

**TEMPLATE OF
OUTCOME-BASED
CURRICULUM
2022
(for Masters program)**



Institutional Quality Assurance Cell (IQAC)

Khulna University, Khulna 9208

Bangladesh

Outcome-based Curriculum of Master of Science in Aquaculture



**Fisheries and Marine Resource Technology Discipline
Khulna University
June 2022**

OUTCOME-BASED CURRICULUM

PART-A

01. Title of the Academic Program

Master of Science in Aquaculture

Program Overview	
Degree	Master of Science in Aquaculture
Abbreviated form of the Degree	MS in Aquaculture
Major (if applicable)	N/A
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	9
International Standard Classification of Education (ISCED) Code	0831
Mode of Study	Full Time & Master's by Mixed Mode (Dissertation)
Language of Study	English
Applicable Session	2022-23 and onwards

02. Name of the University

Khulna University

03. Vision of the University

Khulna University strives to create a knowledge-based just society through accelerating inclusive and transformative growth of Khulna, Bangladesh and the world. The university aims to achieve this vision through cross-cutting research, scholarly enquiry and development of new knowledge.

04. Mission of the University

UM1	To explore human potential to its fullest extent and produce self-motivated,
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	aspiring leaders to work for the betterment of the humankind.
UM2	To create a transformative educational experience for students focusing on poverty eradication, food and nutritional security, environmental sustainability, socio-economic well-being and climate resilient development through judicious management of natural resources of the country.
UM3	To foster creative learning, entrepreneurship and inquisitiveness among students based on moral values, professional ethics, and social responsibilities.
UM4	To ensure a quality educational experience that enables graduates to make demonstrable economic and social impacts through translating knowledge and innovation into practice.
UM5	To nurture an enabling environment that produces human resource inspired by wisdom, freethinking, creativity and unhindered intellectual exercises.

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

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

O1	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;
O2	To build up high level analytical and critical thinking skills for solving emerging problems in the field of fisheries and marine science;
O3	To undertake fundamental and applied research in order to endow developed knowledge and experience to students;

O4	To enhance communication skills, leadership capacity, adaptability, and social interactions;
O5	To impart technology based and need oriented higher education befitting the age;
O6	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

Master of Science in Aquaculture

10. Description of the Program

Fisheries and Marine Resources Technology Discipline (FMRT) is one of the important disciplines under the Life Science School of Khulna University, which started its journey in 1992, the second year of establishment of Khulna University. The Master of Science in Aquaculture program was started with a view to better exploitation of fisheries and marine resources in Bangladesh, a country of numerous and diversified water bodies, through sustainable farming practice of fishes, shellfishes and other aquatic species. The Bay of Bengal with its vast coastal areas along Bangladesh has made the country a unique land endowed with brackish and marine waters and biotic as well as abiotic resources. Particularly the major parts of a world-famous mangrove forest ‘The Sundarbans’ is located in the Khulna region ; the Sundarbans harbor more than 400 small and medium-size creeks which are ideal breeding and nursery ground for many fishes, shellfishes and other aquatic resources. Such potential of this area has encouraged the FMRT Discipline to offer the MS program with a mandate to establish an avenue for education and research in all aspects of aquaculture science. The course-curriculum follow in this program includes multifaceted subjects incusing freshwater, brackish water and marine water aquaculture, breeding, feed and nutrition, aquatic health management directly pertinent to aquaculture ventures. The program also dispenses opportunity for the students to enrich their knowledge of aquaculture integration, livelihood enhancement, and environment friendly practices in relation to professional execution. Major strengths of the program are continually updated syllabus, interdisciplinary approach of the courses with the support of skilled 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 aquaculture issues in the country and the globe as a whole.

11. Graduate Attributes

GA1	Comprehensive knowledge	[<i>fundamental domain</i>]
GA2	Critical thinking, problem solving and decision making skills	[<i>thinking domain</i>]
GA3	Competency in information and communication technology	[<i>fundamental domain</i>]
GA4	Integrity and professionalism	[<i>personal domain</i>]

GA5	Leadership and communication skills	[<i>social domain</i>]
GA6	Competence in Ethics and morality	[<i>social domain</i>]
GA7	Lifelong learning skills and self-awareness	[<i>personal domain</i>]

GA = Graduate Attributes

12. Program Educational Objectives (PEOs)

PEO1	To offer quality education with the highest academic excellence in line with the international educational standard;
PEO2	To generate skilled manpower with a view to increasing finfish, shellfish and other aquatic production for sustainable development of the country as well as contributing to the global demands by equitable participation;
PEO3	To undertake fundamental and applied research in order to endow students with advance concepts, processes, techniques and practices of aquaculture ventures in the world;
PEO4	To develop students' competency in field and laboratory works, and thereby craft them as independent researcher with fitting analytical and critical thinking aptitudes to solve emerging problems through the application of advance knowledge and hands-on experiences in aquaculture;
PEO5	To enhance students' communication skill in written, oral and interactive presentation;
PEO6	To flourish moral and ethical values in profession and all other spheres of life.
PEO7	To facilitate enthusiasm in making scientific investigation and realize