical data) and variables, Types of data, data sources, Processing & presentation (Array Formation, Frequency Distribution/ Table, Graphic Representation).	1, 2
3	Measures of location: Concept and importance, Central tendency: mean (Arithmetic, Geometric, Harmonic), median, mode, midrange, midhinge, quartiles, percentiles. Dispersion: Range, Quartile deviation, Mean deviation, Standard deviation (SD), Variance (Var), Standard error (SE), Coefficient of variation (CV), Population and sample SD/var.	3
4	Sampling: Concept of sample, Advantages of sampling, types of sampling and its uses, Sample size estimation.	4
5	Data accuracy: Bias, accuracy, precision. Errors and their sources, error minimization and separation.	5
Section B		CLOs
6	Correlation: Concept, types, purpose, coefficient of correlation (Pearson and Spearman).	6
7	Regression: Concept, types, purpose, coefficient of regression, linear regression and GLM, Multiple regression analysis, Relation between correlation and regression.	7
8	Probability: Probability theory, addition and multiplication rules.	8
9	Distribution: Normal, Binomial and Poisson distribution.	9
10	Sampling distribution of the mean.	5

	Upon successful completion of the course, the students will be able to:		Mapping with PLOs
Course Learning Outcomes (CLOs)	CLO1	State the main concept of Statistics.	1, 2, 8
	CLO2	Categorize statistical data and present the data in the right way.	1, 2, 8, 9
	CLO3	Calculate central tendency and measure of dispersion.	1, 2, 8
	CLO4	Apply different sampling methods in Fisheries.	1, 2, 8, 9
	CLO5	Write how to minimize the error.	1, 2, 8, 9
	CLO6	State the main concept of Statistics.	1, 2, 8, 9
	CLO7	State the concept and discuss the estimation process of correlation, regression and multiple regression analysis.	1, 2, 8, 9
	CLO8	Recall the previous knowledge, and discuss the concept and write the application of probability,	1, 2, 8, 9
	CLO9	State the concept and describe the application of distribution and sampling distribution of the mean.	1, 2, 8, 9

Mapping CLOs with the Teaching-Learning and Assessment Strategy

CLOs	Teaching-Learning Strategy	Assessment Strategy
CLO1	Lecture, Presentation	Quiz
CLO2	Lecture and interactive learning	Assignment
CLO3	Lecture and Group Discussion	Class test
CLO4	Lecture, practice with data	Quiz, Class test, final exam
CLO5	Lecture and interactive learning	Quiz, Class test, final exam
CLO6	Lecture and interactive learning	Quiz, Class test, final exam
CLO7	Lecture, practice with data	Quiz, Class test, final exam
CLO8	Lecture, practice with data	Quiz, Class test, final exam
CLO9	Lecture, practice with data	Quiz, Class test, final exam

Learning Materials

Recommended Readings	Mian, M.A. and Miyan, M.A., 1994. An introduction to Statistics. Ideal library, Dhaka. Bhujel, R.C., 2009. Statistics for aquaculture. John Wiley & Sons.

Course Code: 0542 06 Stat 2252		Year: Second	Term: Second
Course Title	Principles of Statistics Sessional		
Course Status	Core		
Credit	2.0		
Prerequisite(s)	None		
Rationale	This course is designed to provide hands on training on data presentation and analysis, sampling, correlation and regression analysis, and normality test, and development of any sector.		

	Course Contents	CLOs
	Section A	
1	Statistical data:Array formation and frequency table formation, Construction of histogram and frequency polygon and graph formation; Software based estimation.	1
2	Measures of location: Calculate different measures of location; Software based estimation.	2
3	Sampling: Application of sampling design in Fisheries research. Create random number; Software based estimation and its application.	3
	Section B	CLOs
4	Coefficient of Correlation (Pearson and Spearman): Paper based estimation; Software based estimation.	4
5	Coefficient of Regression (linear regression, GLM and Multiple): Paper based estimation; Software based estimation	4
6	Normality test: Paper based estimation; Software based estimation	4

	Upon successful completion of the course, the students will be able to:		Mapping with PLOs
Course Learning Outcomes (CLOs)	CLO1	Present data, including array formation, table and graph making using software.	3, 7, 9
	CLO2	Calculate different measures of location using software.	3, 7, 9
	CLO3	Apply different sampling methods in Fisheries.	1, 2, 3, 7
	CLO4	Conduct correlation analysis, regression analysis and normality test	3, 7, 9

Mapping CLOs with the Teaching-Learning and Assessment Strategy

CLOs	Teaching-Learning Strategy	Assessment Strategy
CLO1	Collect data from field and analyze, cooperative learning	Assignment, presentation
CLO2	Demonstration, enquiry based learning	Quiz, Viva
CLO3	Software application, interactive learning, Lecture	Assignment, written exam, viva
CLO4	Software application, interactive learning, Lecture	Assignment, written exam, viva

Learning Materials

Recommended Readings	Mian, M.A. and Miyan, M.A., 1994. An introduction to Statistics. Ideal library, Dhaka. Bhujel, R.C., 2009. Statistics for aquaculture. John Wiley & Sons.

Course Code: 0314 06 Soc 2255		Year: Second	Term: Second
Course Title	Rural Sociology		
Course Status	Optional		
Credit	3.0		
Prerequisite(s)	None		
Rationale	Understanding the basic principles of how people can be brought into the main stream of fisheries management in developing nation in general and in Bangladesh in particular.		

	Course Contents	CLOs
	Section A	
1	Introduction: Rationale and philosophy; essence of social fishery, concepts of social fishery, criteria for social fisheries activities, characteristics of an ideal social fishery program, social fishery as a development strategy.	1
2	Elements of Social Fisheries: Targets of social fisheries, goals and objectives of social fisheries, appropriate social fisheries technologies, delivery systems (transfer of technology, farmers fast), learning from experiences, participatory training, impacts of social fisheries.	1, 4
3	Social Fisheries Planning: Definition and concepts, planning process, planning cycle	1, 2
4	Social Fisheries Practices in Bangladesh: Past activities; present initiatives; opportunities, problems and constraints of social fisheries development in Bangladesh	2, 3
5	Social Fisheries Activities in Other Asian Countries: India, Nepal, Thailand, The Philippines, Vietnam, Indonesia, People's Republic of China.	1, 2, 4
	Section B	CLOs
6	Socio-economic condition and problems of rural areas of Bangladesh: Economic condition; social condition; organizational condition; and physical condition and problems of Bangladesh; rural social structures of Bangladesh.	1, 2, 3
7	Introduction to Rural development: Theories; concepts; principles; goals; models; and components of rural development; prerequisite for rural development; strategies of rural development; roles of social fisheries in Rural development of Bangladesh	4
8	Concept of Poverty: Definition, indicators of poverty; environment and poverty linkages in Bangladesh.	1, 2
9	Rural fishery development program in Bangladesh: Integrated Rural Development Programme (IRDP) in Bangladesh and the role of Bangladesh Academy for Rural Development (BARD) Comilla; Rural development Academy (RDA); food for works; Grameen Bank and their impact on rural development.	2
10	Local government institutions and their roles in rural development: Definition of local Government and their structure; history of local Government in Bangladesh in different regime; activities of different local government organizations in Bangladesh; NGOs and their roles in rural development of Bangladesh	1, 2

	Upon successful completion of the course, the students will be able to:		Mapping with PLOs
Course Learning Outcomes (CLOs)	CLO1	Acquire knowledge on rural social structure, rural poverty and local government structure.	1, 5
	CLO2	Come to know about the roles of BARD, IRDP, RDA, Grameen bank and different NGOs in rural development of Bangladesh.	3, 5, 6
	CLO3	Understand the concepts and issues related to rural development in Bangladesh.	5, 6
	CLO4	Improve the social fisheries situation to increase rural livelihood and conservation in Bangladesh	1, 6

Mapping CLOs with the Teaching-Learning and Assessment Strategy

CLOs	Teaching-Learning Strategy	Assessment Strategy
CLO1	Lecture	Quiz
CLO2	Lecture and debate	Assignment
CLO3	Lecture and group Discussion	Presentation, Class test
CLO4	Lecture and seminar	Quiz, Assignment

Learning Materials

Recommended Readings	Velusamy, R Rural. 2018. Sociology and Educational Psychology .Daya Publishing House Rajendra Kumar Sharma. 1997. Rural Sociology. Atlantic Publishers & Dist. S. L. Dosh. 1999. Rural Sociology
Supplementary Readings	Paul L. 1917. Introduction to Rural Sociology Umesh Chinchmalatpure. 2019. A Text Book of Rural Sociology and Educational Psychology

Third Year First Term			
Course Code: 0831 06 FMRT 3101		Year: Third	Term: First
Course Title	Coastal Aquaculture and Mariculture		
Course Status	Core		
Credit	3.0		
Prerequisite(s)	None		
Rationale	The course is designed to provide knowledge and experience in the procedure of farming and management systems of different coastal and marine fish.		

Course Contents		CLOs
Section A		
1	Introduction: Definition, history, objectives, scope, national, regional and global importance of coastal aquaculture, non-fed aquaculture, present status and future potential of coastal aquaculture in Bangladesh. Leading countries for coastal aquaculture. Status of Aquaculture in Asia and others sub-continent. Coastal aquaculture constraints, planning and mitigation measure;	1, 2
2	Design and construction of culture facilities: Shore areas (shallow), intertidal and deep water zones, Use of GIS to determine suitability of aquaculture site to avoid conflicts. Marine fin fishes culture practice in cage, pen floating pond, Cultivable species, Stocking-size, density, feed management, Risk and hazard, cost-benefit, Creating livelihood option in the field of fisheries for the climatically stressed coastal people;	1, 2
3	Seed collection: Wild seed collection of fin fishes, shrimp and other organisms, sorting, and transportation of and nursing for cultivation;	2
4	Culture techniques: Penaeid Shrimp (improved traditional, closed, semi intensive), crab (poly, cage, pen culture and fattening), and lobster;	3
5	Culture techniques: Mullet, Seabass, Milkfish, Tuna, Mackerel;	1, 4
6	Culture techniques: Mussel, oyster, clam, abalone, scallop, squid, pearl oyster (raft, tray, rope, pole, block, net, bottom).	4
Section B		CLOs
7	Stocking of open waters and ranching: Species selection, culture technique, open-water stocking, ranching of anadromous species, contribution of estuary for spawning and larval nursing;	5, 6
8	Culture techniques: Edible seaweed, commercially important marine algae;	5, 6
9	Pearl culture: Life cycle of pearl oyster, techniques of pearl culture;	5, 6
10	Code of conduct: Coastal aquaculture and feed, ownership and regulation in coastal aquaculture;	5, 6
11	Mangrove fisheries: Mangrove ecosystem; silvofishery; energy flow in mangrove swamp; impact of deforestation; prospects of fisheries and fish culture in mangrove areas; sustainable fisheries management in mangrove areas;	5, 6
12	Recirculating aquaculture system: Concept, advantages and disadvantages, equipment and operation, different types of biofilters, design and operation of a recirculating farm. Water quality and nutrient management.	5, 6

Course Learning Outcomes (CLOs)	Upon successful completion of the course, the students will be able to:		Mapping with PLOs
	CLO1	Define coastal aquaculture and state the scope and problems of coastal aquaculture system;	1, 2
	CLO2	Apply the knowledge to design and construct culture facilities in shore areas;	1, 2, 8
	CLO3	Discuss seed collection procedure and transportation of wild fish seed for cultivation;	1, 2
	CLO4	Describe different culture system of Penaeid shrimp, marine crab, Mullet, Seabass, Milkfish, Molluscs, pearl, oyster, sea weeds;	1, 2
	CLO5	Apply recirculating aquaculture system, silvofishery and open water stocking;	1, 2, 7, 8
	CLO6	State the code of conduct in coastal aquaculture.	1, 2, 5, 8

Mapping CLOs with the Teaching-Learning and Assessment Strategy

CLOs	Teaching-Learning Strategy	Assessment Strategy
CLO1	Lecture	Quiz
CLO2	Lecture, Enquiry based learning	Assignment
CLO3	Lecture, Group discussion	Class test
CLO4	Lecture, interactive learning, Video tape	Quiz, Class test, Final Exam
CLO5	Lecture, video tape	Quiz, Class test
CLO6	Group discussion, Case studies, Video tape	Presentation, Final Exam

Learning Materials

Recommended Readings	Bardach, J.E., Ritter, J.H. and Mclarney, W.O., 1972. Aquaculture. John Willey & Sons. Inc. Pillay, T.V.R., 1973. Coastal Aquaculture in the Indo-pacific region (pp.497). Fishing News (Books) Ltd. Imai, T., 1977. Aquaculture in shallow seas: Progress in Shallow sea culture (pp.615). Oxfored IBH Publishing Co. New Delhi. Iverson, E.S., 1968. Farming at the Edge of the sea (pp.301). Fishing News Books Ltd., London. Kurian, C.V. and Sebastian, V.O., 1976. Prawn and Prawn Fisheries of India. Hindustan Publishing Corporation, Delhi.
Supplementary Readings	Lee, D.C.C. and Vichins, J.F., 1991. Crustacean Farming. Fishing News Books/Blackwell Scient. Publ. Ltd. McVey, J.P., 1993. CRC handbook of mariculture: crustacean aquaculture (Vol. 1). CRC Press. McVey, J.P., 1991. CRC Handbook of Mariculture. Volume II: Finfish aquaculture. CRC Press. Mohan, J.J. (ed.), 1980. Aquaculture in Asian Fisheries Society Indian Branch Mangalore.

Course Code: 0831 06 FMRT 3102	Year: Third	Term: First
Course Title	Coastal Aquaculture and Mariculture Sessional and Field Work	
Course Status	Core	
Credit	1.0	
Prerequisite(s)	None	
Rationale	The course is designed to provide knowledge and experience in the procedure of farming and management systems of different coastal and marine fishes.	

	Course Contents/Tasks	CLOs
1	Designing of a coastal fish, shell fish and sea weed farm;	1
2	Transportation of larvae and PL of shrimp;	2
3	Use of GIS for selecting site for coastal aquaculture;	3
4	Survey of different coastal aquaculture techniques; on farm demonstration coastal aqua-farm management practices;	3
5	Prepare virtual model of different aquaculture system;	3

	Upon successful completion of the course, the students will be able to:		Mapping with PLOs
Course Learning Outcomes (CLOs)	CLO1	Design a coastal aquaculture farm;	1, 2, 3, 7, 8
	CLO2	Make a report on visiting of a farm;	1, 2, 3, 8
	CLO3	Demonstrate fish, shell fish and sea weed farm.	1, 2, 3, 8

Mapping CLOs with the Teaching-Learning and Assessment Strategy

CLOs	Teaching-Learning Strategy	Assessment Strategy
CLO1	Field visit, Cooperative learning	Assignment, Presentation
CLO2	Field visit, Cooperative learning	Report, Quiz, Viva
CLO3	Demonstration, Enquiry based learning	Assignment, Presentation

Learning Materials

Recommended Readings	Pillay, T.V.R., 1990. Aquaculture Principles and Practices. Blackwell Science Ltd.

Course Code: 0831 06 FMRT 3103		Year: Third	Term: First
Course Title	Chemical and Geological Oceanography		
Course Status	Core		
Credit	3.0		
Prerequisite(s)	None		
Rationale	This course is designed to provide basic concept on different aspects of chemical reactions and geological processes involved in the Ocean		

Course Contents		CLOs
	Section A	
1	A chemical perspective: Important and unusual chemical properties of seawater, the salinity of seawater, conservative elements, bioactive elements, adsorbed elements;	1, 5
2	Chemical equilibrium in sea waters : The composition of sea water, dissociation of weak acids, pH of sea water, solubilities of minerals, activity coefficients, control of oceanic composition, elements in sea water, major and minor constituents, Eh and salinity of sea water;	1, 2, 4
3	Nutrient cycles: Silicon, phosphorus, nitrogen and carbon cycles;	2, 3, 4
4	Marine organic geochemistry: The nature of organic matter, methods of characterizing organic matter, major organic carbon compounds as biomarkers, dissolved organic matter in seawater;	3, 4
5	Chemical reactions in marine sediments: Diagenesis and preservation of organic matter, diagenesis and preservation of calcium carbonate, diagenesis and preservation of silica, diagenesis and preservation of metals.	3, 4, 8
	Section B	CLOs
6	An introduction to geology: The Science of geology, geologic time, earth's spheres;	4, 5
7	Origin of the universe:Big bang theory; nebular hypothesis; chemical & physical properties of earth; origin of the ocean; life begin in the ocean	4, 5, 6
8	Plate tectonics and the ocean floor: Continental drift, earth's major plates, sea floor spreading and features of the ocean basins,features occur at plate boundaries	4, 5, 7
9	Beaches and shorelines: Beach anatomy, concepts of shoreline dynamics, waves near shore, coastal land form	1, 5, 6
10	Tropical cyclone: Characteristics of cyclone, economic impact of cyclone, storm structure, formation of a tropical cyclone, stages of a tropical cyclone	1, 5, 6, 7
11	Marine Sediments: Classification of marine sediments, distribution of biogenous sediments, silicate minerals	6, 7, 8

Course Learning Outcomes (CLOs)	Upon successful completion of the course, the students will be able to:		Mapping with PLOs
	CLO1	explain the chemical properties of water and its interaction with ocean;	1, 2
	CLO2	illustrate the chemical significance of dissolved elements in seawater;	1, 2
	CLO3	describe the dissolved organic matter, biomarkers and prevailing nutrient cycles in ocean environment;	1, 2,3, 4
	CLO4	explain the chemical processes of different principal components in marine sediments;	1, 2, 4, 6
	CLO5	portray historical background of geology and principles of relative dating;	1, 2
	CLO6	explain dynamic interface of shoreline and various part of coastal zone, oceanic ridge, continental crust and supercontinent cycle;	2, 3
	CLO7	elucidate continental drift hypothesis and plate tectonic theory;	1, 3
	CLO8	describe the nature, composition, distribution and collection of sediments.	1, 5

Mapping CLOs with the Teaching-Learning and Assessment Strategy

CLOs	Teaching-Learning Strategy	Assessment Strategy
CLO1	Lecture and Group discussion	Quiz
CLO2	Lecture, Video tape, Seminar	Assignment
CLO3	Lecture, Video tape, Group discussion	Class test
CLO4	Lecture, Video tape, Enquiry based learning	Quiz
CLO5	Lecture, Discussion, Seminar	Written Exam
CLO6	Lecture, Group discussion, Case study	Assignment
CLO7	Lecture and Group discussion	Presentation
CLO8	Lecture, Case study, Group discussion	Final Exam

Learning Materials

Recommended Readings	Thurman, H.V., Trujillo, A.P., Abel, D.C. and McConnell, R., 1999. Essentials of Oceanography (pp. 2-35). Englewood Cliffs: Prentice Hall. Emerson, S. and Hedges, J., 2008. Chemical oceanography and the marine carbon cycle. Cambridge University Press. Frederick K..Lutgens, Edward J..Tarbuck and Tasa, D., 2014. Essentials of geology. Pearson new international edition.

Course Code: 0831 06 FMRT 3104	Year: Third	Term: First
Course Title	Chemical and Geological Oceanography Sessional and Field Work	
Course Status	Core	
Credit	1.0	
Prerequisite(s)	None	
Rationale	This course is designed to provide laboratory experiments in the field of chemical and geological oceanography.	

	Course Contents/Tasks	CLOs
1	Determining sea water properties: Quantifying dissolved gases, salinity, pH, alkalinity, acidity, metals, different nutrients and productivity of sea water;	1
2	Instruments and Methods: Different instruments used by the marine geologists, different methods of determination;	2
3	Marine sediment analysis: Collection, preservation and analysis of ocean sediments.	3

	Upon successful completion of the course, the students will be able to:		Mapping with PLOs
Course Learning Outcomes (CLOs)	CLO1	Determine different chemical properties of sea water, nutrient contents in sea water and composition of different organic compounds;	1, 2, 3, 4, 7, 8
	CLO2	Handle different instruments used in geology;	3, 4, 7, 8, 9
	CLO3	Collect, preserve and analyze ocean sediments.	5, 6, 9

Mapping CLOs with the Teaching-Learning and Assessment Strategy

CLOs	Teaching-Learning Strategy	Assessment Strategy
CLO1	Field visit, Video tape, Cooperative learning	Assignment, presentation
CLO2	Workshop, Demonstration, Enquiry based learning	Practical book assessment, Quiz, Viva
CLO3	Demonstration, Group discussion, Seminar	Presentation

Learning Materials

Recommended Readings	Thurman, H.V., Trujillo, A.P., Abel, D.C. and McConnell, R., 1999. Essentials of Oceanography (pp. 2-35). Englewood Cliffs: Prentice Hall. Emerson, S. and Hedges, J., 2008. Chemical oceanography and the marine carbon cycle. Cambridge University Press. Frederick K..Lutgens, Edward J..Tarbuck and Tasa, D., 2014. Essentials of geology. Pearson new international edition.

Course Code: 0831 06 FMRT 3107		Year: Third	Term: First
Course Title	Fish Harvest Technology		
Course Status	Core		
Credit	3.0		
Prerequisite(s)	None		
Rationale	The basis of this course conveys scientific knowledge of the methods for optimum fish harvesting. Its focus is in how different fishing crafts and gears can be operated, maintained and preserved. This course will provide information about how we can detect fishing ground to maximize fish harvesting. From this course students will be able to identify fishing vessels and gears for using in the different water bodies		

Course Contents		CLOs
	Section A	
1	Introduction: History and development of fish harvest technology, different fishing techniques, consideration of open water fish harvesting, commercial fisheries, artisanal fisheries, subsistence fisheries;	1
2	Fishing ground detection: Definition, objectives, methods of fishing ground detection, fish tracking;	2
3	Indirect method: Physical, chemical and biological methods;	3, 4
4	Direct methods: Echo sounder, fish finder, fish sonar, lowlight television, laser ray application, satellite investigation and others;	3, 4
5	Responsible Fishing: Integration of fishing and ecosystem conservation, eco friendly fishing methods and fishing gears;	3
6	Fishing grounds in the Bay of Bengal: Fisheries resources in the Bay of Bengal, present exploitation rate and standing stock in the Bay of Bengal, technical strategies for the prospect of Bay of Bengal.	2
	Section B	CLOs
7	Fishing Crafts: Classification of fishing crafts, traditional fishing crafts of Bangladesh, terminology of fishing craft;	5
8	Boat building material: properties, merits and demerits of wood, steel and aluminum, fiberglass, re-inforced plastic and ferrocement;	6, 8
9	Boat building: Designs, care and maintenance of fishing vessels, rules and regulations for fishing vessel fabrication, operation and safety;	6, 8
10	Fishing gears: Definition, classification, fishing gear design, construction and assembly, Interpretation of trawling, net braiding, net mending, preservation and maintenance;	7, 8
11	Fishing Gear Materials: Fibres, selection and purchase of fishing gear materials, care and handling of materials, nets and ropes , construction of twines and ropes , properties and characteristics of fishing gear materials , numbering systems of twines and ropes, quantity and weight estimation of materials;	9
12	Fishing gear accessories: Type of accessories, use of accessories, characteristics of floats and selection criteria, ordering of equipment and accessories, trawl door selection criteria and practical considerations, ropes and rope work;	9
13	Fishing methods: Factors that influence the choice of fishing gears and fishing methods, efficiency and selectivity of fishing gears, fishing legislations.	7

Course Learning Outcomes (CLOs)	Upon successful completion of the course, the students will be able to:		Mapping with PLOs
	CLO1	Write different methods of fishing;	1, 2
	CLO2	Categorize different fishing ground detection methods;	1, 2, 5
	CLO3	Discuss about conservation and eco-friendly fishing methods;	1, 2
	CLO4	State about various modern equipments for fishing and detection;	1, 2
	CLO5	Describe the handling, care and maintenance of fishing gear materials;	1, 2, 7
	CLO6	Describe the effect of different materials on the buoyancy and the resistance of a fishing gear to be constructed;	1, 3, 7
	CLO7	State the specification of craft and gears;	2, 5, 7
	CLO8	Identify materials for construction;	1, 2, 3
	CLO9	Identify fishing gear accessories.	1, 2, 7

Mapping CLOs with the Teaching-Learning and Assessment Strategy

CLOs	Teaching-Learning Strategy	Assessment Strategy
CLO1	Lecture	Quiz
CLO2	Lecture, Video tape	Assignment
CLO3	Lecture, Group discussion	Class test
CLO4	Lecture, Problem based learning	Quiz
CLO5	Lecture, Video tape	Quiz
CLO6	Lecture, Group discussion	Presentation, Class test
CLO7	Lecture, Group discussion	Presentation, Class test
CLO8	Lecture, Group discussion	Presentation, Class test
CLO9	Lecture, Group discussion	Presentation, Class test

Learning Materials

Recommended Readings	Baranov, F.I., 1969. Selected works on fishing gear Vol. I Commercial fishing techniques (pp.631). Israel Programme for Scientific Translations. Ben- Yami, M., 1994. Purse seining manual (pp.416). FAO Fishing manual. Bjordal and Lokkeborg, S., 1998. Long lining (pp.208). Fishing News Books Ltd. Brandt, A.V., 1984. Fish catching methods of the world (pp.432). Fishing news books Ltd. Fridman, A.L., 1986. Calculations for fishing gear designs (pp.264)., FAO Fishing manual, Fishing News Books.
Supplementary Readings	Sreekrishna, Y. and Latha, S., 2001. Fishing gear and craft technology (pp.342). Indian Council of Agricultural Research, New Delhi. Kristionsson, H., 1975. Modern Fishing Gear of the World (pp.594). The White Friars Press Limited. Biswas, K.P., 1996. Harvesting Aquatic Resources (pp.207). Daya Publishing House, Delhi. Hameed, M.S., and Boopendranath, M.R., 2000. Modern Fishing Gear Technology (pp.193). Garner, J., 1988. Modern Deep Sea Trawling Gear (pp.91). Fishing News Books Ltd.

Course Code: 0831 06 FMRT 3108		Year: Third	Term: First
Course Title	Fish Harvest Technology Sessional and Field Work		
Course Status	Core		
Credit	1.0		
Prerequisite(s)	None		
Rationale	This course is designed to provide the student hands on practice in different aspects of fish harvest technology. This will cover different practical techniques of identifying crafts and gears with an emphasis on practical use to maximize harvesting to minimize environmental loss.		

	Course Contents/Tasks	CLOs
1	Exercises on scale drawing of different types of fishing gears;	2
2	Model net calculations, Calculations of energy requirements of different crafts and gears;	1
3	Onboard experience of different fishing methods;	1
4	Study of fishing gears and vessels through models of nets/vessels and field study;	1
5	Design of different accessories for fish harvesting;	2
6	Survey of gears and preparation of designs according to scale by taking sample.	1

	Upon successful completion of the course, the students will be able to:		Mapping with PLOs
Course Learning Outcomes (CLOs)	CLO1	Apply different equipments, accessories, methods of operation and preservation;	1, 2, 3
	CLO2	Repair and construct fish harvesting nets and vessels.	1, 7

Mapping CLOs with the Teaching-Learning and Assessment Strategy

CLOs	Teaching-Learning Strategy	Assessment Strategy
CLO1	Field visit, Cooperative learning	Assignment, presentation
CLO2	Demonstration, Enquiry based learning	Practical book assessment, Quiz, Viva

Learning Materials

Recommended Readings	Kristionsson, H., 1975. Modern Fishing Gear of the World (pp.594). The White Friars Press Limited. Biswas, K.P., 1996. Harvesting Aquatic Resources (pp.207). Daya Publishing House, Delhi.
Supplementary Readings	Hameed, M.S., and Boopendranath, M.R., 2000. Modern Fishing Gear Technology (pp.193). Garner, J., 1988. Modern Deep Sea Trawling Gear (pp.91). Fishing News Books Ltd.

Course Code: 0831 06 FMRT 3109		Year: Third	Term: First
Course Title	Integrated Coastal Zone Management		
Course Status	Optional		
Credit	2.0		
Prerequisite(s)	None		
Rationale	The course is designed to be familiar with and understand a sound, balanced and sustainable integrated management of a tropical coastal zone.		

Course Contents		CLOs
Section A		
1	Introduction: Concepts of coast, coastal environment, coastal zone and its integrated management, sustainability;	1
2	Background: Necessity of integrated management, background of integrated management concept, adoption of integrated management;	2
3	Scope of ICZM: Boundaries of the coastal zone, anthropogenic actions and management strategy, characteristics of the coastal zone and its vulnerability, scope and objectives of ICZM;	3
4	Sustainability and conflicts: Conflicts in agriculture, fisheries, livestock and forests; coastal rehabilitation, setback; case studies.	4
Section B		CLOs
5	Resource management dilemma: coastal development and pollution, resource depletion, impacts from anthropogenic actions and global environmental change, sea level rise;	5
6	Social involvement for ICZM: principles and core values, steps for social involvement, awareness and participation;	6
7	ICZM planning and implementation: guidelines, principles, institutional and legal arrangements, economic aspects, programs and initiatives; national programs and problems; case studies.	7

	Upon successful completion of the course, the students will be able to:		Mapping with PLOs
Course Learning Outcomes (CLOs)	CLO1	Describe the concepts of coastal zone and its integrated management;	1, 2
	CLO2	State the necessity and background of ICZM;	1, 2, 5
	CLO3	Explain the activities in coastal zone, and state the scope and objectives of ICZM;	1, 2
	CLO4	Describe the conflicts among different resource sectors, and actions for resolutions;	1, 2
	CLO5	Explain the coastal development activities and its impacts as well as impacts due to global environmental change and sea level rise;	2, 3, 5, 6
	CLO6	Describe the necessity and process for public awareness and their participation for a successful ICZM programme;	1, 2
	CLO7	Explain the initiatives for an ICZM plan including the guidelines, and institutional and legal arrangements for the programme;	3, 8

Mapping CLOs with the Teaching-Learning and Assessment Strategy

CLOs	Teaching-Learning Strategy	Assessment Strategy
CLO1	Lecture	Quiz
CLO2	Lecture, Demonstration	Assignment
CLO3	Lecture, Group Discussion	Class test
CLO4	Lecture, Cooperative learning	Quiz
CLO5	Lecture, Case study	Quiz
CLO6	Lecture, Group discussion	Presentation, Class test
CLO7	Leccture	Class test, Final Exam

Learning Materials

Recommended Readings	Kay, R. and Alder, J., 1998. Coastal planning and management. CRC Press. Clark, J.R. ed., 1995. Coastal zone management handbook. CRC Press. FAO, 1992. Integrated management of coastal zone (pp.167). FAO Fisheries Technical Paper, No. 327.

Course Code: 0831 06 FMRT 3111		Year: Third	Term: First
Course Title	Aqua Farm Design and Construction		
Course Status	Optional		
Credit	2.0		
Prerequisite(s)	0831 06 FMRT 2109		
Rationale	The course is designed to focus about the design and construction of aquaculture farm for commercial and sustainable production. This course is also designed to provide knowledge on the operation and management of aquafarm in a sustainable way.		

Course Contents		CLOs
Section A		
1	Introduction: Definition, scope, strategy of aquaculture planning;	1
2	Basic data required for planning: Total requirement for domestic consumption and export; sources of production, extent of suitable cultivable area, availability of water, fertilizers, feed and labour, estimated production through capture and culture fisheries, likely socio-economic benefits to rural sector, national priorities with regard to type of product, consumer preferences;	1
3	Planning of small scale and large scale aquaculture: Site selection, design and construction of aquaculture installation;	1
4	Manpower resource management: Assessment of manpower requirements, training of personnel;	2
5	Research and extension: Research support and extension service.	3
Section B		CLOs
6	Water supply: Sources of water supply for aquaculture farm, quality of water;	4
7	Fluid: Fluid statics unit of pressure intensity pressure measurement fluid dynamics-types of flow, conservation of mass, conservation of energy, open channel flow measurement, direct volume measurement system;	5
8	Design criteria of pond, tank and other impounding structure: Site selection, design and construction of pond and tank and its construction materials embakement and dikes. Design and construction of water control structure and its construction materials. Design and construction of raceway and its construction materials. Filtration and Aeration-types, function and uses of different types of filter and aerator for aquaculture farm;	6, 7
9	Hatchery: Site selection for hatchery, design and construction of small scale and large scale hatchery. Hatchery facilities.	8

	Upon successful completion of the course, the students will be able to:		Mapping with PLOs
Course Learning Outcomes (CLOs)	CLO1	Give outlines how to plan and design different types of aqua farm;	1
	CLO2	Assess various kinds of manpower requirements and their skill development;	1, 2
	CLO3	Demonstrate why and how to establish the research section in the farm and to disseminate its outcomes;	1, 2
	CLO4	Explain about water supply and quality aquafarm;	2, 3
	CLO5	Describe the principles of fluid dynamics;	1, 2, 3
	CLO6	Familiar with different types of water pumps, their installation and operation;	1, 2, 3
	CLO7	Explain the basic design of various types of aquafirm structures;	1, 2, 3, 4
	CLO8	Describe hatchery design and construction.	1, 2, 3, 4

Mapping CLOs with the Teaching-Learning and Assessment Strategy

CLOs	Teaching-Learning Strategy	Assessment Strategy
CLO1	Lecture	Final Exam
CLO2	Lecture, Demonstration	Class test, Final Exam
CLO3	Lecture, Group Discussion	Class test, Final Exam
CLO4	Lecture, Problem based learning	Class test, Final Exam
CLO5	Lecture, Demonstration	Quiz, Final Exam
CLO6	Group discussion	Presentation, Final Exam
CLO7	Lecture, Demonstration	Class test, Final Exam
CLO8	Lecture, Demonstration	Assignment, Final Exam

Learning Materials

Recommended Readings	Bardach, J. E. John H. Ryther, J. H. and McLarney W. O., 1974. Aquaculture: The Farming and Husbandry of Freshwater and Marine Organisms. John Wiley & Sons, New York. Landau, M., 1992. Introduction to aquaculture. John Wiley & Sons, New York.
Supplementary Readings	Pillay, T.V.R., 1977. Planning of Aquaculture Development: An Introductory Guide. Food and Agriculture Organization of the United Nations by Fishing News Books, USA.

Course Code: 0831 06 FMRT 3112		Year: Third	Term: First
Course Title	Aqua Farm Design and Construction Sessional and Field Work		
Course Status	Optional		
Credit	1.0		
Prerequisite(s)	0831 06 FMRT 2110		
Rationale	This sessional course is designed to provide the student hands on practice in designing aqua farm for the commercial culture of fish and shellfish.		

	Course Contents/Tasks	CLOs
1	Identification of building materials;	1
2	Drawing and construction of foundation, brick walls, columns, lintels, beams, floors, roofs and stairs;	1, 2
3	Estimation of different building and construction materials;	1, 2
4	Preparation of aquaculture farm estimate;	1, 2
5	Preparation of hatchery building estimation.	3

	Upon successful completion of the course, the students will be able to:		Mapping with PLOs
Course Learning Outcomes (CLOs)	CLO1	Plan, design and construct a suitable aqua farm.	1, 2, 3, 4, 7
	CLO2	Design different ponds and related establishment required for aquaculture purpose	1, 2, 3, 4, 7
	CLO3	Plan, design and construct a fish hatchery	1, 2, 3, 4, 7

Mapping CLOs with the Teaching-Learning and Assessment Strategy

CLOs	Teaching-Learning Strategy	Assessment Strategy
CLO1	Demonstration, Field visit	Assignment, Presentation, Viva
CLO2	Demonstration, Enquiry based learning, Field visit	Quiz, Viva
CLO3	Demonstration, Enquiry based learning, Field visit	Quiz, Viva

Learning Materials

Recommended Readings	Bardach, J. E. John H. Ryther, J. H. and McLarney W. O., 1974. Aquaculture: The Farming and Husbandry of Freshwater and Marine Organisms. John Wiley & Sons, New York. Landau, M., 1992. Introduction to aquaculture. John Wiley & Sons, New York.
Supplementary Readings	Pillay, T.V.R., 1977. Planning of Aquaculture Development: An Introductory Guide. Food and Agriculture Organization of the United Nations by Fishing News Books, USA.

Course Code: 0542 06 Stat 3151		Year: Third	Term: First
Course Title	Biostatistics		
Course Status	Core		
Credit	3.0		
Prerequisite(s)	0542 06 Stat 2251		
Rationale	This course is designed to understand and familiar the students on various inferential statistical measures and their respective application on fisheries and marine science.		

Course Contents		CLOs
Section A		
1	Introduction: Importance and scope of biostatistics; review of previous understanding;	1
2	Data transformation: Concept, types, purpose, and process;	3
3	Hypothesis: Concept, types, major terminologies, and purpose. Classical approach and p value approach for general hypothesis testing;	2, 3
4	Inferential measure in correlation and regression analysis: concept and process;	3
5	Experimental design: Purpose, types, process of Randomized Block, Complete randomized block, Latin square, and factorial design;	3
6	ANOVA: One-way, Two-way ANOVA and LSD;	3
7	ANOCOVA and MANOVA: Concept and process.	3
Section B		CLOs
8	t-test: One-sample t-test, Paired t-test, Independent sample t-test;	4
9	Chi-square: Analysis of Attribute Data (Test for a Fixed-Ratio Hypothesis, Test for Independence in a Contingency Table, Test for Homogeneity of Ratio);	4
10	Non-parametric: Wilcoxon test, Mann-Whitney test, Kruskal-Wallis test, Friedman test, Spearman's Rank correlation, Non-parametric regression;	4
11	Probit analysis;	4
12	Principle component analysis (PCA).	4

	Upon successful completion of the course, the students will be able to:		Mapping with PLOs
Course Learning Outcomes (CLOs)	CLO1	Recall the previous knowledge about descriptive statistics and state the scope of inferential statistics;	4, 7, 9
	CLO2	Write the concept and the general hypothesis testing process;	4, 7
	CLO3	State the concept and process of data transformation, inferential measure correlation and regression analysis, ANOVA, ANCOVA and MANOVA, experimental design;	4, 7, 9
	CLO4	Describe the concept, application, and the process of t-test, Chi-square, non-parametric test, probit analysis and PCA.	4, 7, 9

Mapping CLOs with the Teaching-Learning and Assessment Strategy

CLOs	Teaching-Learning Strategy	Assessment Strategy
CLO1	Lecture	Quiz
CLO2	Lecture, Problem based learning	Assignment
CLO3	Lecture, Problem Based Learning	Class test
CLO4	Lecture, Problem Based Learning	Quiz, Viva

Learning Materials

Recommended Readings	Zar, H. J., 1999. Biostatistical Analysis. Pretice-Hall Inc., USA. Bhijel, R.C., 2008. Statistics for aquaculture. Wiley-Blackwell.
Supplementary Readings	Gomez, K.A. and Gomez, A.A., 1984. Statistical procedures for agricultural research. John Wiley & Sons. Jayaraman, K., 2000. A statistical manual for forestry research. FORSPA.

Course Code: 0542 06 Stat 3152		Year: Third	Term: First
Course Title	Biostatistics Sessional		
Course Status	Core		
Credit	2.0		
Prerequisite(s)	0542 06 Stat 2252		
Rationale	Inferential statistics are prerequisite for understanding, managing, predicting and developing of any sector. This section of the course is designed to understand and familiar the students on various inferential statistical measures and their respective application on fisheries and marine science.		

	Course Contents/Tasks	CLOs
1	Inferential measures in Correlation analysis: Software based estimation;	2
2	Inferential measures in Regression (GLM, Multiple): Software based estimation;	2
3	Data transformation process: Software based estimation;	1
4	Z-test, ANOVA, ANOCOVA, MANOVA;	2
5	t-test (One-sample t-test, Paired t-test, Independent sample t-test): Software based estimation;	3
6	Chi-square (Analysis of Attribute Data): Software based estimation;	3
7	Non-parametric: Software based estimation;	3
8	Probit analysis: Software based estimation;	3
9	Principle component analysis (PCA): Software based estimation.	3

	Upon successful completion of the course, the students will be able to:		Mapping with PLOs
Course Learning Outcomes (CLOs)	CLO1	transform data	4, 7, 9
	CLO2	conduct correlation and regression analysis, Z-test, ANOVA, ANOCOVA, MANOVA	4, 7, 9
	CLO3	perform t-test, Chi-square test, non-parametric test, probit analysis and PCA.	4, 7, 9

Mapping CLOs with the Teaching-Learning and Assessment Strategy

CLOs	Teaching-Learning Strategy	Assessment Strategy
CLO1	Demonstration, Problem based learning	Quiz
CLO2	Demonstration, Problem based learning	Assignment, Lab test
CLO3	Demonstration, Problem based learning	Assignment, Lab test

Learning Materials

Recommended Readings	Zar, H. J., 1999. Biostatistical Analysis. Pretice-Hall Inc., USA. Bhijel, R.C., 2008. Statistics for aquaculture. Wiley-Blackwell.
Supplementary Readings	Gomez, K.A. and Gomez, A.A., 1984. Statistical procedures for agricultural research. John Wiley & Sons. Jayaraman, K., 2000. A statistical manual for forestry research. FORSPA.

Third Year Second Term			
Course Code: 0831 06 FMRT 3201		Year: Third	Term: Second
Course Title	Fish Population Dynamics		
Course Status	Core		
Credit	3.0		
Prerequisite(s)	None		
Rationale	The course is designed to provide the knowledge on fish population dynamics which is prerequisite to control population with a view to conserve and manage the fisheries resources following rules and regulation.		

Course Contents		CLOs
Section A		
1	Introduction: Concept of stock, population and fish population dynamics, identifying fish stocks;	1
2	Biometrics of fish population: Length-length relationship (LLR), length weight relationship, condition factor and form factor;	1, 2
3	Age structure and growth of fish: Age and growth, types of growth, factors affecting growth, importance of age and growth determination, age and growth determination methods and Von-Bertalanffy's growth equation;	2
4	Reproduction of fish: Timing of reproduction, gonad maturation stages, gonadosomatic index (GSI), length at sexual maturity (LM) and fecundity;	3
5	Fish distribution and abundance: Types of fish distribution, factors influencing fish distribution, relative abundance, absolute abundance, uses, estimation;	4, 5
6	Stock assessment: Methods to assess fish stock in open-water.	6
Section B		CLOs
7	Recruitment and Mortality: Definition, types, estimation, factors affecting the mortality;	7
8	Marking and Tagging: Types, purposes, methods of administration;	8
9	Regulations of Fish populations: Stock-recruitment relationship, Bevertonand Halt plot, Ricker curve;	9
10	Fishery Models: Modeling sustainable yield, modeling economic yield, CPUE, fishing effort, catchability;	10
11	Overfishing: Concept, types, impact and consequences;	11
12	Fishery Management Regulations: Different management strategies, and rules and regulations to control fish population and their methods of application.	12

Course Learning Outcomes (CLOs)	Upon successful completion of the course, the students will be able to:		Mapping with PLOs
	CLO1	State the main concept of fish population dynamics;	1
	CLO2	Explain the biometric indices of fish population;	1, 2
	CLO3	Determine the age and size of different fish population;	2
	CLO4	Determine the spawning period, size at first sexual maturity of different fish populations;	1
	CLO5	Assess the abundance of fish population;	1, 2
	CLO6	Assess the stock of fish population;	2
	CLO7	Quantify recruitment and mortality pattern and rate of any fish population;	1
	CLO8	Use fish marks and tags;	1, 3
	CLO9	Explore biological management considerations to control fish population;	2
	CLO10	Estimate maximum sustainable and economic yield of any fishery;	1
	CLO11	State the fishing rate and its consequences;	1, 7
	CLO12	Select rules purposively and apply in open-water fishery.	2, 4

Mapping CLOs with the Teaching-Learning and Assessment Strategy

CLOs	Teaching-Learning Strategy	Assessment Strategy
CLO1	Lecture	Quiz
CLO2	Lecture, Enquiry based learning	Assignment
CLO3	Lecture, Group Discussion	Class test
CLO4	Lecture	Quiz
CLO5	Lecture, Video tape	Quiz
CLO6	Group discussion	Presentation, Final Exam
CLO7	Lecture	Class test
CLO8	Lecture, Enquiry based learning	Class test
CLO9	Lecture, Video tape	Assignment
CLO10	Lecture	Quiz
CLO11	Lecture	Assignment
CLO12	Group discussion	Final Exam

Learning Materials

Recommended Readings	King, M., 1995. Fisheries biology, assessment and management (pp.341). Fishing News Books. Gulland, J.A., 1977. Fish population dynamics (pp.372). Wiley & Sons, USA.

Course Code: 0831 06 FMRT 3202		Year: Third	Term: Second
Course Title	Fish Population Dynamics Sessional and Field Work		
Course Status	Core		
Credit	1.0		
Prerequisite(s)	None		
Rationale	This course is designed to provide practical knowledge on development of different models of fish population and estimation of fish abundance using mark-recapture data.		

	Course Contents/Tasks	CLOs
1	Exploration of Length-weight relationship;	1
2	Modeling growth parameter using length-frequency data; growth, recruitment, mortality estimation by FiSAT;	2
3	Estimation of fish abundance using mark-recapture data;	1, 2, 3
4	Application and administration of fish marks and tags;	2
5	Determination of maximum sustainable yield of any fishery;	4
6	Determination of maximum economic yield of any fishery.	5, 6

	Upon successful completion of the course, the students will be able to:		Mapping with PLOs
Course Learning Outcomes (CLOs)	CLO1	apply the knowledge to develop length and weight relationship model;	1
	CLO2	estimate growth of a fish population;	2
	CLO3	determine fish abundance;	1, 2
	CLO4	use fish marks and tags;	2
	CLO5	develop the model for sustainable yield;	4
	CLO6	develop the model for economic yield.	2, 4

Mapping CLOs with the Teaching-Learning and Assessment Strategy

CLOs	Teaching-Learning Strategy	Assessment Strategy
CLO1	Field visit, Cooperative learning	Assignment, presentation
CLO2	Demonstration, Enquiry based learning	Practical book assessment, Quiz, Viva
CLO3	Demonstration, Case study	Assignment
CLO4	Demonstration, Lecture	Assignment, Quiz
CLO5	Demonstration, Lecture	Assignment, Quiz
CLO6	Demonstration, Lecture	Assignment, Quiz

Learning Materials

Recommended Readings	King, M., 1995. Fisheries biology, assessment and management (pp.341). Fishing News Books. Gulland, J.A., 1977. Fish population dynamics (pp.372). Wiley & Sons, USA.

Course Code: 0831 06 FMRT 3203		Year: Third	Term: Second
Course Title	Fish Breeding and Hatchery Management		
Course Status	Core		
Credit	3.0		
Prerequisite(s)	None		
Rationale	The course is designed to provide knowledge about brood management technique of freshwater and marine fishes, crustacean, mollusks, sea weed etc. and hatchery management technique to perform induced breeding of freshwater and marine commercially important species. Moreover, the focus of the course is to deliver several lectures in order to teach the students about diversified ornamental fish, their breeding and various factors that can affect their breeding.		

Course Contents		CLOs
Section A		
1	Introduction of natural breeding: Species wise Breeding season, Introduction about natural breeding of commercially important fishes in Bangladesh; Fish breeding behavior, spawning, parental care, seed collection from natural water body and its merit demerit, closed season and protection of brood; contribution of mangrove forest for natural breeding and nursing of coastal species;	1
2	Brood stock management: Present practices of brood management and impact of brood management on fish seed production, sources of brood fish, brood rearing strategies- brood pond preparation, characteristics of brood pond, fertilization and manuring, natural feeds, physioco-chemical parameter; wild and hatchery reared brood management system; selective breeding;	2
3	Brood management techniques of freshwater fish and crustacean: Carps-indigenous and exotic; Cat fishes- indigenous and exotic. Galda (freshwater giant prawn).; Gift tilapia, Thai and Vietnam Koi;	2
4	Brood management of Marine fishes, crustacean and mollusk: Marine fin fishes- Vetki, Mullet, Nona Tengra; Crustacean- Penaeid shrimp, Mud crab, Lobster; Mollusc- Mussel, Oyster, Scallop, Clam, Abalone, Octopus, Squid etc;	2
5	Transportation of live brood: Importance, conditioning, equipment for live fish transportation; traditional and modern transportation systems, use of aerator, anesthetics, antiseptics and antibiotics during transportation;	2
6	A model hatchery: Definition,site selection, layout of a model finfish and shellfish hatchery; essential components - types of incubators, hatching trays, catfish troughs/funnel, hatching jars, circular incubator, bottle hatchery, hapa and vertical tray incubators, their advantages and disadvantages;	3
7	Hatchery management techniques: Definition, objective, scope, present status and importance of fish hatchery, water supply and treatment, treatment of water for reuse, water pollutants from hatchery; egg handling, washing of fertilized eggs, types of incubation tanks/pool, tank/pond preparation, stocking practice, larval feed and feeding- first feeding, feed particle size, live food cleaning and water exchange;	4
Section B		CLOs
8	Induced breeding techniques of freshwater fishes and crustacean: Artificial/induced breeding, spawning, incubation and larval rearing techniques of- Carps: Indian major, minor, Chinese & common; Cat fishes: Pangus (indigenous and exotic), Shing, Magur, pabda, Tengra; Tilapia (procedure of all male); Koi (indigenous, Thai, Viatnam), Predator fish; Shol, Boal, Chital; Freshwater giant prawn- Macrobrachiumrosenbergii;	5
9	Induced breeding techniques: marine fin fishes- Vetki, Mullet, Lona Tengra; Crustacean- Penaeid shrimp, Mud Crab, Lobster; Mollusk-Mussel and Oyster; Propagation procedure of commercially important Marine Sea Weed in hatchery;	5
10	Ornamental fish breeding: Concept and importance of ornamental fish, commercially important exotic and indigenous ornamental fishes, fabrication and setting up of aquariums for ornamental fish breeding, breeding of live bearers, breeding of egg layers, water quality management, food and feeding;	6

	Section B	CLOs
11	Induced spawning concern: Hybridization, inbreeding, genetic conservation (cryopreservation), gametes, cryogenic gene banking, Chromosome manipulation, importance of brood bank;	7
12	Common diseases in hatchery and their control measures: Introduction, biosecurity issues in hatchery; common diseases occur in finfish and shellfish hatcheries and their control measures.	8

	Upon successful completion of the course, the students will be able to:		Mapping with PLOs
Course Learning Outcomes (CLOs)	CLO1	Differentiate natural breeding season and spawning process of commercially important different freshwater and marine species;	1
	CLO2	Explain broodstock management techniques of different freshwater and marine/brackish water fishes;	1, 2
	CLO3	Design the layout of finfish and shellfish hatcheries;	1
	CLO4	Describe different components and management principles/techniques of hatchery;	2, 3
	CLO5	Explain induced/artificial breeding techniques, spawning, incubation and larval rearing techniques of commercially important fin fish and shellfish;	1, 2, 3
	CLO6	Develop knowledge about commercially important species, brood stock management, breeding techniques of different ornamental fish;	1, 2, 3
	CLO7	Explain the induced spawning related genetics and importance of brood bank;	1, 2, 7
	CLO8	Acquire important knowledge on common diseases in hatchery and their preventive measures;	1

Mapping CLOs with the Teaching-Learning and Assessment Strategy

CLOs	Teaching-Learning Strategy	Assessment Strategy
CLO1	Lecture	Quiz, Final Exam
CLO2	Lecture, Enquiry based learning	Assignment, Final Exam
CLO3	Lecture, Group Discussion	Class test, Final Exam
CLO4	Lecture	Class test, Final Exam
CLO5	Lecture, Video tape	Quiz, Final Exam
CLO6	Group discussion	Presentation, Final Exam
CLO7	Lecture	Class test, Final Exam
CLO8	Lecture	Presentation, Final Exam

Learning Materials

Recommended Readings	Huet. M., 1972. Text Book of Fish Culture: Breeding and cultivation of fish. Fishing News Books Ltd. Jhingran, V.G. andPullin,R.S.V.,1985. A Hatchery Manual for the Common, Chineseand Indian Major Carps. Asian Development Bank and International Centre for Living Aquatic Resources Management, Manila, Philippines. Al-Hajj, A.B. and Farmer, ASD, 1984. Shrimp hatchery manual (pp.85). Safut, Kuwit Institute for Scientific Research. Piper, R.G., McElwain, I.B., Orme, L.E., McCraren, J.P., Fowler, L.G. and Leonard, J.R., 1982. Fish hatchery management. Question, E.T., 1989. Prawn, Hatchery Design and Operation, SEAFDEC Aquaculture Ext. Man. (pp.47).
Supplementary Readings	Waynarovich, E. and Horvath, L., 1980. The artificial propagation of warm-water finfishes manual for extension. Food and Agricultural Organization. Ahilan, B, Felix., N. and Santhanam, R., 2008. Text book of Aquariculture (pp.157). Daya Publishing House, New Delhi. Aexlrod, H.R. and Schultz, P.L., 1983. Hand Book of Tropical Aquarium Fishes (pp.28-30). T.F.H. Publications, Hongkong

Course Code: 0831 06 FMRT 3204	Year: Third	Term: Second
Course Title	Fish Breeding and Hatchery Management Sessional and Field work	
Course Status	Core	
Credit	1.0	
Prerequisite(s)	None	
Rationale	The course is designed to provide practical knowledge on broodstock management and induced breeding of fishes in hatchery	

	Course Contents/Tasks	CLOs
1	Location and removal of pituitary gland;	1
2	Preservation of pituitary gland and administration of the extract;	1
3	Induced breeding of fish-brood fish care and maintenance, selection of breeders, selection of inducing agent and hatching techniques;	2
4	Dose calculation of inducing agents, injection, stripping and fertilization;	1, 2
5	Use of incubators and hatching of eggs;	2
6	Visit to commercial and shrimp hatcheries.	3

	Upon successful completion of the course, the students will be able to:		Mapping with PLOs
Course Learning Outcomes (CLOs)	CLO1	Select the location of pituitary gland and can remove and preserve it;	2, 3, 4, 7
	CLO2	Design the breeding and hatching technique of fish;	2, 3, 4, 7
	CLO3	Write a report describing the hatchery complex after visiting a commercial hatchery.	3, 4, 7, 8

Mapping CLOs with the Teaching-Learning and Assessment Strategy

CLOs	Teaching-Learning Strategy	Assessment Strategy
CLO1	Lecture, Demonstration, Enquiry based learning	Assignment, presentation
CLO2	Demonstration, Video tape	Quiz and viva
CLO3	Lecture, Demonstration	Assignment and viva

Learning Materials

Recommended Readings	Jhingran, V.G. andPullin,R.S.V.,1985. A Hatchery Manual for the Common, Chineseand Indian Major Carps. Asian Development Bank and International Centre for Living Aquatic Resources Management, Manila, Philippines. Haylor, G., 1998. A Fish Hatchery Manual for Africa. Pisces Press Ltd., Stirling, Scotland
Supplementary Readings	Huet, M., 1972. Text Book of Fish Culture: Breeding and Cultivation of Fish. Fishing News Books Ltd.

Course Code: 0831 06 FMRT 3207		Year: Third	Term: Second
Course Title	Fish Parasitology and Disease		
Course Status	Core		
Credit	3.0		
Prerequisite(s)	None		
Rationale	This course provides fundamental concepts of parasitology, and understandings of major groups of fish parasites and, their relationship with hosts, mode of replication and reproduction, host-parasite interaction.		

	Course Contents	CLOs
	Section A	
1	Introduction: General concept of parasite & parasitism. Symbiosis and its relationship to parasitism, role of parasitology in fisheries and aquaculture;	1, 2
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;	1, 2
3	Types of host parasite relationship: Facultative parasitism and pscudoparasitism, spatial relationship between parasites and their hosts, temporary parasitism and permanent parasitism;	3
4	The origin of parasitism: Ectoparasitism, endoparasitism and haemoparasitism;	4
5	Morphological adaptations of parasite and their mode of life: Shape, size, colour and structure of parasites.	5
	Section B	CLOs
6	Reproduction and development of parasites: Reproduction, life span and development cycles of some representative fish parasites;	6
7	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;	7
8	Host specificity and the problem of species in parasitism: Host specificity, species in parasites, special features in the evolution of parasitic species;	8
9	Ecology of fish parasites: Host-parasite-environment relationship, ecological factors- mode of life, age, migration of fish, environmental influence, types of water bodies, influence of human, aquaculture and introduction fish and their parasite fauna;	9
10	Common parasitic diseases of fishes: causative agents, clinical and pathological signs, prevention and control.	1, 10

	Upon successful completion of the course, the students will be able to:		Mapping with PLOs
Course Learning Outcomes (CLOs)	CLO1	Illustrate general concept of parasite & parasitism;	1, 2, 7
	CLO2	Elucidate common fish parasites that are found in aquatic environment;	1, 2, 7
	CLO3	Categorize various types of parasitisms with aquaculture sector;	1, 2
	CLO4	Describe various parasites with their origin;	1, 2
	CLO5	State various morphological adaptations in aquatic environment;	1, 2, 7
	CLO6	Write the life history pattern of some important parasites in fish;	1, 2, 7
	CLO7	Illustrate the host parasite interaction, host cell and tissue reactions, humoral reactions;	1, 2, 7
	CLO8	Explain host specificity, special features in the evolution of parasitic species;	1, 2, 3
	CLO9	Describe host-parasite-environment relationship, ecological factors, environmental influence in fish and their parasite fauna;	1, 2, 3
	CLO10	Explain the concept of various parasitic diseases that are found in fish and also in human.	1, 2, 3

Mapping CLOs with the Teaching-Learning and Assessment Strategy

CLOs	Teaching-Learning Strategy	Assessment Strategy
CLO1	Lecture	Quiz
CLO2	Lecture	Assignment
CLO3	Lecture	Class test
CLO4	Lecture	Quiz
CLO5	Lecture	Quiz
CLO6	Lecture, Group discussion, Case study	Quiz, Presentation
CLO7	Lecture, Group discussion	Class test
CLO8	Lecture, Group discussion	Quiz
CLO9	Lecture, Case study	Assignment
CLO10	Lecture, Case study	Assignment, Quiz

Learning Materials

Recommended Readings	Chandra, K.J., 2009. Fish Parasitology (2nd Edition) (pp.183). Chaudhury Printing and Publication. Dogiel, V.A., 1962. General Parasitology (pp.516). Oliver and Boyd, Edinburgh, U.K. Woo, P.T.K. (ed.), 1995. Fish Diseases and Disorders. Vol. I. Protozoa and Metazoa infections (pp.808). CAB, International Publishing. Oxon, U.K. Cheng, T.C., 1982. General Parasitology. Academic Press Inc. N.Y.
Supplementary Readings	Kabata, Z., 1985. Parasites and Diseases of fish cultured in the tropics. Taylor and Francis, London. Kenndy, C.R., 1975. Ecological Animal Parasitology. Blacwell Scientific Publications, Oxford, London, Edinburgh and Melbourne.

Course Code: 0831 06 FMRT 3208		Year: Third	Term: Second
Course Title	Fish Parasitology and Disease Sessional and Field Work		
Course Status	Core		
Credit	1.0		
Prerequisite(s)	None		
Rationale	This course intends to endow students with the practical knowledge and skill necessary for identification and classification of major groups of fish parasites.		

	Course Contents/Tasks	CLOs
1	Study of museum specimens of fish parasites;	1
2	Calibration of the microscope for measurements;	2
3	Technique of investigation of fish host for parasitological study;	1, 2
4	Collection, fixation and preservation of parasites;	3
5	Permanent preservation of parasites-staining, dehydration, clearing and mounting (Histopathology);	3
6	Key out, identification and description of collected parasites;	3
7	Field trip to a fish farm and preparation of report on parasitological investigation.	2

	Upon successful completion of the course, the students will be able to:		Mapping with PLOs
Course Learning Outcomes (CLOs)	CLO1	Isolate various parasites from various organ samples of fishes.	1, 2, 6
	CLO2	Characterize and identify the major groups of parasites;	1, 2, 6
	CLO3	Preserve various groups of parasites.	1, 6

Mapping CLOs with the Teaching-Learning and Assessment Strategy

CLOs	Teaching-Learning Strategy	Assessment Strategy
CLO1	Lecture, demonstration	laboratory assessment, assignment
CLO2	Lecture, demonstration	assignment
CLO3	Lecture, demonstration, field visit	laboratory assessment, assignment class test, quiz, viva

Learning Materials

Recommended Readings	Cable, R.M., 1943. Illustrated Laboratory Manual of Parasitology. Burgess Publ. Co. Minneapolis, New York, San Francisco, London translation, Jerusalem. Chandra, K.J., 2008. A Practical Text book of Fish Parasitology and Health Management. Published by the Bangladesh University Grants Commission, Dhaka.
Supplementary Readings	Tonguthai, K., Chinabut, S., Somsiri, T., Chandratchakool, P. and Kanchanakhan, S., 1999. Diagnostic Procedures for Fin fish Diseases. AAHRI, Department of Fisheries. Yamaguti, S., 1963. Systema Helminthum. Vol. I-V. Interscience Publishers Inc.

Course Code: 0831 06 FMRT 3211		Year: Third	Term: Second
Course Title	Marine Botany		
Course Status	Optional		
Credit	2.0		
Prerequisite(s)	None		
Rationale	This course offers a lecture-based introductory overview of aquaculture; culturing and farming of aquatic microphytes and macrophytes grow in freshwater, brackishwater and saltwater. Overall, this course is designed to provide in-depth knowledge on the biology and culture of aquatic floral resources found in different types of habitat.		

Course Contents		CLOs
Section A		
1	Biology of Marine Plants: Types and taxonomy of commercially important aquatic plants grow in marine water, their structure, biology and mode of development;	1
2	Biology of Marine/Brackish water Plants: Brief species description of marine (including brackish water) microphytes and macrophytes; Marine algal resources- Taxonomy, diversity, life history, structure and biology of commercial important species; Seaweed resources- Taxonomy, diversity, life history, structure and biology of commercial important species;	2
3	Importance of Aquatic Flora: Utilization of Commercially important aquatic floral resources; Ecological and economic importance of different aquatic flora available in Bangladesh.	3
Section B		CLOs
4	Culture Technique of Marine Plants: Cultural techniques of commercially important marine plants available in Bangladesh;	4
5	Culture Technique of Marine Algae: Cultural techniques of commercially important marine algae available in Bangladesh; cultural techniques of commercially important seaweeds available in Bangladesh;	5
6	Marketing condition of Aquatic Plants: Existing marketing channel of commercially important aquatic flora; strategies' for mainstreaming eccentric aquatic plants available in Bangladesh.	6

	Upon successful completion of the course, the students will be able to:		Mapping with PLOs
Course Learning Outcomes (CLOs)	CLO1	Write the biology of different aquatic plants grow in freshwater;	1
	CLO2	Explain the basic biology of microphytes and macrophytes grow in Marine environment;	1, 2, 3
	CLO3	Point out the utilization of aquatic plants for commercial purpose;	1, 2
	CLO4	Explain the artificial and natural growing systems of freshwater plants;	2, 3
	CLO5	Conclude the culture technique of algae and seaweeds;	1, 2, 3
	CLO6	Connect the supply chain, value chain and marketing strategy of edible aquatic plants available in Bangladesh.	1, 2, 3

Mapping CLOs with the Teaching-Learning and Assessment Strategy

CLOs	Teaching-Learning Strategy	Assessment Strategy
CLO1	Lecture	Final Exam
CLO2	Lecture	Final Exam
CLO3	Lecture, Group Discussion	Class test, Final Exam
CLO4	Lecture	Class test, Final Exam
CLO5	Lecture	Quiz, Final Exam
CLO6	Lecture	Presentation, Final Exam

Learning Materials

Recommended Readings	Boyd, B., 2003. Introduction to Algae. Englewood Cliffs. Wickens, G.E., 2004. Economic Botany: Principles and Practices, Springer. Kuwer Publishers, Dordrecht, The Netherlands. Richmond, A. (Ed.), 2004. Handbook of Microalgal Culture. Blackwell. Chapman, V.J. and Chapmen, D.J., 1980. Seaweeds and Their Uses. Chapman & Hall. Sundaralingam, V.S., 1990. Marine Algae (Morphology, Reproduction and Biology). Bishen Singh Mahendra Pal Singh, Dehra Dun.
Supplementary Readings	Boolootion, R.A. and Thomas, J., 1967. Marine Biology. Holt, Rinehart and Winston, Inc., New York. Toronto. London. Russel, S.F.S. and Yonge, S.M., 1973. Advances in Marine Biology (vol.II). Academic press, London and New York. Eriedrich, H., 1973. Marine biology. Sidgasick and Jackson London.

Course Code: 0831 06 FMRT 3212		Year: Third	Term: Second
Course Title	Marine Botany Sessional and Field Work		
Course Status	Optional		
Credit	1.0		
Prerequisite(s)	None		
Rationale	To provide in-depth knowledge on the identification, categorization, utilization, nutritional composition and marketing of aquatic plant resources.		

	Course Contents/Tasks	CLOs
1	Collection, preservation and identification of some aquatic plants from brackishwater and marine environment;	1
2	Phenological observations of flora, seaweed and algae resources and preparation of charts – Herbaria preparation;	2
3	Proximate composition analysis of edible aquatic plants, algae and seaweeds;	3
4	Market/Stakeholder survey to identify the market condition, supply chain of edible aquatic plants.	4

	Upon successful completion of the course, the students will be able to:		Mapping with PLOs
Course Learning Outcomes (CLOs)	CLO1	Identify, define and compare aquatic plants grow in different environment;	3
	CLO2	Categorize aquatic flora and prepare charts;	1, 2
	CLO3	Determine moisture, ash, protein, carbohydrates, lipid and micronutrients from aquatic flora;	1, 2, 3, 4
	CLO4	Differentiate the existing market condition.	2, 3

Mapping CLOs with the Teaching-Learning and Assessment Strategy

CLOs	Teaching-Learning Strategy	Assessment Strategy
CLO1	Field visit, cooperative learning	Assignment, Presentation
CLO2	Demonstration	Quiz, Viva
CLO3	Demonstration	Lab test, viva
CLO4	Lecture	Viva

Learning Materials

Recommended Readings	Boyd, B., 2003. Introduction to Algae. Englewood Cliffs. Wickens, G.E., 2004. Economic Botany: Principles and Practices. Springer. Kuwer Publishers, Dordrecht, The Netherlands. Richmond, A. (Ed.), 2004. Handbook of Microalgal Culture. Blackwell.
Supplementary Readings	Chapman, V.J. and Chapmen, D.J., 1980. Seaweeds and Their Uses. Chapman & Hall. Sundaralingam, V.S., 1990. Marine Algae (Morphology, Reproduction and Biology). Bishen Singh Mahendra Pal Singh, Dehra Dun.

Course Code: 0610 06 CSE 3250		Year: Third	Term: Second
Course Title	Computer Programming		
Course Status	Optional		
Credit	2.0		
Prerequisite(s)	None		
Rationale	This course provides students advance understanding of computer applications in fisheries, as so to make students capable of applying the gained knowledge in fisheries management.		

	Course Contents/Tasks	CLOs
1	Introduction: Overviewof computer programming;	1
2	Computer programming: Design and development of computer programme using BASIC Language;	1, 2
3	Analysis and visualization: Advanced statistical analysis using a programming language, visualize data through graphs and tables using example data sets, handling large datasets;	1, 2, 3
4	Software exercises: Report writing, presentation, and reference citations using software.	3

	Upon successful completion of the course, the students will be able to:		Mapping with PLOs
Course Learning Outcomes (CLOs)	CLO1	Compose programming language for advanced statistical analysis of data;	1, 2, 4, 9
	CLO2	Compose reports using word processors;	3, 8, 9
	CLO3	Create table of contents and reference citations using software.	4, 6, 9

Mapping CLOs with the Teaching-Learning and Assessment Strategy

CLOs	Teaching-Learning Strategy	Assessment Strategy
CLO1	Lecture, Video tape, Problem based learning	Quiz, Assignment
CLO2	Lecture, Problem based learning	Assignment
CLO3	Lecture, Group-topic presentation	Group discussion responses, Assignment

Learning Materials

Recommended Readings	V. Rajaraman, V., 2007. Computer Basics and C Programming. Prentice Hall India Learning Private Limited. Solem, J.E., 2012. Programming Computer Vision with Python: Tools and algorithms for analyzing images, O'Reilly Media. Megrey, B. A. and ErlendMoksness, E., 2008. Computers in Fisheries Research. Springer.
Supplementary Readings	Sparre, P., 1987. Computer Programs for Fish Stock Assessment: Length-based Fish Stock Assessment for Apple II Computers. Volume 2 of Computer programs for fish stock assessment Issue 101 of FAO fisheries technical paper, Food and Agriculture Organization.

Course Code: 0511 06 BGE 3251		Year: Third	Term: Second
Course Title	Principles of Genetics		
Course Status	Core		
Credit	3.0		
Prerequisite(s)	None		
Rationale	This course is designed to provide basic concept of different principles and theories of genetics, followed by subsequent applications in aquaculture and fisheries management.		

Course Contents		CLOs
	Section A	
1	Introduction: Milestones, branches, scope and significance of genetics, Mendelian genetics;	1
2	Cytogenetics: Variation in chromosomal structure single breaks, two breaks in the same chromosome, two breaks in nonhomologous chromosomes, centromeric breaks, duplications, chromosomal rearrangements in human beings, variation in chromosome Number, aneuploidy, mosaicism, euploidy, consequences of meiosis, gene recombination, linkage disequilibrium, genetic mapping;	1, 2, 3
3	Sex determination in fish: Sex chromosome, different sex determining systems, sex-linked inheritance, sex-fluencing and sex-limited traits, environmentalsex determination;	1, 2, 3
4	Population genetics: Genotypic frequencies, allelic frequencies, Hardy-Weinberg equilibrium, geographic and temporal variation in frequencies of the allele, change of genetic structure, natural selection; genotype - environment interaction, estimates of genotype-environment interaction in aquaculture species.	4
	Section B	CLOs
5	Kinship, relationship and inbreeding: Concepts, calculating coefficients of kinship, relationship and inbreeding value, uses of inbreeding, consequences of inbreeding, effective breeding number (Ne), genetic drift, inbreeding programs, management of genetic variation in fish breeding schemes;	1, 2, 5
6	Genetics of qualitative phenotypes: single autosomal gene, gene action, dihybrid inheritance, two or more autosomal gene, epistasis interaction, multiple allele, pleiotropy;	1, 6
7	Genetics of quantitative phenotypes: Phenotypic variance, genetic variance, heritability, role of environment in phenotypic expression;	1, 7
8	Mating design in fish breeding: Effect of mating design on genetic diversity, paired mating, factorial mating design, associated models in different mating design;	1, 8
9	Selection programs: Factors considered for selection, individual selection, cut off value, tandem selection, independent culling, selection index, family selection, crossbreeding, hybridization, heterosis, genome wide association studies (GWAS).	9

Course Learning Outcomes (CLOs)	Upon successful completion of the course, the students will be able to:		Mapping with PLOs
	CLO1	Explain the transmission of hereditary characteristics from generation to generation and the relationship between genes and traits;	1, 2
	CLO2	Illustrate the nature and consequences of chromosomal breakage and reunion and the variation in chromosomal structure;	1, 2
	CLO3	Sex determination mechanisms, sex-linked and sex-influenced and sex-limited characters;	1, 2, 3, 7
	CLO4	Explain the concept of population-level genetic processes and test whether a population is in hardy-weinberg equilibrium;	1, 2
	CLO5	Calculate inbreeding co-efficient, effective breeding number and genetic drift;	1, 2, 3, 4
	CLO6	Explain qualitative phenotypes and its important in aquaculture;	1, 2
	CLO7	Illustrate quantitative phenotypes and it application in heritability;	1, 2
	CLO8	Elucidate different types mating design;	5, 6
	CLO9	Illustrate different types selection program in fish breeding.	7, 8

Mapping CLOs with the Teaching-Learning and Assessment Strategy

CLOs	Teaching-Learning Strategy	Assessment Strategy
CLO1	Lecture	Quiz
CLO2	Lecture, Group Discussion	Assignment
CLO3	Lecture, Video tape, Group Discussion	Class test
CLO4	Lecture, Enquiry based learning	Quiz
CLO5	Lecture, Video tape, Co-operative Learning	Written Exam
CLO6	Lecture, Case Study	Assignment
CLO7	Lecture, Group Discussion	Presentation
CLO8	Lecture, Case Study, Group Discussion	Written Exam
CLO9	Lecture, Video Tape, Group Discussion	Final Exam

Learning Materials

Recommended Readings	Pierce, B.A., 2012. Genetics: A conceptual approach. Macmillan. Gjedrem, T. and Baranski, M., 2010. Selective breeding in aquaculture: an introduction (Vol. 10). Springer Science & Business Media.
Supplementary Readings	Tamarin, R.H., 2015. Principles of genetics. McGraw-Hill.

Course Code: 0511 06 BGE 3252		Year: Third	Term: Second
Course Title	Principles of Genetics Sessional		
Course Status	Core		
Credit	1.0		
Prerequisite(s)	None		
Rationale	This course is designed to provide laboratory experiments in the field of fish genetics and biotechnology		

	Course Contents/Tasks	CLOs
1	Cell Division: Study of different stages of mitosis and meiosis;	1
2	Mendelian Genetics: Working out problems on Mendelian inheritance pattern, working out problems on two- and three-point test cross for linkage and crossing over, study on heritability;	2
3	Population Genetics: Study of inheritance pattern of some simple and linked inherited characters of human in population.	3

	Upon successful completion of the course, the students will be able to:		Mapping with PLOs
Course Learning Outcomes (CLOs)	CLO1	Explain different stages of cell division, Illustrate the recombination of genetic materials;	3, 4, 7, 8
	CLO2	Elucidate inheritance pattern of fish, explain heritability of different fish species;	3, 4, 7, 8
	CLO3	Analyze population genetics.	6, 9

Mapping CLOs with the Teaching-Learning and Assessment Strategy

CLOs	Teaching-Learning Strategy	Assessment Strategy
CLO1	Field visit, Video tape, Cooperative learning	Assignment, Presentation
CLO2	Workshop, Demonstration, Rnquiry based learning	Practical book assessment, Quiz, Viva
CLO3	Demonstration, Group discussion, Seminar	Presentation

Learning Materials

Recommended Readings	Pierce, B.A., 2012. Genetics: A conceptual approach. Macmillan. Gjedrem, T. and Baranski, M., 2010. Selective breeding in aquaculture: an introduction (Vol. 10). Springer Science & Business Media.
Supplementary Readings	Tamarin, R.H., 2015. Principles of genetics. McGraw-Hill.

Course Code: 0111 06 Res 3253		Year: Third	Term: Second
Course Title	Research Methodology		
Course Status	Core		
Credit	3.0		
Prerequisite(s)	None		
Rationale	The course is designed to provide knowledge about the aims and scope of research methodology, formulation of research problems and planning, sampling and research design and writing and presentation of research results, so that students can identify the problems, realize the way of doing scientific research, plan and design a research, and ultimately write a report/ thesis in a systematic way.		

Course Contents		CLOs
Section A		
1	Introduction: Aims and scope of research methodology, meaning of research, objective, motivation and types of research; research methods versus methodology;	1
2	Research process: Primary and secondary research, qualitative and quantitative research, choosing appropriate methods;	2
3	Identifying and analyzing research problems: Research problem and problems selection techniques;	3
4	Review of literature: Contents and style of presentation;	4
5	Writing a research proposal: Different components in the PPs.	5
Section B		CLOs
6	Sampling design: Census and sampling, implication of sample design, nature of good sample designs, different sampling designs;	6
7	Experimental designs: Meaning and needs of research, design, nature of good research design, important concepts relating to research design, different research designs;	7
8	Designing experiments in fisheries;	8
9	Writing scientific papers and reports;	9

	Upon successful completion of the course, the students will be able to:		Mapping with PLOs
Course Learning Outcomes (CLOs)	CLO1	Reframe the subject with scope and application;	1, 2
	CLO2	Evaluate the elements of research process;	1, 2
	CLO3	Generalize the research problems and problem selection techniques;	1, 2, 3, 4
	CLO4	Criticize the literature as the important component of research undertaking and publication;	1, 2, 4, 6
	CLO5	Develop the components of different PPs	1, 2
	CLO6	Select the types, methods and techniques of sampling;	2, 3
	CLO7	Design different types of research ;	1, 3
	CLO8	Design and conduct experiments in fish culture;	1, 5
	CLO9	Write a scientific paper and report.	6, 7

Mapping CLOs with the Teaching-Learning and Assessment Strategy

CLOs	Teaching-Learning Strategy	Assessment Strategy
CLO1	Lecture, Group Discussion	Quiz
CLO2	Lecture, Video tape, Seminar	Assignment
CLO3	Lecture, Video tape, Group discussion	Class test
CLO4	Lecture, Video tape, Enquiry based learning	Quiz
CLO5	Lecture, discussion, Seminar	Written Exam
CLO6	Lecture, Group discussion, Case study	Assignment
CLO7	Lecture, Group discussion	Presentation
CLO8	Lecture, Case study, Group discussion	Assignment, Presentation
CLO9	Lecture, Group discussion, Case study	Final Exam

Learning Materials

Recommended Readings	Kothari, C.R., 2004. Research Methodology: Methods and techniques. New Age International. Bhamrah, H.S., Sandhu, G.S. and Gupta, K.C., 2006. Research Techniques in Biological Science. Dominant Publishers.
Supplementary Readings	Schlieper, C., 1972. Research methods in marine biology. University of Washington Press.

Course Code: 0111 06 Res 3254		Year: Third	Term: Second
Course Title	Research Methodology Sessional		
Course Status	Core		
Credit	2.0		
Prerequisite(s)	None		
Rationale	The course is designed to provide practical knowledge on performing different test and experimental design to conduct research, so that the students can design and conduct a research and write a scientific paper by using the acquired knowledge.		

	Course Contents/Tasks	CLOs
1	Exercises in review of literature;	1, 2
2	Identification of research problem; establishing hypothesis;	1, 2
3	Designing experiments;	1, 2
4	Exercise in writing abstract, introduction, result, discussion and conclusion ; Citation and reference writing style; application of Endnote.	1, 2

Course Learning Outcomes (CLOs)	Upon successful completion of the course, the students will be able to:		Mapping with PLOs
	CLO1	Design and conduct a research;	1, 4, 5, 7, 8, 9
	CLO2	Write a scientific paper.	3, 4, 7, 8, 9

Mapping CLOs with the Teaching-Learning and Assessment Strategy

CLOs	Teaching-Learning Strategy	Assessment Strategy
CLO1	Field visit, Video tape, Cooperative learning	Assignment, Presentation
CLO2	Workshop, Demonstration, Enquiry based learning	Practical book assessment, Quiz, Viva

Learning Materials

Recommended Readings	Kothari, C.R., 2004. Research Methodology: Methods and techniques. New Age International. Bhamrah, H.S., Sandhu, G.S. and Gupta, K.C., 2006. Research Techniques in Biological Science. Dominant Publishers.
Supplementary Readings	Schlieper, C., 1972. Research methods in marine biology. University of Washington Press.

Fourth Year First Term			
Course Code: 0831 06 FMRT 4101		Year: Fourth	Term: First
Course Title	Fish Processing		
Course Status	Core		
Credit	3.0		
Prerequisite(s)	None		
Rationale	The contents of this course will give in depth idea on post-harvest technology of fisheries resources to the students. Students will learn about scientific way of proper handling, various ways of preservation and processing, and value addition of fish and other fisheries products. Thus, knowledge obtained from this course will make the students efficient enough to work field level to industrial level in the post- harvest sector of fisheries in Bangladesh and abroad as well.		

Course Contents		CLOs
	Section A	
1	Introduction to fish processing: Objectives, scope and potentialities, production and marketing of fish and fishery products in Bangladesh.	1, 2
2	Wet fish handling: Preservation and processing broad aims.	1, 2
3	Fish and shellfish muscles: Structural characteristics, biochemical composition and role of biochemical compositions in fish quality and process ability.	3
4	Postmortem changes in fish: Rigor mortis, factors affecting rigor mortis, bio-chemical phenomenon of rigor mortis, impact of rigor mortis on processing and keeping quality of fish, spoilage of fish and delaying spoilage.	3, 4
5	Microbial limit and Freshness index: Concepts, assessing methods and applications.	5
	Section B	CLOs
6	Chilling and icing of fish: Principles, types and nature, preparation of ices, icing and chilling methods, distribution and retailing of iced and chilled fish, shelf life of iced.	6
7	Freezing: Mechanism of freezing, factors involved in freezing, methods and equipment, commercial freezing of shellfish and finfish in Bangladesh, factors associated with frozen and cold storage of fish, thawing of frozen products	7
8	Curing: Basic principles, methods and constraints of sun drying and dehydration, salting, smoking and fermentation of fish.	8
9	Canning: Principles, preparation of raw materials and steps, examination of processed fish can, appropriate species for fish canning in Bangladesh.	8
10	Packaging, storage and marketing: package selections, package regulations and modern approaches of packaging.	8

Course Learning Outcomes (CLOs)	Upon successful completion of the course, the students will be able to:		Mapping with PLOs
	CLO1	State the scope and importance of fish processing	1, 2, 3
	CLO2	Explain the principle of wet fish handling	1, 2, 3
	CLO3	Analyze the biochemical composition and process ability of fish and shellfish muscles	2, 3, 4
	CLO4	Explain the molecular mechanism of postmortem changes in fish	2, 3, 4
	CLO5	Categorize the microbial limit and freshness index of fish	1, 2, 7
	CLO6	Point out the basic procedure of chilling and icing of fish	1, 2, 7, 8
	CLO7	Explain the basic principle of fish freezing	1, 2, 3
	CLO8	Distinguish the basic principle of curing (drying, salting and smoking), canning and packaging	4, 8

Mapping CLOs with the Teaching-Learning and Assessment Strategy

CLOs	Teaching-Learning Strategy	Assessment Strategy
CLO1	Lecture	Quiz
CLO2	Lecture	Continuous assessment
CLO3	Lecture and Group Discussion	Presentation, Final Exam
CLO4	Lecture	Quiz, Presentation
CLO5	Lecture and Group Discussion	Quiz
CLO6	Lecture and video tape	Continuous assessment
CLO7	Group discussion	Presentation, Final Exam
CLO8	Lecture and video tape	Quiz, Presentation, Final exam

Learning Materials

Recommended Readings	Balachandran, K.K., 2001. Post-harvest Technology of Fish and Fish Products (pp.440). Daya Publishing House, Delhi – 110035. India. Clucas, I.J. and Ward, A.R., 1996. Post-harvest Fisheries Development: A Guide to Handling, Preservation, Processing and Quality (pp.443). Natural Resource Institute, UK.
Supplementary Readings	Hall, G.M. (Ed.), 1997. Fish Processing Technology (2nd Edition). (pp.309) Blackie Academic & Professional.

Course Code: 0831 06 FMRT 4102		Year: Fourth	Term: First
Course Title	Fish Processing Sessional and Field Work		
Course Status	Core		
Credit	1.0		
Prerequisite(s)	None		
Rationale	The contents of this course will help the students to achieve practical knowledge on how to maintain/control post-harvest quality of shrimp, fish, crabs and other fisheries resources, and estimation of the biochemical composition of fish, crustaceans and other fisheries species.		

	Course Contents/Tasks	CLOs
1	Acquaintance with fish processing laboratory and safety use of lab equipment, glassware and chemicals.	1, 2
2	Preparation of standard chemical solutions and reagents.	1, 2
3	Estimation of moisture, ash, protein, lipid and non-protein nitrogen content of fish by oven drying method.	3
4	Assessment of post-harvest quality loss of wet fish through sensory method.	3, 4
5	Determination of rigor index of fish.	4, 5
6	Preparation of wet fish: Skinning, dressing and filleting.	6

	Upon successful completion of the course, the students will be able to:		Mapping with PLOs
Course Learning Outcomes (CLOs)	CLO1	Familiarize with primary and safety lab equipment	1, 2, 3
	CLO2	Explain the preparation method of standard chemical solutions and reagents	1, 2, 3
	CLO3	Describe the estimation procedure of moisture, ash, protein, lipid and non-protein nitrogen content of fish	1, 2, 3
	CLO4	Analyze the post-harvest quality loss of wet fish	1, 2, 6
	CLO5	Explain the determination procedure of rigor index of fish	1, 2, 3
	CLO6	Reframe the basic preparation procedure of wet fish	7, 8

Mapping CLOs with the Teaching-Learning and Assessment Strategy

CLOs	Teaching-Learning Strategy	Assessment Strategy
CLO1	Lecture and practical session	Quiz
CLO2	Lecture and practical session	Quiz
CLO3	Lecture and practical session	Presentation
CLO4	Lecture and practical session	Presentation
CLO5	Lecture and practical session	Quiz, Presentation
CLO6	Lecture and practical session	Quiz, Presentation

Learning Materials

Recommended Readings	Balachandran, K.K., 2001. Post-harvest Technology of Fish and Fish Products (pp.440). Daya Publishing House, Delhi – 110035. India. Clucas, I.J. and Ward, A.R., 1996. Post-harvest Fisheries Development: A Guide to Handling, Preservation, Processing and Quality (pp.443). Natural Resource Institute, UK.
Supplementary Readings	Hall, G.M. (Ed.), 1997. Fish Processing Technology (2nd Edition). (pp.309) Blackie Academic& Professional, London, Weinheim, New York, Melbourne, Madras.

Course Code: 0831 06 FMRT 4103		Year: Fourth	Term: First
Course Title	Fish Pathology and Immunology		
Course Status	Core		
Credit	3.0		
Prerequisite(s)	None		
Rationale	This course makes the students familiar with various fish and shellfish diseases, and diagnosis through understanding their etiology, pathology, classification and identification processes of major groups of fish and diseases. The course provides the students basic understanding of immune systems of fish and shellfishes, and of immune responses and control strategies against diseases.		

	Course Contents	CLOs
	Section A	
1	Introduction: Definitions of disease, pathogen, symptom, syndrome etc. classification of diseases; importance of studying pathology and immunology;	1, 2
2	Diagnosis of diseased fish: Healthy and unhealthy one. Clinical and laboratory diagnosis;	2
3	Infection of diseases: Definition, types, prevalence and intensity of infection; source and spread of infections;	1, 3
4	Disease associated factors: Environmental and non environmental factors related to disease;	1, 3
5	Disease produced by pathogen: Bacterial, viral, fungal, and parasitic;	2, 3
6	Pathological changes in fish and shell fishes: their etiology, epizootiology, clinical signs, pathology, distribution, prevention measures.	3
	Section B	CLOs
7	Immunology: General concepts in immunology, innate and adaptive immunity;	4, 5
8	Non-specific defense mechanism in fishes: Surface barriers, non-specific humoral and cellular factors; leucocytes – types and function;	4, 5
9	Specificimmune responses in fishes: Organs involved in specific immunity, humoral anti body and cell mediated immunity, lymphocytes and their formation and function, immunoglobulin types and function, monoclonal and polyclonal antibodies, antibody response, autoimmunity;	5
10	Defense mechanisms in crustaceans: Humoral and cellular defenses;	4, 5
11	Immune modulation: Factors modulating immune responses, stress and immunological tolerance, adjuvant, types of adjuvant, role of different types of adjuvant in immune modulation and vaccine development;	6
12	Vaccination: Principles of vaccination, classification of vaccine, methods of vaccine development; current trends in fish vaccination, advantages and disadvantages of vaccines, industrial production of fish vaccines.	6, 7

Course Learning Outcomes (CLOs)	Upon successful completion of the course, the students will be able to:		Mapping with PLOs
	CLO1	Conceptualize various diseases, the factors related to diseases	1, 2
	CLO2	Diagnose a diseased fish and assess the infection processes of the pathogens;	2, 3
	CLO3	Explain the pathological changes in fish and shell fishes, their etiology, epizootiology, clinical signs, pathology, distribution;	2, 3, 4, 8
	CLO4	Distinguish the immune responses of fish and shell fishes;	1, 2
	CLO5	Depict the specific and non-specific defense mechanisns and organs involved in immune response;	1, 2, 4, 8
	CLO6	Point out various factors that affect the immune responses, immunological memory, immunological tolerance;	2, 5, 7
	CLO7	Demonstrate their knowledge and skill in developing vaccines and other control strategies against various infectious diseases of fishes and shellfishes.	2, 7, 8, 9

Mapping CLOs with the Teaching-Learning and Assessment Strategy

CLOs	Teaching-Learning Strategy	Assessment Strategy
CLO1	Lecture and video tape	Quiz
CLO2	Lecture	Assignment and Quiz
CLO3	Lecture and case studies	Assignment and Class test
CLO4	Lecture, video tape and Group Discussion	Quiz, Class test and group presentation
CLO5	Lecture	Quiz and Class test
CLO6	Lecture and Group discussion	Quiz and group presentation
CLO7	Lecture and problem based learning	Assignment and Quiz

Learning Materials

Recommended Readings	Hoole, D., Bucke, D., Burgess, P. and Wellby, I., 2001. Diseases of carp and other cyprinid fishes (pp. 140-143). Oxford,, UK: Fishing News Books. Woo, P.T., Leatherland, J.F. and Bruno, D.W. eds., 2011. Fish diseases and disorders (Vol. 3). CABI.
Supplementary Readings	Austin, B. and Newaj-Fyzul, A. 2017. Diagnosis and Control of Diseases of Fish and Shellfish. Wiley, 320 p. Kindt, T.J., Goldsby, R.A. and Osborne, B.A., 2007. Immunology. In Cellular and Molecular Immunology. Abbas, A.K., Lichtman, A.H. and Pallai, S. (eds). Elsevier Publication.

Course Code: 0831 06 FMRT 4104		Year: Fourth	Term: First
Course Title	Fish Pathology and Immunology Sessional and Field Work		
Course Status	Core		
Credit	1.0		
Prerequisite(s)	None		
Rationale	This intends to provide the students practical knowledge necessary to distinguish, and understand the various diseases occurred in fishes and shellfishes as well as the causative factors linked to diseases.		

	Course Contents/Tasks	CLOs
1	Technique of disease investigation: Principles and processes, sample collection, and preservation;	1, 3
2	Identification features: Key out, identification and description of pathogens (bacteria, virus and fungus) infecting fishes and shellfishes;	2, 3
3	Collection and examination: Live and/or post mortem examination of diseased or healthy fish and shellfishes for disease diagnosis;	2, 3
4	Immunoserological tests: Principles, procedures, different methods applied in aquaculture.	1, 4
5	Field trip: Fish farms/markets and preparation of report on disease investigation.	1, 2, 3

	Upon successful completion of the course, the students will be able to:		Mapping with PLOs
Course Learning Outcomes (CLOs)	CLO1	Apply their experience to diagnose and healthy fish and shellfishes;	1, 3, 6
	CLO2	Identify the pathogens from the host;	1, 2, 3, 4, 5, 7, 9
	CLO3	Point out the host and pathogen for studying disease producing factors.	2, 4, 6, 8
	CLO4	Depict different immunoserological method used in aquaculture	1, 3, 4, 5, 9

Mapping CLOs with the Teaching-Learning and Assessment Strategy

CLOs	Teaching-Learning Strategy	Assessment Strategy
CLO1	Lecture, video tape	Quiz
CLO2	field visit, laboratory work and demonstration	Laboratory test and assessment
CLO3	field visit, discussion, case studies	Quiz, group presentation, viva
CLO4	Lecture, video tape, laboratory work	Quiz and assessment

Learning Materials

Recommended Readings	Woo, P.T.K. and Bruno, D.W., 1999. Fish Diseases and Disorders Vol. 3. CABI Publishing Co., London. Austin, B. and Austin, D.A., 1999. Bacterial Fish Pathogens: Diseases in Farmed and Wild Fish (3rd ed). Ellis Horwood, England. Tonguthai, K., Chinabut, S., Somsiri, T., Chanratchakool, P. and Kanchanakhan, S., 1999. Diagnostic procedures for finfish diseases. AAHRI, Department of Fisheries, Kasetsart Univ. Campus,Bangkok, Thailand.
Supplementary Readings	Plumb, J.A., 1994. Health Maintenance of Cultured Fishes: Principal Microbial Diseases. Argent: B-HEAL-MCF. Thoesen, J.C. (ed.), 1994. Bluebook: Suggested Procedures for the Detection and Identification of Certain Finfish and Shellfish Pathogens, AFS, Fish Health Section (4th ed). Argent. B- BLUE-SPD. Lom, J. and Dykova, I., 1992. Protozoan Parasites of Fishes. Development in Aquaculture and Fisheries Science, Vol. 26. Elsevier, Amsterdam.

Course Code: 0831 06 FMRT 4105		Year: Fourth	Term: First
Course Title	Fish Biotechnology and Genetic Engineering		
Course Status	Core		
Credit	3.0		
Prerequisite(s)	None		
Rationale	This course is designed to provide basic concept of genetic engineering and biotechnology involved in fisheries science for the increase of fish production by genetic improvement through gene regulation.		

Course Contents		CLOs
Section A		
1	Chemical nature of gene: Characteristics of genetic material, molecular basis of heredity, Griffith's experiment, Hershey and Chase experiment, structure of DNA and RNA, DNA replication, DNA organization in chromosomes.	1, 2, 3
2	Expression and regulation of genetic information: The genetic code and translation, translation and protein, gene mutation, regulation of gene expression in prokaryotic and eukaryotic.	4
3	Recombinant DNA Technology: Basic concepts of recombinant DNA technology, recombinant DNA techniques, applications of recombinant DNA technology.	5
4	Molecular techniques: Electrophoresis, Southern blotting, Northern blotting, Western blotting, hybridization of nucleic acid, polymerase chain reaction (PCR), DNA sequencing, Genetic bar coding, CRISPER, TALEN, microarray, qPCR.	6
5	Molecular markers: Principles and techniques of RFLP, RAPD, AFLP, and microsatellite DNA markers, ITS and their applications.	6
Section B		CLOs
6	Gene-transfer Technology: Gene-transfer Technique in Fish, Promoters, Integration, Transmission of Transgenes, Transgene Expression of Growth-hormone and Reporter Genes, Performance of Transgenic Fish, Growth, Cold tolerance, Disease resistance, Transgenic Production of Pharmaceuticals, Gene Knockout Technology, Potential Role of Mitochondrial DNA in Gene Transfer.	7
7	Functional and Comparative Genomics: Organization of the Genome, Describing Patterns of Gene Expression, Site-Specific Mutagenesis of DNA, Analysis of Expression of Individual Genes, Analysis of Protein–Protein Interactions, Classes of DNA Polymorphisms, Mutations, DNA Typing, Gene Therapy, RNAi	7
8	Chromosome manipulation: Production of gynogens, androgens, triploids and tetraploids, production of mono-sex populations, applications	8
9	Bioethics and biosafety: Bioethics and moral virtues biosafety of transgenic fish.	8

Course Learning Outcomes (CLOs)	Upon successful completion of the course, the students will be able to:		Mapping with PLOs
	CLO1	Explain the molecular model of genetic materials and their information carrying features	1, 2, 3
	CLO2	Write the central dogma of molecular biology	3, 4, 7
	CLO3	Elucidate the mechanisms of dna restriction, ligation and transformation of genetic materials, molecular techniques, dna hybridization and pcr technique.	3, 4, 7
	CLO4	Design different molecular markers and their applications is genetic studies	4, 5, 7
	CLO5	Write the transgenic techniques, knock out and knock down of genes.	3, 4, 7
	CLO6	Explain the functionality of genomics	1, 5, 7
	CLO7	Distinguish chromosome manipulation techniques, including production of gynogens, androgens, triploids,tetraploids and application of mono-sex populations	1, 6, 7
	CLO8	Write the bioethics and morality in biotechnology and biosafety of transgenic fish	2, 3, 4

Mapping CLOs with the Teaching-Learning and Assessment Strategy

CLOs	Teaching-Learning Strategy	Assessment Strategy
CLO1	Lecture, demonstration, discussion	Class test
CLO2	Lecture, demonstration, discussion	Class test
CLO3	Lecture, demonstration, discussion	Class test
CLO4	Lecture, demonstration, discussion	Class test
CLO5	Lecture, demonstration, discussion	Class test
CLO6	Lecture, demonstration, discussion	Class test
CLO7	Lecture, demonstration, discussion	Class test
CLO8	Lecture, demonstration, discussion	Class test

Learning Materials

Recommended Readings	Pierce, B.A., 2012. Genetics: A conceptual approach. Macmillan. Genetics: A Molecular Approach, Peter Russell, Publisher : Benjamin-Cummings Pub Co (January 1, 2005), Language : English

Course Code: 0831 06 FMRT 4106		Year: Fourth	Term: First
Course Title	Fish Biotechnology and Genetic Engineering Sessional		
Course Status	Core		
Credit	1.0		
Prerequisite(s)	None		
Rationale	This course is designed to provide laboratory experiments in the field of cell analysis and fish genetics, so that the students can apply the basic molecular techniques in fisheries science by DNA analysis and chromosome manipulation		

	Course Contents/Tasks	CLOs
1	Study of chemical nature of gene.	1
2	Working out on DNA replication and recombinant DNA.	2
3	DNA isolation from aquatic animals.	3
4	Study on PCR technique and gel electrophoresis.	4
5	Fish hybridization and chromosome manipulation.	5
6	Study on molecular markers	6

	Upon successful completion of the course, the students will be able to:		Mapping with PLOs
Course Learning Outcomes (CLOs)	CLO1	Explain chemical components of gene.	7, 8
	CLO2	Elucidate DNA replication and recombination.	7, 8
	CLO3	Isolate DNA from fish tissue and bacterial.	7, 8
	CLO4	Explain PCR and electrophoresis techniques	7, 8
	CLO5	RAPD analysis	7, 8
	CLO6	Explain molecular markers	7, 8

Mapping CLOs with the Teaching-Learning and Assessment Strategy

CLOs	Teaching-Learning Strategy	Assessment Strategy
CLO1	Lecture, demonstration and field visit	Assignment, Presentation, Practical book assessment, Quiz, Viva
CLO2	Lecture, demonstration and field visit	Assignment, Presentation, Practical book assessment Quiz, Viva
CLO3	Lecture, demonstration and field visit	Assignment, Presentation, Practical book assessment Quiz, Viva
CLO4	Lecture, demonstration and field visit	Assignment, Presentation, Practical book assessment Quiz, Viva
CLO5	Lecture, demonstration and field visit	Assignment, Presentation, Practical book assessment Quiz, Viva
CLO6	Lecture, demonstration and field visit	Assignment, Presentation, Practical book assessment Quiz, Viva

Learning Materials

Recommended Readings	Nelson, D.L., Lehninger, A.L. and Cox, M.M., 2008. Lehninger Principles of biochemistry. Macmillan. Sambrook, J. and Russell, D.W. (2001) Molecular Cloning A Laboratory Manual. 3rd Edition, Vol. 1, Cold Spring Harbor Laboratory Press, New York.

Course Code: 0831 06 FMRT 4107		Year: Fourth	Term: First
Course Title	Aquaculture Extension		
Course Status	Core		
Credit	3.0		
Prerequisite(s)	None		
Rationale	The course is intended to orient the students to acquire competence and hands-on skills on preparation and application of various extension tools. Besides, the students will be able to learn about the recent development in extension management in terms of concepts, approaches and methods.		

Course Contents		CLOs
	Section A	
1	Introduction: Introduction to extension education and fisheries extension - concepts, objectives, philosophy and principles; extension education, formal and informal education; teaching and learning process, social and cultural factors affecting extension programs. Extension systems in Bangladesh; Scope and importance of fisheries and aquaculture extension	1, 2, 4
2	Communication: Definition, process, theories and models; Traditional communication; Individual, group and mass communication, levels of communication; non-verbal communication; AV aids – selection and use.	4, 5, 6
3	Communicator: Role of communicator in extension education, communicator's behavior; communication skills; fidelity of communication; communication competence and empathy; communication effectiveness and credibility; improving oral and written communication; communicating with fishers and fish farmers; barriers in communication.	4, 6
4	Recent communication technologies: Internet based technologies, video and teleconferencing, computer assisted instructions, Information kiosks, Village Resource Centers, Community networks, WAN, MAN, AGRINEt, e-Governance; Cyber extension and e-learning.	2, 9
5	Extension program planning in aquaculture: objectives of having a program, principle of extension program planning, steps in extension program planning, Participatory Rural Appraisal (PRA), program evaluation.	3
	Section B	CLOs
6	Participatory approaches in Extension: Participatory approaches for aquatic resources management and development: need, importance and guiding principles; Community mobilization methods. Participatory Learning Approach (PLA), Participatory appraisal, selection of participatory methods and their uses; Farmer Field Schools for Aquaculture.	5, 7
7	Monitoring and evaluation of development program: Monitoring, evaluation and impact assessment - importance and scope in fisheries program; conceptual frameworks, results frameworks and logic models, Difference between outcome and impact; Types of impact assessment.	4, 5, 6
8	Extension services related to aquaculture: Transfer of technology, support service and credit facilities, marketing and distribution system, training of fish farmers in aquaculture techniques, aquaculture information system, and institutional support in extension service.	6
9	Extension training: Purpose and scope; training of technicians and extension officers; training of fish farmers.	8
10	Aquaculture technology demonstration.	8, 10

Course Learning Outcomes (CLOs)	Upon successful completion of the course, the students will be able to:		Mapping with PLOs
	CLO1	Evaluate different communication strategies used in mass, group and personal contact methods of extension program.	2, 4
	CLO2	Reframe participatory approaches in fisheries extension program.	4, 5, 6
	CLO3	Gain insights into different concepts, principles, practice, recent changes and emerging challenges in aquaculture extension.	4, 6
	CLO4	Get hands on training in application of extension methods and communication aids.	2, 9
	CLO5	Apply different aspects of planning processes.	3
	CLO6	Impart knowledge on diffusion of fisheries innovations.	5, 7
	CLO7	Critically analyze the innovation decision processes in the fisheries sector.	4, 5, 6
	CLO8	Familiarize the students with the basic concepts of human resource management with special reference to organizations in fisheries sector.	6
	CLO9	Train the farmers as well as extension worker to broaden the aquaculture sector.	8
	CLO10	Demonstrate new aquaculture technology.	8

Mapping CLOs with the Teaching-Learning and Assessment Strategy

CLOs	Teaching-Learning Strategy	Assessment Strategy
CLO1	Lecture	Quiz
CLO2	Lecture and Enquiry based learning	Assignment
CLO3	Lecture and Group Discussion	Class test
CLO4	Lecture	Quiz
CLO5	Lecture and video tape	Quiz
CLO6	Group discussion	Presentation
CLO7	Lecture and Group Discussion	Class test
CLO8	Lecture and Enquiry based learning	Assignment
CLO9	Group discussion	Presentation
CLO10	Lecture and video tape	Final Exam.

Learning Materials

Recommended Readings	Ray, G.L., 1996. Extension Communication and Management. Naya Prokash, India. Singh, A.K., 2001. Agricultural Extension: Impact and Assessment. Agrobios, India. Brown, D., Derek, S. and Simon, F.S., 2005. Mainstreaming Fisheries Co-Management in the Asia-Pacific. Asia-Pacific Fishery Comm. Rep.Publ. 2005/24, FAO, United Nations Regional Office for Asia andthe Pacific, Bangkok.
Supplementary Readings	Chambers, R., Arnold, P. and Thrupp, L.A., 1989. Farmers First: Farmer Innovation and Agricultural Research. Intermediate TechnologyPubl. Edwards, P., Little, D.C. and Demaine, H., 2002. Rural Aquaculture. CABI. Kumar, D., 1999. Trickle Down System (TDS) of Aquaculture Extension for Rural Development. RAP Publ.

Course Code: 0831 06 FMRT 4108	Year: Fourth	Term: First
Course Title	Aquaculture Extension Sessional and Field Work	
Course Status	Core	
Credit	1.0	
Prerequisite(s)	None	
Rationale	This course is designed to provide the student hands on practice in different aspects to acquire skills required to practice various fisheries extension approaches, so that the students can acquire competency to plan, implement, monitor and evaluate extension and development program.	

	Course Contents/Tasks	CLOs
1	Case study through participatory rural appraisal techniques needs assessment.	1, 2
2	Success story writing; Practical exercises on conducting fish farmers meet.	2, 3
3	Exercise on development of extension and field manuals; Exercises on participatory learning / co-learning;	2, 3, 4
4	Organizing meetings, guided discussions; organizing field demonstrations and field days.	2, 3
5	Preparation of information, education and communication materials on various aspects of fisheries; instructional video and ICT.	4
6	Practicing tele and video conferencing, case study of a community radio, tele-centres and farmer discussion groups; designing a website on fisheries and aquaculture.	3, 4
7	Preparing investigative report of fishing/fish farming village considering culture, language, values, norms,	3, 5

	Upon successful completion of the course, the students will be able to:		Mapping with PLOs
Course Learning Outcomes (CLOs)	CLO1	Point out different communication strategies used in mass, group and personal contact methods of extension program.	1
	CLO2	Apply their hands on training in application of extension methods and communication aids.	2
	CLO3	Design structures and functions of community institutions	5
	CLO4	Explain preparation and application skill of various multimedia tools and ICT.	6, 9
	CLO5	Criticize issues related to gender, livelihood and development.	8

Mapping CLOs with the Teaching-Learning and Assessment Strategy

CLOs	Teaching-Learning Strategy	Assessment Strategy
CLO1	Field visit, cooperative learning	Assignment, presentation
CLO2	Demonstration, enquiry based learning	Practical book assessment, Quiz, Viva
CLO3	Field visit, Lecture	Quiz, Assignment
CLO4	Field visit, Lecture	Quiz, Assignment
CLO5	Field visit, Lecture	Quiz, Assignment

Learning Materials

Recommended Readings	Brown, D., Derek, S. and Simon, F.S., 2005. Mainstreaming Fisheries Co- Management in the Asia-Pacific. Asia-Pacific Fishery Comm. Rep.Publ. 2005/24, FAO, United Nations Regional Office for Asia andthe Pacific, Bangkok. Sinha, V.R.P., 1999. Rural Aquaculture in India. FAO, United Nations, Thailand. RAP Publ.
Supplementary Readings	Donald, L.K., 1998. Evaluating Training Programmes: The Four Levels. Berrett-Koehler. Lynton, R.P. and Pareek, U., 1973. Training for Development. Sage Publ. Phillips, J.J., 1998. Handbook of Training Evaluation and Measurement Methods. Gulf Publ.

Course Code: 31 06 FMRT 4110	Year: Fourth	Term: First
Course Title	Proposal Development	
Course Status	Core	
Credit	2.0	
Prerequisite(s)	None	
Rationale	This course is designed to provide students the practical knowledge about how to identify a research problem, develop the experimental design, select an appropriate methodology, and write up the synopsis to find out the probable solution of the identified research problem.	

	Course Contents/Tasks	CLOs
1	Students will be given a task to prepare a synopsis for research work. The work will be done under a supervisor to be selected by the Discipline. The synopsis will be presented and the research plan will be confirmed by the respective committee.	1

Course Learning Outcomes (CLOs)	Upon successful completion of the course, the students will be able to:		Mapping with PLOs
	CLO1	At the end of the course the students will be able to prepare a synopsis for a project thesis.	1, 2, 3, 4, 5, 7, 8

Mapping CLOs with the Teaching-Learning and Assessment Strategy

CLOs	Teaching-Learning Strategy	Assessment Strategy
CLO1	Field visit, demonstration, project modular group discussion, seminar	Presentation, viva and synopsis

Learning Materials

Recommended Readings	Brown, D., Derek, S. and Simon, F.S., 2005. Mainstreaming Fisheries Co- Management in the Asia-Pacific. Asia-Pacific Fishery Comm. Rep.Publ. 2005/24, FAO, United Nations Regional Office for Asia andthe Pacific, Bangkok. Sinha, V.R.P., 1999. Rural Aquaculture in India. FAO, United Nations, Thailand. RAP Publ.
Supplementary Readings	Donald, L.K., 1998. Evaluating Training Programmes: The Four Levels. Berrett-Koehler. Lynton, R.P. and Pareek, U., 1973. Training for Development. Sage Publ. Phillips, J.J., 1998. Handbook of Training Evaluation and Measurement Methods. Gulf Publ.

Course Code: 0831 06 FMRT 4113		Year: Fourth	Term: First
Course Title	Fish Food Safety and Quality Control		
Course Status	Optional		
Credit	2.0		
Prerequisite(s)	None		
Rationale	This course is designed to familiarize students with fish food safety and quality control. The course will also help the students to recognize various methods of quality assessment and assurance as well as having detailed idea about micro flora degrading fishery products. Finally students will learn how to produce quality fish product which will meet the demand of the people as well as earning foreign currency.		

Course Contents		CLOs
Section A		
1	Introduction: Concept of food safety in fishery products, purpose, scope and importance of food safety programs, Quality management, total quality concept and application in fish trade, problems in food safety and quality assurance of fishery products. Researchable issues in this sector.	1, 2
2	Quality assurance: Hygiene and safety aspects of quality control, standard sanitary operating system (SSOP) and standard operating system (SOP) in processing plant, Good manufacturing procedure (GMP), inspection of fish and fishery products. Quality management information, HACCP.	1, 3
3	Quality assessment: Quality assessment of fish and fishery products - physical, chemical, organoleptic and microbiological quality standards.	2
Section B		CLOs
4	Food hazards: Physical, chemical and biological hazards.	4, 5
5	Traceability for food safety: Background concept, importance, method, implementation, steps.	6
6	Food laws, regulations and institutions: Food legislations and standards, competent authority, organization of quality control and official inspection system, Regulatory standards for products and processing plants.	6

	Upon successful completion of the course, the students will be able to:		Mapping with PLOs
Course Learning Outcomes (CLOs)	CLO1	Explain the basics of fisheries food safety and quality control.	1, 2
	CLO2	State and criticize different laws and regulations.	1, 3
	CLO3	Develop various methods of quality assessment and assurance.	2
	CLO4	Write hygiene and safety aspects of fisheries products.	4, 7
	CLO5	Compare raw materials and finished products quality.	1, 2
	CLO6	Compile fish food safety and quality control management	2

Mapping CLOs with the Teaching-Learning and Assessment Strategy

CLOs	Teaching-Learning Strategy	Assessment Strategy
CLO1	Lecture	Quiz
CLO2	Lecture and Enquiry based learning	Assignment
CLO3	Lecture and Group Discussion	Class test
CLO4	Lecture	Quiz
CLO5	Lecture and video tape	Presentation
CLO6	Group discussion	Final Exam

Learning Materials

Recommended Readings	Anthony, T.T., 1988. Handbook of Natural Toxins. Marine Toxins andVenom. Vol. III. Marcel Dekker. Balachandran, K.K., 2001. Post Harvest Technology of Fish and Fish Products. Daya Publ. House. Connell, J.J., 1995. Control of Fish Quality. Fishing News Books. John, D.E.V., 1985. Food Safety and Toxicity. CRC Press. Hui, Y.H., Merle, D.P. and Richard, G.J. (Eds.), 2001. Food Borne DiseaseHandbook. Seafood and Environmental Toxins. Vol. IV. Marcel Dekker.
Supplementary Readings	Huss, H.H., Jakobsen, M. and Liston, J., 1991. Quality Assurance in the Fish Industry. Elsevier. Krenzer R. 1971. Fish Inspection and Quality Control. Fishing News. Sen, D.P., 2005. Advances in Fish Processing Technology. Allied Publ. Vincent, K. and Omachonu, J.E.R., 2004. Principles of Total Quality. CRC Press. Kreuzer, R. (ed.), 1971. Fish Inspection and quality control. Fishing News (books), Limited. London, EC4, England. Connell, J.J., 1985. Control of Fish Quality. Fishing News Book Ltd.

Course Code: 0521 06 ES 4151		Year: Fourth	Term: First
Course Title	Environmental Impact Assessment		
Course Status	Optional		
Credit	2.0		
Prerequisite(s)	None		
Rationale	This course is designed to provide fundamental concepts of environmental impact assessment and processes how to conduct the assessment, so that the students can predict the impacts of aquaculture and fisheries on the environment and take the mitigating actions to resolve the problems.		

Course Contents		CLOs
Section A		
1	Introduction: concepts of environment, ecology, development and impacts; interconnection between development and environment;	1, 2
2	Background: historical background of EIA; adoption of EIA; development of EIA;	1, 2
3	Scope of EIA: scope and importance of EIA to sustainable development; EIA in project planning and implementation;	2
4	Environmental assessment in perspective: foundations of assessment: purpose and aims of EIA; principles of EIA; EIA procedures;	3
Section B		CLOs
5	EIA processes: evaluation of proposed action; scooping EIA methodology; risk assessment and risk management; mitigation measures;	1, 4
6	Social impact assessment: principles and core values; steps for social impact assessment process; public participation	4
7	Review and decision: comparison of alternatives; compensatory actions; review of procedures, practices and guidelines in developing countries;	1, 5
8	Monitoring: monitoring environmental impact; effective data collection and management; participatory monitoring and evaluation.	6, 7

	Upon successful completion of the course, the students will be able to:		Mapping with PLOs
Course Learning Outcomes (CLOs)	CLO1	Explain conceptions of environment, ecology, development, impacts, assessment and sustainability.	1, 2, 7
	CLO2	Evaluate the background of EIA, its adoption and development.	1, 2, 7, 8
	CLO3	Explain importance, planning and implementation strategy of EIA.	1, 2, 7
	CLO4	Distinguish the perspective of aims, principles and procedures of EIA.	1, 2, 7
	CLO5	Explain about EIA methodology including the risk assessment and mitigation.	1, 2, 7
	CLO6	Design social impact assessment; process of review and decision	1, 2, 7, 8
	CLO7	Make and assess guidelines for developing countries.	1, 2, 7, 8

Mapping CLOs with the Teaching-Learning and Assessment Strategy

CLOs	Teaching-Learning Strategy	Assessment Strategy
CLO1	Lecture	Quiz
CLO2	Lecture and Enquiry based learning	Assignment
CLO3	Lecture and Group Discussion	Continuous assessment
CLO4	Lecture	Continuous assessment
CLO5	Lecture and video tape	Quiz
CLO6	Group discussion, interactive learning	Presentation, Final Exam
CLO7	Group discussion	Presentation, Final Exam

Learning Materials

Recommended Readings	Wathern, P., 1996. Environmental Impact Assessment. McGraw-Hill Co. Glasson, J., Therivel, R. and Chadwick, A., 1998. Introduction to Environmental Impact Assessment. UCL Press. Wood, C., 1995. Environmental Impact Assessment. Iongman.

Course Code: 0512 06 BGE 4154		Year: Fourth	Term: First
Course Title	Bioinformatics Sessional		
Course Status	Optional		
Credit	1.0		
Prerequisite(s)	basic computer including operating systems, software, networking		
Rationale	This course provides students basic knowledge of bioinformatics, and hands-on training on its application in biological data analyses.		

	Course Contents/Tasks	CLOs
1	Introduction: Why bioinformatics; RNA structure; DNA Structure and properties; reading DNA; gene and genome; transcriptome; high throughput technologies in genomics;	1
2	Genetic Data base: Nucleic acid sequence databases; protein sequence databases; genome databases;	1, 2
3	Sequence analysis: Common bioinformatic tools and programmes (R), various file formats; sequence similarity, identity and homology, pairwise and multiple sequence alignments; gene identification and characterization; protein motifs and domain prediction;	2, 3
4	Primer design: concepts; designing and specificity validation;	2, 3
5	Phylogeny: Common bioinformatic tools of phylogenetic and molecular evolutionary analysis;	3, 4
6	Gene expression analysis: differential gene identification; gene network analysis.	3, 4

	Upon successful completion of the course, the students will be able to:		Mapping with PLOs
Course Learning Outcomes (CLOs)	CLO1	Conceptualize the basic features of bioinformatics;	1, 9
	CLO2	Crows and collect data from different sources including NCBI, UniProt, DDBJ;	2, 3, 4
	CLO3	Run common bioinformatic tools and programs (R);	3, 4, 6
	CLO4	Analyze genetic data.	3, 4, 5

Mapping CLOs with the Teaching-Learning and Assessment Strategy

CLOs	Teaching-Learning Strategy	Assessment Strategy
CLO1	Lecture, demonstration, discussion	Quiz
CLO2	Lecture, enquiry based learning, video tape,	Assignment
CLO3	Lecture, demonstration, video tape	Lab test
CLO4	Lecture, demonstration, video tape	Assignment and presentation

Learning Materials

Recommended Readings	Xiong, J., 2006, Essential Bioinformatics, Cambridge University Press. Moorhouse, M. and Barry, P., 2004, Bioinformatics, Biocomputing and Perl: An Introduction to Bioinformatics Computational Skills and Practice, John Wiley and Sons.
Supplementary Readings	Claverie, J.M. and Notredame, C. 2007. Bioinformatics For Dummies. Wiley Publishing, Inc.

Fourth Year Second Term			
Course Code: 0831 06 FMRT 4201		Year: Fourth	Term: Second
Course Title	Aquatic Pollution and Toxicology		
Course Status	Core		
Credit	3.0		
Prerequisite(s)	None		
Rationale	This course is designed to provide knowledge on causes of inland and marine water pollution and impacts of pollution on aquatic environment		

	Course Contents	CLOs
	Section A	
1	Introduction: Introduction to aquatic chemistry, chemical processes in the aquatic systems, the carbonate system, oxidation and reduction in natural waters, horizontal and vertical distribution of chemical constituents, biological and chemical regulation of the composition of natural waters.	1, 5
2	Nature, Type and Sources of Pollution: Definition, types of pollution, effects of pollution on aquatic organisms, pathways of pollution to man. Nature, types and sources of pollutants both in the inland and marine environment.	1, 2, 4
3	Pollution due to heavy metals and their compounds: Type, sources, bio-accumulation of heavy metal compounds and their management in aquatic systems	2, 3, 4
4	Oil pollution: Sources of oil pollution; Lessons from oil spills and remedial action; Effects of oil pollution on living organisms and ecosystem, proper management of oil pollution.	3, 4, 8
	Section B	CLOs
5	Introduction to ecotoxicology and Ecological indicators: Methods for detecting, identifying and quantifying pollutants and ascertaining their points of input into the ecosystems.	4, 5
6	Eutrophication: Eutrophication, anoxia, pathogens, organochlorine insecticides, organophosphate and carbamate insecticides, fertilizers, thermal pollution, detergents.	1, 5, 6
7	Toxic Responses: Discriminating between acute responses and chronic effects such as teratogenesis, mutagenesis and carcinogenesis; The application of animal models in predicting and assessing risk to human health.	1, 5, 6, 7
8	Environmental Legislation: Environmental legislation for the toxic and harmful substances; International convention for protecting aquatic environment.	6, 7, 8

	Upon successful completion of the course, the students will be able to:		Mapping with PLOs
Course Learning Outcomes (CLOs)	CLO1	Explain the basics of aquatic chemistry and distribution of chemical components in aquatic system	1, 2
	CLO2	Categorize the types and effects of pollutant on organism and environment	1, 2
	CLO3	Explain the heavy metal induced bio-accumulation and pollution in aquatic system	1, 2, 3, 4
	CLO4	Adapt the mode and mitigation of oil pollution	1, 2, 4, 6
	CLO5	Conclude the basic of ecotoxicology and design various techniques to identify pollutants	1, 2
	CLO6	Rank some agents of pollution	2, 3
	CLO7	Evaluate the effects of pollutants on organism	1, 3
	CLO8	Reframe the environmental legislation related to aquatic pollution	1, 5

Mapping CLOs with the Teaching-Learning and Assessment Strategy

CLOs	Teaching-Learning Strategy	Assessment Strategy
CLO1	Lecture and Group Discussion	Quiz
CLO2	Lecture, Video Tape and Seminar	Assignment
CLO3	Lecture, Video Tape and Group Discussion	Class test
CLO4	Lecture, Video Tape and Enquiry based learning	Quiz
CLO5	Lecture, Discussion and Seminar	Written Exam
CLO6	Lecture, Group Discussion and Case Study	Assignment
CLO7	Lecture and Group Discussion	Presentation
CLO8	Lecture, Case Study and Group Discussion	Final Exam

Learning Materials

Recommended Readings	Tripathi, A.K. and Pandey, S.N., 1990. Water Pollution. SB Nangia. Asian Publishing House. Ali, S.M., 1992. Legal aspects of environmental pollution and management. Brown, V.K., 1980. Acute Toxicity in Theory and Practice. Wiley, NY. Butler, G.C. (ed.), 1978. Principles of Ecotoxicology. John Wiley and Sons, New York. Katyal, T. and Satake, M., 1989. Environmental pollution. Anmol Publication Pvt. Ltd., New Delhi.
Supplementary Readings	Satake, M. and Mido, Y., 1997. Environmental Toxicology. Discovery publishing house, New Delhi. Ruivo, M., 1972. Marine Pollution and Sea Life. Academic Press. Alabaster, J.S., 1986. Review of the state of water pollution affecting inland fisheries in South East Asia. FAO, UN. Baird, C. and Cann, M., 2008. Environmental Chemistry, Freeman and Co.

Course Code: 0831 06 FMRT 4202		Year: Fourth	Term: Second
Course Title	Aquatic Pollution and Toxicology Sessional and Field Work		
Course Status	Core		
Credit	1.0		
Prerequisite(s)	None		
Rationale	This course is designed to provide practical laboratory skills to determine the toxic chemicals and its dose of lethality, so that the students can identify those chemicals from the water body and take necessary action to manage it.		

	Course Contents/Tasks	CLOs
1	Detecting Pollutants: Determination of concentration levels of different pesticides and organic chemicals containing effluents.	1
2	Heavy Metal Detection: Determination of some heavy metal concentration in Marine and estuarine waters, sediments and organisms - Fe, Cu, Zn, Cd, Pb. Hg, Ni, Co, Mo, etc.	2
3	Organic Pollution Detection: Identification and quantification of hydrocarbons from marine water, sediments and organisms.	1, 2
4	Monitoring Toxicity: Monitoring the level of selected pesticide/trace metal/hydrocarbon in various aquatic trophic levels and habitats. Determination of LC50/LD50 a selected pesticide/trace metal/hydrocarbon on commercially important fish/crustaceans/molluscs of fresh, brackish and marine water origin.	1, 2

Course Learning Outcomes (CLOs)	Upon successful completion of the course, the students will be able to:		Mapping with PLOs
	CLO1	Develop various methods to determine pollutants from the water sample	1, 2, 3, 4, 7, 8
	CLO2	Assess the LC50/LD50 value for a selected pesticide in a water system.	3, 4, 7, 8, 9

Mapping CLOs with the Teaching-Learning and Assessment Strategy

CLOs	Teaching-Learning Strategy	Assessment Strategy
CLO1	Field visit, video tape, cooperative learning	Assignment, presentation
CLO2	Workshop, Demonstration, enquiry based learning	Practical book assessment, Quiz, Viva

Learning Materials

Recommended Readings	Ruivo, M., 1972. Marine Pollution and Sea Life. Academic Press. Laws, E.A., 2000. Aquatic Pollution. Wiley. Rand, G.M., 1995. Fundamentals of Aquatic Toxicology. Effects, environmental fate and risk assessment. Taylor & Francis. Haslam, S.M., 1991. River pollution and ecological perspective. Belhaven Press, London. Mohan, I., 1989. Environmental pollution and Management. SB Nangia, New Delhi.
Supplementary Readings	Chhatwai, G.R. and Satake, M., 1989. Environmental water pollution and its control. Anmol Publication Pvt. Ltd. New Delhi. Hill, I.R. and Wright, S.J.L. (eds.), 1978. Pesticide Microbiology. Academic Press, NY. Manahan, S.E., 1991. Toxicological Chemistry: A Guide to Toxic Substances in Chemistry (4th Printing). Lewis Publishers Inc., Michigan, 317 pp. ISBN: 0-87371-149-1. Rand, G.M. and Petrocelli, S.R., 1985. Fundamentals of Aquatic Toxicology. Hemisphere Publishing Corporation, New York, 666pp. ISBN: 0-89116-382-4 (SB); 0-89116-302-6 (HB).

Course Code: 0831 06 FMRT 4203		Year: Fourth	Term: Second
Course Title	Fisheries Management and Conservation		
Course Status	Core		
Credit	3.0		
Prerequisite(s)	None		
Rationale	This course is designed to provide scientific studies on fisheries management and conservation issues, so that the students can manage and protect the natural resources during their future professional life.		

	Course Contents	CLOs
	Section A	
1	Introduction: Definition, concept and history of fisheries management, importance of life history data in fisheries management, types of inland water bodies with multipurpose uses.	1
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.	2
3	Fisheries Cooperative - Roles, objectives, general principles, activities and problems of fisheries cooperative, mitigation measures; Community Based Fisheries Management.	3
4	Recreational Fisheries: History, objectives, major recreational fisheries resources, recreational fisheries and tourisms, management and future development of recreational fisheries with tourism activities. V	4
5	Sustainable Fisheries Management: Concept, framework, sustainable management factors (social, economic, environmental and technological aspects), ecosystem approach to fishing.	5
	Section B	CLOs
6	Introduction to fisheries conservation: definition, necessity, objectives, areas, functions, problems, models and methods of fisheries conservation.	6
7	Aquatic conservation: Direct and indirect causes of fish decline, ecological/biological principles and concepts in fish conservation, survey, surveillance and monitoring, status and characteristics of vulnerable species, conservation strategies - habitat management, harvest/population management, protection/ preservation, animal damage control, etc.	6
8	Legislation and conservation: Policies that influence and/or regulate fish conservation and use, legal framework for conservation - protected area and species, current practices employed in the conservation and management of aquatic habitats. . Conservation of fisheries resources and conservation methods adopted by Bangladesh within EEZ. Biodiversity rules and regulations and Conservation of Biological Diversity (CBD).	7
9	Conservation and protection: protected species and habitats (Red List, Fauna-Flora-Habitat Directive), national and international aspects.	6

	Upon successful completion of the course, the students will be able to:		Mapping with PLOs
Course Learning Outcomes (CLOs)	CLO1	Write the introductory aspects of fisheries management	2, 4, 7
	CLO2	Explain the techniques of habitat restoration in fisheries management	2, 4, 7
	CLO3	Criticize the concept of cooperative fisheries management	2, 4, 7
	CLO4	Reframe the recreational fisheries management	2, 4, 7
	CLO5	Design the concept of sustainable fisheries management	2, 4, 7
	CLO6	Write the introductory aspects of aquatic and as well as fisheries conservation	2, 4, 7
	CLO7	Judge the concept of legislation and policies that influence and/or regulate fish conservation	2, 4, 7

Mapping CLOs with the Teaching-Learning and Assessment Strategy

CLOs	Teaching-Learning Strategy	Assessment Strategy
CLO1	Lecture and Group Discussion	Presentation
CLO2	Lecture	Quiz
CLO3	Lecture and Group Discussion	Presentation
CLO4	Lecture and Video	Quiz
CLO5	Lecture and Group Discussion	Presentation
CLO6	Lecture and Group Discussion	Class Test
CLO7	Group Discussion	Presentation, Viva, Final Exam

Learning Materials

Recommended Readings	Cowx, I.G., 2000. Management and Ecology of River Fisheries. Fishing News Books, Blackwell Limited, Oxford OX2 OEL, UK. Templeton, R.G., 1995. Freshwater Fisheries Management. Fishing News Books, Farnham, Surey, UK.
Supplementary Readings	Tsai, C. and Ali, M.Y., 1997. Open water Fisheries of Bangladesh. The University Press Limited, Dhaka 1000, Bangladesh. Welcome, R.L., 2001. Inland Fisheries: Ecology and Management. Fishing News Books, Farnham, Surrey, UK. R 68.

Course Code: 0831 06 FMRT 4204	Year: Fourth	Term: Second
Course Title	Fisheries Management and Conservation Sessional and Field Work	
Course Status	Core	
Credit	1.0	
Prerequisite(s)	None	
Rationale	This course is designed to provide experimental field visits in fisheries practicing areas markets, so that the students can recognize the management strategies and approaches of natural resources.	

	Course Contents/Tasks	CLOs
1	Preparation for Participatory Rural/Rapid Appraisal (PRA) tools and techniques for field visits and data collection on fisheries.	1, 2
2	Field trip to observe different fisheries management practices and to identify management constraints and mitigation measures.	1, 2
3	SWOT analysis of different fisheries management in Bangladesh	1, 2, 3
4	Debate on fisheries management rules and regulations	3

	Upon successful completion of the course, the students will be able to:		Mapping with PLOs
Course Learning Outcomes (CLOs)	CLO1	Categorize the approaches and tools for collection and analysis of fisheries management and conservation data	1, 2, 7
	CLO2	Evaluate the management constraints and mitigation measures for fisheries management	1, 2, 7
	CLO3	Identify the appropriate rules and regulations for fisheries management perspectives.	1, 2, 7

Mapping CLOs with the Teaching-Learning and Assessment Strategy

CLOs	Teaching-Learning Strategy	Assessment Strategy
CLO1	Field Visit, Demonstration	Presentation
CLO2	Demonstration and problem based learning	Presentation, assignment
CLO3	Demonstration problem based learning	Presentation

Learning Materials

Recommended Readings	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, 1999. Sustainable Livelihoods Guidance Sheets. Department for International Development, London, UK. Engle, C.R. and Quagrainie, K., 2006. Aquaculture Marketing Handbook. Blackwell Publishing Ltd, Oxford OX4 2DQ, UK. Hoggarth, D.D., Cowan, V.J., Halls, A.S., Aeron-Thomas, M., McGregor, A.J., Garaway, C.A., Payne, A.I. and Welcome, R.L., 1999. Management Guidelines for Asian Floodplain River Fisheries. FAO Fisheries Technical Paper 384 (l&2), FAO, Rome, Italy. Murphy, B.R. and Willis, D.W., 1996. Fisheries Techniques. American Fisheries Society, USA.

Supplementary Readings	Narayanasamy, N., 2009. Participatory Rural Appraisal: Principles, Methods and Applications. SAGE Publications Pvt. Ltd, India. Pound, B., Braun, A., McDougall, C. and Snapp, S., 2003. Managing Natural Resources for Sustainable Livelihoods — Uniting Science and Participation. Natural Resource Institute, University of Greenwich, Chatham, UK. Sultana, P. and Thompson, P., 2003. Methods of Consensus Building for Community Based Fisheries Management in Bangladesh and Mekong Delta. CAPRi Working Paper No. 30, International Food Policy Research Institute, Washington DC, USA. Villareal, L.V., 2004. Guidelines on the Collection of Demographic and Socio-economic information on Fishing Communities for use in Coastal and Aquatic Resources Management. Food and Agriculture Organisation (FAO) of the United Nations, Rome, Italy. Sultana, P. and Thompson, P., 2003. Methods of Consensus Building for Community Based Fisheries Management in Bangladesh and Mekong Delta. CAPRI Working Paper No. 30, International Food Policy Research Institute, Washington DC, USA.70.

Course Code: 0831 06 FMRT 4205		Year: Fourth	Term: Second
Course Title	Fish Pharmacology		
Course Status	Core		
Credit	3.0		
Prerequisite(s)	None		
Rationale	This course is designed to expand the advanced practice student's knowledge of pharmacotherapeutics. Broad categories of pharmaceutical agents are explained. Students will be able to take proper steps to prevent and to take curative measures for various fish diseases faced by the rural farmers are emphasized.		

Course Contents		CLOs
Section A		
1	Introduction: Introduction of fish pharmacology, pharmacological terms and definitions, scope, history.	1, 6
2	Pharmacokinetics: Sources of drugs, principles of drug activity, absorption, distribution, biotransformation and elimination of drugs.	2
3	Pharmacodynamics: Concept of drug receptor, dose response relationship, half-life and withdrawal period, factors affecting drug effect and dosage, principles of drug safety in terms of species and environment.	3, 6
4	Antibacterial agents, antiviral, antiparasitic, antiseptic and disinfectant.	4, 5
Section B		CLOs
5	Fish medicine and safety of fish medicine; Drugs used to manipulate breeding, sex of off-spring.	4, 5, 6
6	Methods of drugs administration against bacterial, viral, fungal, parasitic diseases	5, 6
7	Fish anaesthesia and anesthetics; Guide line for anesthesia for fish, stages of anesthesia & recovery, chemical and methods for anaesthesia	4, 5, 6
8	Commercial Chemicals: Feed additives, Pro & Prebiotics, Immunostimulants. Medicines and Related substances, Control Act, Drug regulation & legislation in various country including Bangladesh.	4, 5, 6

	Upon successful completion of the course, the students will be able to:		Mapping with PLOs
Course Learning Outcomes (CLOs)	CLO1	Explain the basic concepts of fish pharmacology.	1, 2, 5, 6, 7,
	CLO2	Write the process by which a drug is absorbed, distributed, metabolized and eliminated by the body.	2, 3, 4, 5, 6, 7, 9
	CLO3	Write the interactions of a drug and the receptors responsible for its action in the body.	2, 3, 4, 5, 6, 7, 9
	CLO4	Describe comparative aspects various pharmacodynamic and chemotherapeutic agents those are useful to protect various diseases	2, 3, 4, 5, 6, 7, 9
	CLO5	Decide the way to use drugs in the aquaculture system for various fish diseases caused by bacterial, viral, fungal, parasites.	2, 3, 4, 5, 6, 7, 8, 9
	CLO6	Plan the safety use of aquaculture medicines and the laws of national and abroad, legislation relating to fish disease and treatment	2, 3, 4, 5, 6, 7, 8, 9,

Mapping CLOs with the Teaching-Learning and Assessment Strategy

CLOs	Teaching-Learning Strategy	Assessment Strategy
CLO1	Lecture and enquiry-based learning	Assignment
CLO2	Lecture and video tape	Class test
CLO3	Lecture and video tape	Class test
CLO4	Lecture and enquiry-based learning	Presentation
CLO5	Lecture and video tape	Quiz
CLO6	Lecture and Group discussion	Assignment, Presentation, Final Exam

Learning Materials

Recommended Readings	Howland, R.D., Mycek, M.J., Harvey, R.A., and Champe, P.C., 2005. Pharmacology. Lippincott Williams and Wilkins 552p. Brown, K.M.T., 2000. Applied Fish Pharmacology. Aquaculture Series 3, Kluwer Academic Publishers. Dordrecht. The Netherlands. 309 p. Stoskopf, M.K., 1993. Fish medicine. W B Saunders company Philadelphia. 882 p.
Supplementary Readings	Stoskopf, M. K., 1988. Tropical Fish medicine. Vet. Clins .N.Am.(SAP) Noga, E.J., 1996. Fish disease diagnosis and treatment. Mosby-Year book Inc., St. Louis,Missouri.

Course Code: 0831 06 FMRT 4206	Year: Fourth	Term: Second
Course Title	Fish Pharmacology Sessional and Field Work	
Course Status	Core	
Credit	1.0	
Prerequisite(s)	None	
Rationale	This course is designed to provide the practical knowledge and skill necessary to prevention and understand the remedy for various diseases to control.	

	Course Contents/Tasks	CLOs
1	Studies on Histopathological changes caused due to chemotherapy.	1, 3
2	Practical application of various drugs and dose preparations.	1, 3
3	Antibiotic residual assays; important anesthetics, probiotics, immune-stimulant, vaccine and their mode of action.	1, 2, 3
4	Monitoring of fish and pond health status by field visits.	1, 3

	Upon successful completion of the course, the students will be able to:		Mapping with PLOs
Course Learning Outcomes (CLOs)	CLO1	Develop various doses of medicine for disease control in the aquatic environment.	1, 2, 3, 4, 5, 6, 7, 9
	CLO2	Know mechanisms of action of drugs, various drug interactions and therapeutic uses of drugs	1, 3, 4, 5, 6, 5, 6
	CLO3	Demonstrate antibiotic sensitivity assays and techniques in histology.	1, 3, 4, 5, 6, 5, 6

Mapping CLOs with the Teaching-Learning and Assessment Strategy

CLOs	Teaching-Learning Strategy	Assessment Strategy
CLO1	Field visit, demonstration, enquiry-based learning, cooperative learning	Problem based assessment, Assignment, presentation
CLO2	Demonstration, video tape	Practical book assessment, Quiz, Viva
CLO3	Video tape, Demonstration, enquiry-based learning	Practical exam, viva

Learning Materials

Recommended Readings	Howland, R.D., Mycek, M.J., Harvey, R.A., and Champe, P.C., 2005. Pharmacology. Lippincott Williams and Wilkins 552p. Brown, K.M.T., 2000. Applied Fish Pharmacology. Aquaculture Series 3, Kluwer Academic Publishers. Dordrecht. The Netherlands. 309 p. Stoskopf, M.K., 1993. Fish medicine. W B Saunders company Philadelphia. 882 p.
Supplementary Readings	Stoskopf, M.K., 1988. Tropical Fish medicine. Vet. Clins .N.Am.(SAP) Noga, E.J., 1996. Fish disease diagnosis and treatment. Mosby-Year book Inc., St. Louis,Missouri.

Course Code: 0831 06 FMRT 4209		Year: Fourth	Term: Second
Course Title	Mangrove Fisheries		
Course Status	Optional		
Credit	3.0		
Prerequisite(s)	None		
Rationale	This course is designed to provide an advance knowledge on mangrove environments, its biotic and abiotic compositions, nutrients cycling, restoration and conservation & management, so that the students the can manage the mangrove forest in an economic way and protect it for future fisheries and aquaculture extension.		

	Course Contents	CLOs
	Section A	
1	Introduction: Definitions, landforms of mangrove forest; area of mangrove forests of Bangladesh, major features of Sundarbans: the largest mangrove forest in the world.	1, 2
2	Mangrove environment: Geological and hydrological features of mangrove forests. physical characteristics of the mangrove (attachment points, shelter from predators, physical environment), distribution of macrophytes along water depth gradient and their effects on mangrove environment; hydrologic budget and characteristics of mangrove forests.	1, 2
3	Mangrove macro-flora and fauna: Characteristics of macrophytes found in mangroves; gas-space continuum, heterophylly and clonal growth; mangrove birds and their evolutionary adaptation; special features of fish and their adaptation to tropical mangroves; introduction to amphibians, reptiles, and mammals of mangroves.	3
	Section B	CLOs
4	The unique characteristics that enhance the mangrove fisheries: Primary productivity in mangrove forests – the foundation of the fishery food web (primary production by mangrove trees, by periphyton, in the water column, from outside the mangrove), The detrital pathway (Leaching of soluble compounds, Colonisation by decomposers, Wood decomposition), Nutrient export mechanisms from the mangrove, Mangrove food chains (Detritivores and grazers, Deposit feeders, Filter and suspension feeders, Higher level consumers), Mangroves as nursery grounds, Linkages with adjacent ecosystems (Ecological linkages, Nutritional linkages – import and export, Environmental modification).	4, 5
5	Mangrove-associated fisheries: Valuing mangrove fisheries, various types of mangrove fishery (Inshore mixed species fisheries, Inshore mollusc and crustacean fisheries, Offshore commercial fisheries, Recreational fisheries), Drivers of mangrove fishery catch and value (Environmental factors and potential fishable biomass, Human impacts, Socio-economic factors and fished biomass).	6
6	Conservation and management of mangroves and fisheries: Avoiding mangrove loss, Restoring mangroves, Managing fisheries, Communication and engagement, The future of mangroves; International treaties to conserve mangroves; Conservation and management status of mangroves in Bangladesh.	6

Course Learning Outcomes (CLOs)	Upon successful completion of the course, the students will be able to:		Mapping with PLOs
	CLO1	Categorize the various forms of mangrove, their classification, environment, hydrology and mangrove macroflora and fauna.	1
	CLO2	Categorize the various forms of mangrove, their classification, environment, hydrology and mangrove macroflora and fauna.	1
	CLO3	Describe the organizational set up of mangrove flora and fauna.	1
	CLO4	Understand the ecosystem and key to the enormous fishery productivity of mangrove ecosystems.	1, 4
	CLO5	Understand the ecosystem and key to the enormous fishery productivity of mangrove ecosystems.	1
	CLO6	Evaluate the restoration mechanisms of mangroves and plan for conservation and management.	2

Mapping CLOs with the Teaching-Learning and Assessment Strategy

CLOs	Teaching-Learning Strategy	Assessment Strategy
CLO1	Lecture	Quiz
CLO2	Lecture and Enquiry based learning	Assignment
CLO3	Lecture and Group Discussion	Class test
CLO4	Lecture	Quiz
CLO5	Lecture and video tape	Quiz
CLO6	Group discussion	Presentation, Final Exam

Learning Materials

Recommended Readings	Anneboina, L. R., and Kumar, K. S., 2016. Contribution of Mangroves to Marine Fisheries in India (No. 2016-145). Hutchison, J., Spalding, M., and zuErmgassen, P., 2014. The role of mangroves in fisheries enhancement. The Nature Conservancy and Wetlands International, UK.
Supplementary Readings	Burgess, P., Li, X., and Qin, S., 2015. Mangroves in Ecuador: An application and comparison of ecosystem service models.

Course Code: 0831 06 FMRT 4210	Year: Fourth	Term: Second
Course Title	Thesis	
Course Status	Core	
Credit	4.0	
Prerequisite(s)	0831 06 FMRT 4110	
Rationale	This course is designed to provide the students an opportunity to conduct and write their thesis based on the knowledge of his research work.	

	Course Contents/Tasks	CLOs
1	Focusing criteria of the Research work: (a) Importance of the problems. Data collection and analysis and presentation appropriate conceptual framework. Conclusions, recommendations based on observation and/or analysis. (b) Relevance: Topic is directly related to current issues. (c) Simplicity, clarity and originality. The thesis duly approved by the Head of the Discipline will have to be submitted to the Discipline within two weeks of the last examination date of the second term.	1

Course Learning Outcomes (CLOs)	Upon successful completion of the course, the students will be able to:		Mapping with PLOs
	CLO1	At the end of the course the students will be able to conduct a research work and will be able to face dissertation.	1, 2, 3, 4, 5, 7, 8

Mapping CLOs with the Teaching-Learning and Assessment Strategy

CLOs	Teaching-Learning Strategy	Assessment Strategy
CLO1	Field visit, demonstration, modular group discussion, seminar, workshop	Presentation, viva, and thesis

Learning Materials

Recommended Readings	Bhamrah, H.S., Sandhu, G.S. and Gupta, K.C., 2006. Research Techniques in Biological Science. Dominant Publishers. Bryman, A., 2008. Social research methods (3rd Edition). Oxford: OUP. Creswell J.W., 2003. Research Design: Qualitative, Quantitative, and Mixed Methods Approaches (2nd edition). London: SAGE Publications. Kothari, C.R., 2004. Research Methodology: Methods and techniques. New Age International.
Supplementary Readings	Gomez, K.A. and Gomez, A.A., 1984. Statistical procedures for agricultural research. John Wiley & Sons. Schlieper, C., 1972. Research methods in marine biology. University of Washington Press.

Course Code: 0831 06 FMRT 4213		Year: Fourth	Term: Second
Course Title	Fisheries Products and By-products		
Course Status	Optional		
Credit	2.0		
Prerequisite(s)	None		
Rationale	The course is designed to disseminate information on the state of Fish Products and By-Products Technology and its application to various aspects.		

	Course Contents	CLOs
	Section A	
1	Introduction to fishery products and by-products in Bangladesh: Scientific and technological development in fishery products.	1
2	Fish muscle structure, myofibrillar, protein and their role in elasticity formation. Extruded products – theory of extrusion, equipments used, advantages of extruded products, methods of preparation of extruded products.	2
3	Fish protein concentrate. Fish hydrolysate, partially hydrolyzed and deodorized fish meat, functional fish protein concentrate and their incorporation to various products.	3
	Section B	CLOs
4	Principles and methods of preparation of fish products: fish sausage, fish ham, surimi, fish cake, kamaboko etc.	4
5	Fish meal and oil: Dry reduction and wet reduction methods. Fish maws, shark leather, Chitin, chitosan, fish glue, fish gelatin, isinglass, pearl essence, shark fin rays, beach de mer, and biochemical and pharmaceutical products.	5
6	Diversified fish products: battered and braided products-fish finger, fish cutlet, fish wafer, and fish soup powder etc and imitation products.	6
7	Utilization of seaweeds: agar agar, algin, carrageenan. Diversified fish products: battered and braided products-fish finger, fish cutlet, fish wafer, and fish soup powder etc and imitation products. Value addition, HACCP in safe products production.	7

	Upon successful completion of the course, the students will be able to:		Mapping with PLOs
Course Learning Outcomes (CLOs)	CLO1	Explain basic information about the fishery products and by-products in Bangladesh	1, 2
	CLO2	Know the basic structure of fish muscle and the theory and practice of preparation of extruded fisheries products	1, 2
	CLO3	Design the techniques of production of hydrolyzed and deodorized fish production	1, 3
	CLO4	Reframe various principles and methods of preparation of fish products	1, 3, 4
	CLO5	Develop different techniques of fish meal and oil production	1, 4, 6
	CLO6	Modify the concepts of production of diversified fish products	1, 8
	CLO7	Assess the utilization of seaweeds and other fisheries by-products	1, 8

Mapping CLOs with the Teaching-Learning and Assessment Strategy

CLOs	Teaching-Learning Strategy	Assessment Strategy
CLO1	Lecture	Class Test
CLO2	Lecture	Assignment
CLO3	Lecture and Group Discussion	Assignment
CLO4	Audio-visual Lecture and Group Discussion	Oral demonstration
CLO4	Audio-visual Lecture	Report writing
CLO6	Audio-visual Lecture and Group Discussion	Oral Presentation
CLO7	Audio-visual Lecture	Assignment

Learning Materials

Recommended Readings	Nikerson, J. and Sinskey, A.J., 1977. Micro¬biology of Foods andFood Processing (3rd edition). Elsevier, New York, Oxford, Amsterdam. Kreuzer, R. (ed.), 1971. Fish Inspection and quality control. Fishing News (books), Limited. London, EC4, England Connell, J.J., 1985. Control of Fish Quality. Fishing News Book Ltd. Bonnell, A.D., 1994. Quality assurance in sea food processing: A practical guide. Chapman & Hall, New York and London. Huss, H.H., 1998. Fresh Fish-Quality and Quality Changes. FAO Fisheries Series No. 29, Rome.
Supplementary Readings	Pierson, M.D., Donald, A. and Corlett, J., 1992. HACCP: Principles and Applications. An AVI Book, Published by Van Nostrand Reinhold, New York. Kramer, A. and Twigg, B.A., 1966. Fundaments of Quality Control for the Food Industry. The Avi. Publishing Co. Inc., West port. Wiryanti, J. and Madakia, H. (Ed)., 1997. Improved Quality Control for the Handling and Processing of Fresh and Frozen Tuna at sea and on shore. ASEAN-CANADA Fisheries Post-harvest Technology Project-Phase II.

Course Code: 0311 06 Econ 4251		Year: Fourth	Term: Second
Course Title	Fisheries Economics		
Course Status	Core		
Credit	3.0		
Prerequisite(s)	None		
Rationale	The course intends to dispense students an introduction of basic concepts of economics, and help students apply the knowledge in fisheries resource and aquaculture management.		

	Course Contents	CLOs
	Section A	
1	Introduction: Definition, nature and scope of economics, microeconomics versus macroeconomics, concept of scarcity, choice, commodity, wealth, production, distribution, exchange, consumption, economic system- capitalistic, socialistic, mixed;	1, 2
2	Economic concepts and laws: Law of demand and supply, determinants of demand and supply; demand and supply functions, equations, schedules and curves; market equilibrium; price, income, cross and supply elasticity; total and marginal utility; law of diminishing marginal utility; Indifference curve analysis;	1, 2
3	Production: Factors of production, production function; stages of production, returns to scale; iso-quant and iso-cost curve; producer's equilibrium; cost and revenue; market - definition, classification, price and output determination under different market structure; market demand analysis;	2
4	Basic macroeconomic concepts: GNP, GDP, NNP, NI, PI, DI, methods of measuring national income, problems in measuring national income, circular flow of income, concept of inflation, unemployment and international trade.	1
	Section B	CLOs
5	Concepts: Maximum sustainable yield, open-access fishery, economic optimal harvesting, discounting effects;	3, 4
6	Fisheries production: Fish stocks as capital, production function in fishery, open access bioeconomic equilibrium, maximum economic yield, constant cost fishery, increasing cost fisheries, economic optimal harvesting;	4, 5
7	Production analysis: Product-factor relationship, combination of products, cost-return analysis, production function analysis, economic feasibility analysis.	2, 4, 5

	Upon successful completion of the course, the students will be able to:		Mapping with PLOs
Course Learning Outcomes (CLOs)	CLO1	Describe basic principles of economics, and different economic system, demand and supply functions, macroeconomics;	1, 2
	CLO2	Explain production function, market structure and trend analysis;	3, 4, 6, 7
	CLO3	Apply understandings of economics in open fisheries;	1, 2, 4, 7
	CLO4	Perform economic analysis of fisheries and aquaculture production systems;	3, 5, 8, 9
	CLO5	Provide an interface between marketing and management decision.	1, 4, 5, 6, 7

Mapping CLOs with the Teaching-Learning and Assessment Strategy

CLOs	Teaching-Learning Strategy	Assessment Strategy
CLO1	Lecture, group work	Quiz and presentation
CLO2	Lecture, group discussion	Presentation
CLO3	Lecture, problem based learning	Class test
CLO4	Lecture, demonstration, case study	Assignment
CLO5	Lecture and group discussion	Quiz

Learning Materials

Recommended Readings	Anderson, L. G., 2004. The economics of fisheries management. The Blackburn Press, London. Bishop C. E. and Toussaint, W. D., 1958. Introduction to agricultural economic analysis. John Wiley and Sons, New York. Dewell, K.K., 1946. Modern economic theory. Chand (S.) & Co Ltd, India. Samuelson, P. A., and Nordhaus, W. D., 2009. Economics, McGraw Hill; 19th edition.

Course Code: 0521 06 ES 4253		Year: Fourth	Term: Second
Course Title	Climate Change and Fisheries		
Course Status	Optional		
Credit	2.0		
Prerequisite(s)	None		
Rationale	This course is designed to introduce the graduate students with preliminary concept on the reasons for climate change, its impacts on aquatic ecosystems, effects on fisheries and aquatic production systems, and mitigation and adaptations measures, so that they become aware and develop skills to provide the necessary support services to the fisheries and livelihood of the vulnerable communities.		

Course Contents		CLOs
Section A		
1	Introduction to climate change: Historical trends and future climate change, global warming, causes of climate change, greenhouse effects, human effects on climate; ecosystem impacts of climate change, predicting climate change.	1
2	Vulnerability to climate change and adaptation responses: Extremes of temperatures, droughts, changes in precipitation and excessive rainfalls and floods, storms, hurricanes and tropical cyclones, sea level rise, salinity intrusion and land subsidence, impacts to the livelihood of the communities.	2
3	Climate change: The physical basis in freshwater, brackish water and marine systems, heat content and temperature, inland waters, ocean ecosystems, ocean salinity, density and stratification, coastal upwelling, ocean acidification and changes in other chemical properties.	3
4	Climate variability and changes on ecosystem and fish production processes: Primary production, secondary production, food web impacts from plankton to fish, physiological effects, spawning, growth and recruitment processes, species invasions and diseases	4
Section B		CLOs
5	Climate change and capture fisheries: Inland fisheries, small-scale and artisanal marine fisheries, large-scale marine fisheries, potential positive and negative impacts, vulnerability of regions, groups and hot spots (global, Bangladesh), adaptation of fisheries management, the role of institutions in adaptation.	3, 4
6	Climate change and aquaculture: Food fish production and needs, aquaculture production, impacts of climate change on aquaculture (both freshwater and coastal), potential impacts of aquaculture on climate change, estimating aquaculture's contribution to climatic change, other adaptive measures.	5, 6
7	Global negotiations on climate change:lessons from Montreal and Kyoto protocols, Copenhagen declaration, IPCC, CCIA, compliance of the rich and poorer countries including position of Bangladesh.	7

	Upon successful completion of the course, the students will be able to:		Mapping with PLOs
Course Learning Outcomes (CLOs)	CLO1	Categorize different topics of climate change	1, 2, 3
	CLO2	Explain the effect of various extreme climatic change	3, 4, 7
	CLO3	Evaluate different features of climate change in various ecological parameters	3, 4, 7
	CLO4	Explain the impact of climate change on ecology of fish	4, 5, 7
	CLO5	Evaluate the impact of Climate change on capture fisheries	3, 4, 7
	CLO6	Write the impact of Climate change on aquaculture	1, 5, 7
	CLO7	Criticize the Global initiatives on tackle climate change related issues	1, 6, 7

Mapping CLOs with the Teaching-Learning and Assessment Strategy

CLOs	Teaching-Learning Strategy	Assessment Strategy
CLO1	Lecture, demonstration, discussion	Class test
CLO2	Lecture, demonstration, discussion	Class test, Assignment
CLO3	Lecture, demonstration, discussion	Class test, Quiz
CLO4	Lecture, demonstration, discussion	Class test, Quiz
CLO5	Lecture, demonstration, discussion	Class test, Quiz
CLO6	Lecture, demonstration, discussion	Class test, Assignment
CLO7	Lecture, demonstration, discussion	Class test, Assignment

Learning Materials

Recommended Readings	Bazzaz, F. and Sombroek, W., 1996. Global Climate Change and Agricultural Production. John Wiley and Sons, England, 345 pp. Glantz, M.H. (ed), 1992. Climate Variability, Climate Change and Fisheries. Cambridge University Press, 458 pp. Brander, K., 2012. Impacts of Climate Change on Fisheries. Journal of Marine Systems79 (3-4), 389-402. Cochrane, K., Young, C.D., Soto, D. and Bahr, T., 2009. Climate change implications for fisheries and aquaculture: Overview of current scientific knowledge. 2009. FAO Fisheries and Aquaculture Technical Paper. 530. FAO, Rome, Italy. 221 pp. Cushing, D.H., 1982. Climate and Fisheries. Academic Press, UK. 375 pp.
Recommended Readings	Flelds, P.A., Graham,J.B., Rosenblatt, R.H., and Somero, G.N., 1993. Effects of expected global climate change on marine faunas. Trends in Ecology & Evolution, 8(10), 361–367. Jennings, S. and Brander,K., 2010. Predicting the effects of climate change on marine communities and the consequences for fisheries. Journal of Marine Systems, 79 (3-4), 418–426. Kremer, J.N. and Nixon, S.W., 1978. A Coastal Marine Ecosystem. Springer-Verlag. Heidelberg, 217 pp. Laevastu, T., 1993. Marine Climate, Weather and Fisheries. Fishing News Books, 224 pp.

20 Grading and Evaluation

20.1 Grading Scale

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

Numerical Grade	Letter Grade	Grade Point
80% or above	A+ (A plus)	4.00
75 to less than 80%	A (A regular)	3.75
70 to less than 75%	A- (A minus)	3.50
65 to less than 70%	B+ (B plus)	3.25
60 to less than 65%	B (B regular)	3.00
55 to less than 60%	B- (B minus)	2.75
50 to less than 55%	C+ (C plus)	2.50
45 to less than 50%	C (regular)	2.25
40 to less than 45%	D	2.00
Less than 40%	F	00
Incomplete	I	
Withdrawn	W	
Continuation (for the project, thesis design, etc. course)	X	

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 and Class Participation	10
2	Continuous Assessments	30
3	Term 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

c) The continuous assessments of the theory courses may be conducted in the form of class tests, assignments, homework, presentation, quiz, viva voce, etc. The course teacher(s) will evaluate every continuous assessment and share the result with the students within 2(two) weeks of conducting that continuous assessment.

d) The duration of a class test may be 20-45 minutes, and it will preferably be given during class hours.

e) If a student does not attend the class test for reasons satisfactory enough to the course teacher, the course teacher may allow the student one more chance for such assessment during the term; however, it must be held before the term final examinations. A student who has been absent for a short period, up to a maximum of three weeks due to illness, should approach the course teacher(s) or Coordinator(s) for make-up of quizzes/class tests or assignments, etc.,

immediately on returning to the classes. Such request should be supported by a medical certificate endorsed by the Chief Medical Officer of the University. The medical certificate issued by a registered medical practitioner (with the registration number shown explicitly on the certificate) and endorsed by the Chief Medical Officer of the University will also be acceptable only when the student has valid reasons for his/her absence from the University.

f) The number of Continuous Assessments (CAs) in each course will be as follows:

No. of credit(s)	Total no. of CA required	CAs to be consideredfor grading
3 – 4	4 (2 in each section)	Section best assessments shall be averaged for grading
1.5 – 2	3 (at least one in each section)	

g) If two teachers teach a course, both the teachers will conduct continuous assessments individually.

h) Answer scripts of the continuous assessment may be shown to the students to identify their strengths and weaknesses, but those would not be returned to them. The concerned teacher would submit the evaluated continuous assessment answer scripts and attendance register to the Head of the Discipline/Program Offering Entity (POE). The final score of attendance and class participation (out of 10) and continuous assessment (out of 30) should be displayed on the Discipline's notice board/ Discipline website/ Course web page before starting the term final examination.

i) The course teachers must submit the continuous assessment mark sheets to the Chair of the Examination Committee before the starting of the term final examination.

j) The Term Final Examination will carry 60 marks. There will be two separate answer scripts for Section A and Section B in the Term Final Examination.

k) When a student repeats a course in which he/she previously obtained an F grade, he/she will be given just an immediate lower grade that he/she obtained in the repeated course. However, in case he/she obtains a D grade, that will be maintained, and this grade will be shown in the transcript. If a student has to repeat a course due to punishment on him/her, the grade obtained will be maintained. If a student obtains a grade other than an F in a course, he/she will not be allowed to repeat the course for grade improvement.

l) If a student obtains an 'F' grade in any Core course in any term, this 'F' grade will not be counted for Grade Point Average (GPA) but will be shown on the grade sheet, and in such case, he/she will have to retake the course for grade improvement.

m) While registering for a retake/re-retake theoretical course, a student must be given an option to decide whether s/he intends to sit for continuous assessment of the course. If s/he opts to sit for continuous assessments, his/her fresh mark will be counted to prepare the result. However, the class attendance and participation marks will be taken from the previous record.

n) A student has to register for the backlog/retake/re-retake core courses first followed by the fresh courses offered by the Discipline for the term s/he is going to enrol subject to the compliance with: (i) completion of prerequisite courses (if any) and (ii) maximum registration limit of 25 credits per term. However, s/he may not choose to register the optional backlog/retake/re-retake courses first.

o) In addition, a student may be allowed to register for advance course(s) in a term subject to: (i) his/her all backlog/retake/re-retake and offered core courses are either clear or registered, (ii) his/her current terms' offered all core courses are registered, (iii) completion of corresponding prerequisite courses (if any), (iv) compliance with a maximum registration limit of 25 credits per term, and (v) the desired advance courses are offered by the Discipline/POE in the current term. However, such advance course registration option will not be applicable for capstone courses like Thesis/Project/ Internship/ Research study/ Monograph/ Portfolio, and so on.

p) A Special Term may be offered for the final year students who have retake/re-retake course(s). In this case, the maximum credit limit for a student will be 15 credits. This will be a Non-Taught Term. The Examination of Special Term will start 4 (four) weeks after publishing 4th-year 2nd Term results and will continue not more than 2 (two) weeks. The continuous assessment marks (40%) will be carried over from previously registered theory course(s), and Special Term Final Examination will carry the remaining (60%) marks. Final Year Term Thesis/Dissertation/Design or Core Sessional(s) supervisor(s)/course teacher(s) in consultation with the Head may allow the student(s) to re-submit the Thesis/

Dissertation Design or Core Sessional(s) within the Special Term schedule. However, it must be within the allowed limits of the Special Term credits.

20.1.2 Evaluation of Sessional Courses

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

Sl. No.	Items	Marks
1	Attendance/Class Participation/Contact with teachers	10
2	Sessional Evaluation/Internal criticism/Observation	60
3	Viva Voce/ Final Jury	30
	Total	100

b) Sessional evaluation would be done through a laboratory test, class test, quiz, assignment, assigned project, report, oral test, performance/behaviour of the students, etc. The course teacher(s) will complete every sessional evaluation and share the result with the students within 2(two) weeks of conducting that item. Attendance and sessional evaluation mark sheets (out of 10+60=70) will be displayed on the Discipline's notice board/Discipline website/Course web page before starting the term final examination.

c) Viva Voce of each sessional course will usually be conducted by the course teacher(s). The senior most among the course teachers (if any) will be the Chair of the viva board. However, such viva voce/final assessment of a sessional course can also be done through jury board in applicable cases. The jury board will be headed by the Head of the Discipline or any other senior teacher of the Discipline/POE not below the rank of Assistant Professor. The Chairman of the viva/jury board may appoint other teacher(s) as a board member if necessary. A student must attend a sessional evaluation and viva voce. In case of absence in any component, he/she will get an F grade in that course.

d) The course teachers must submit the continuous assessment mark sheets to the Chair of the Examination Committee before the starting of the term final examination.

e) A student may register sessional courses as retake/re-retake (if applicable) on the Discipline Head's written approval. For retake/re-retake sessional courses, no previous records/marks will be counted.

20.1.3 Evaluation of Capstone Courses

a) The distribution of marks for a Capstone (Thesis/ Monograph/ project paper/ etc.) course will be as follows:

Sl. No.	Description	Marks
1	Contact/Discussion/Communication with the Supervisor	10
2	Evaluation	60
3	Oral presentation and/or Viva voce	30
	Total	100

b) There will be two examiners (including the Supervisor) to examine the Thesis. Each examiner will evaluate the Thesis separately, and the average marks will be considered for grading. However, if the marks given by the First and Second Examiners vary 20% or more, a Third Examiner to be appointed by the concerned Examination Committee from the outside the University will evaluate the Thesis Monograph/Project paper. Among these numbers, the average of the closest two numbers will be considered for grading. However, if the marks given by the Third Examiner happen to stand at the middle of the marks given by the first two Examiners, the average of the three marks will be considered for grading.

c) For the thesis/dissertation/final project/other projects like the thesis of the final year students, there will be a presentation and defense session before the defense board. If deemed necessary to the concerned defense board, these sessions might be arranged online. A three-member defense board will evaluate the presentation and defense session. The Supervisor of the thesis/ project/ internship/ research study/ monograph/ portfolio courses will normally be the Chairman of the board while the second examiner and one member nominated by the Head of the Discipline/POE will be the members of the defense board. Every member of the defense board will evaluate individually and the final marks will be calculated by averaging all the marks given by the three members. The defense board members will be remunerated individually as per the approved rate of the university. For Jury board or in other special circumstances, the Head of the Discipline/POE might include additional member(s) in the board for justifiable reasons.

d) A Discipline might allow some students to register for an Internship program/ Project paper/ Monograph/ Research study according to the course curriculum of the respective Discipline. Such an internship program/ Project paper/Research study course might be considered as the substitute of Thesis for those students. The evaluation and related activities of such Internship program/ Project paper/ Research study courses will be similar to Thesis. Usually, a Thesis will carry double weight in terms of credit compared to other alternatives like Project/ Internship/ Research study/ Monograph/ Portfolio and so on.

e) A Discipline might allow splitting the thesis/similar course into more than one term. 'X' grade may be assigned for continuing the same course in multiple terms to assign a complete grade in the last term. Alternatively, multiple courses under thesis/similar course might be assessed by providing complete grades at the end of each term. The curriculum of the concerned Discipline/Entity will clarify all such issues.

20.1.4 Evaluation of Viva Voce

a) There might be a grand viva voce in each term. A student will not usually be allowed to register for more than one course of this type bearing 01 (one) credit in a term. The concerned Examination Committee of that Term will conduct the viva and assess the students. The distribution of marks for viva voce will be as follows:

Description	Marks
Viva voce	100

20.2 Grades

Grade related issues are reported in section 20.1.

20.3 Grade Point Average (GPA) and Cumulative Grade Point Average (CGPA)

a) Grade Point Average (GPA) is the weighted average of Grade Points obtained in all the courses passed/completed by a student. For example, if a student has passed/completed five courses in a term having credits of C1, C2, C3, C4, and C5 and his/her points in these courses are G1, G2, G3, G4, and G5, respectively, then,

$GPA = \sum CiGi/\sum Ci$

b) A Numerical Example: Suppose a student has completed five courses in a term and obtained the following grades:

Course	Credit	Grade	Grade Point
A	3	A+	4.00
B	3	C+	3.00
C	3	A	3.75
D	2	B	3.25
E	1	B+	3.50

Then his/her GPA for the term will be computed as follows:
GPA= 3(4.0) + 3(3.0) + 3(3.75) + 2(3.25) + 1(3.5) /(3 + 3 + 3 + 2 + 1) = 3.52

c) A student's performance will be evaluated in terms of three indices- Term Grade Point Average (TGPA), Yearly Grade Point Average (YGPA), and Cumulative Grade Point Average (CGPA). The TGPA is computed by dividing the total points earned in a Term by the number of credits taken in the Term. The YGPA is computed by dividing the total grade points earned in two Terms in a year by dividing the number of credits taken in that year. The CGPA is computed by dividing the total grade points accumulated till date by the total completed credits. Thus a student who has earned 275 grad points in attempting 100 credits of courses would have an overall CGPA of 2.75.

20.4 Course Withdrawal

a) 'W' is the corresponding grade for withdrawn of a course, as mentioned in section 20.1.

b) If any student cannot complete the Term Final Examination due to severe illness or serious accident, he/she may apply to the Dean through the Head of the concerned Discipline for total withdrawal from the Term within eight working days after the Term Final Examination. However, he/she may choose not to withdraw from any sessional course if the grade obtained in such a course is C or better. A medical certificate endorsed by the Chief Medical Officer of the University must support the application. The Dean of the concerned School will decide on such an application and inform the Academic Council. If a student is allowed to withdraw from a Term, he/she will have to register as fresh from the Term he/she has withdrawn. However, he/she may be allowed to register for backlog courses, if offered.

20.5 Incomplete (I) Courses

'I' is the corresponding grade for an incomplete course, as mentioned in section 20.1.

20.6 Retake

Retake related issues are reported in sections 20.1.1 and 20.1.2.

20.7 Grade Improvement

Grade improvement related issues are reported in section 20.1.1.

20.8 Dropout/Cancellation of Studentship

a) A first-year first term student's admission will stand cancelled if he/she fails to complete course registration by ten working days from the beginning of the classes.

b) A first-year first term student's admission will stand cancelled if he/she fails to attend at least 50 percent of classes during ten working days from the beginning of the classes. However, in case of severe illness/accident this provision may be relaxed subject to submission of a medical certificate issued by a registered medical practitioner (with the registration number shown explicitly on the certificate) and endorsed by the Chief Medical Officer of the University.

c) A student's studentship will stand cancelled if he/she fails to comply with registration of minimum credit requirements under article 12.2 of the latest (July 2022) 'Ordinance for Undergraduate Program' of Khulna University. According to that article, a student must register for at least 15 credits per term and may be allowed to register for up to a maximum of 25 credits if recommended by his/her Discipline Head. The Discipline/POE might offer less than, greater than or equal to 25 credits per term as per the approved curriculum. The student will enjoy the option of choosing backlog, re-take, re-retake, advance courses (subject to compliance with applicable requirements/restrictions, as reported in other articles of the Ordinance) in addition to fresh courses to comply with the restriction of maximum 25 credits per term. If any student fails to register, in any way, for minimum credits (15 credits), his/her studentship at the University will stand cancelled. This minimum 15-credit registration limit may be relaxed if: (i) the student requires less than 15-credit to complete his/her graduation, or (ii) the sum of applicable (for the student) credits offered by the Discipline is less than 15-credit in the corresponding term for any valid reason.

d) A student's studentship will stand cancelled if he/she fails to earn minimum credits under article 12.5.2 of the latest (July 2022) 'Ordinance for Undergraduate Program' of Khulna University. According to that article, when a student is going to register for his/her courses in the 3rd year 2nd term, his/her earned credits up to 2nd year 2nd term must be at least 36. Otherwise, his/her studentship at the University will stand cancelled.

Approval Records	
Approving Authority	Date of Approval
Curriculum Committee of the Discipline	February 28, 2022
Executive Committee of the School	
BOAS (if applicable)	
Academic Council	October 12, 2022
Syndicate (if applicable)	October 20, 2022

Appendix 01: Summary of Major Changes in the OBE Format Curriculum

Program : Bachelor of Science in Fisheries (Honours)
Discipline : Fisheries and Marine Resource Technology Discipline
School : Life Science School

Sl. No.	Criteria	Existing Curriculum	OBE Curriculum
1	Duration of the Program (in Year)	4	4
2	Total Available Credits	193	191
3	Minimum Credit Requirement to Complete the Degree	160	160
4	Available Credits from GED Courses	-	56
5	Credits from GED Courses (% of Total Credits)	-	29.32
6	Credits from GED Courses (% of Required Credits)	-	25
7	Available Credits from Core Theory Courses*	104	83
8	Available Credits from Core Sessional Courses*	38	28
9	Available Credits from Optional Theory Courses*	39.25	15
10	Available Credits from Optional Sessional Courses*	11.75	03
11	Available Credits from Capstone Courses	-	06
12	Term Duration (in week)	19	22
13	Credits from Newly Introduced Courses	-	-
14	Number of Newly Introduced Courses	-	-
15	Number of Omitted Courses	-	02
16	Change in Course Title (Number of Courses)	-	02
17	Change in Course Status (Number of Courses)	-	02
18	Inter-term Shift (Number of Courses)	-	-
19	Change in Course Contents (Number of Courses)	-	3
20	Name of Majors (if Applicable)	-	-
21	Name of Modes (if applicable)	-	-

* including GED

Appendix 02: Concerned Committee of the Discipline/POE

Sl. No.	Name and Address	Designation in Committee
01	Prof. Dr. Muhammad Abdur Rouf	Chairman
02	Prof. Dr. Ghausiatur Reza Banu	Member
03	Prof. Dr. Golam Sarower	Member
04	Prof. Dr. AFM Hasanuzzaman	Member
05	Prof. Dr. Md. Lifat Rahi	Member

Appendix 03: Program Self Assessment Committee (PSAC)

Sl. No.	Name	Affiliation	Designation
01	Dr. Md. Golam Sarwar	Professor, FMRT Discipline, KU	Chairman
02	Dr. Sk. Mustafizur Rahman	Professor, FMRT Discipline, KU	Member
03	Dr. A. F. M. Hasanuzzaman	Professor, FMRT Discipline, KU	Member

Appendix 04: Concerned Executive Committee Approved by the School

Sl. No.	Name and Address	Designation in Committee
1	Prof. Dr. Muhammad Abdur Rouf	Chairman
2	Prof. Dr. Md. Nazmul Ahsan	Member
3	Prof. Dr. Khandakar Anisul Huq	Member
4	Prof. Dr. Ghausiatur Reza Banu	Member
5	Prof. Dr. Sk Mustafizur Rahman	Member
6	Prof. Dr. Golam Sarower	Member
7	Prof. Dr. Md. Yousuf Ali	Member
8	Prof. Dr. Mst. Muslima Khatun	Member
9	Prof. Momotaz Khanom	Member
10	Prof. Dr. AFM Hasanuzzaman	Member
11	Prof. Dr. Md. Lifat Rahi	Member
12	Prof. Dr. Wasim Sabbir	Member
13	Md. Rashedul Islam	Member
14	Shamima Sultana	Member
15	Sudip Debnath	Member
16	Md. Shahin Parvez	Member
17	Prof. Dr. Md. Serazul Islam, FMB, Jashore Science and Technology University	External Member
18	Prof. Dr. S. M. Rofiquzzaman, Bangabondhu Sheikh Mujibur Rahman Agricultural University	External Member

Appendix 05: Concerned Alumni/Employers/Guests in OBE workshop

	Sl. No.	Name and Address	Designation in Committee	Organization
Alumni	1	HM Rakibul Islam	SSO	BFRI
	2	A.T.M. Toufiq Mahmud	DPD, Union Project, DOF, Khulna	DOF
	3	Md. Jahidul Hasan	FIQCO, DOF, Khulna	DOF
	4	A.B.M. Jakaria	FQO, FIQC, Khulna	DOF
	5	Ashim Kumar Ghosh	AD (R) Dhaka	DOF
	6	SM Ashikur Rahman	Project Director IFSS Project	DOF
	7	Md. Nazmul Huda	SUFO	DOF
	8	Md. Mizanur Rahman	Inspector, FIQC	DOF
Employer	9	Lipton Sarder	Fish Inspection & Quality Control Officer	FIQC, DOF
	10	SM Masud Karim	Consultant Feed Nutrition	Nutrition Feeds Ltd.
	11	Kh. Mazhabuddin	General Manager	Animal Health Division
Guests	12	K.G. Quddus	Dean	Life Science School, KU
	13	Mohammed Ziaul Haider	Director	IQAC, KU
	14	Dr. S.M Rafiquzzaman	Dean, FOF	BSMRAU, Gazipur
	15	Dr. Md. Sherazul Islam	BSMRAU, Gazipur	JUST
	16	Dr. Jagadish Chandra Joardar	Professor, Additional Director, IQAC	IQAC, KU
	17	Dr. Mohammad Sayadur Rahaman	Professor	Dept. of Chemistry, CU

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OUTCOME BASED EDUCATION

Fisheries and Marine Resource Technology Discipline
Life Science School
Khulna University
Khulna 9208, Bangladesh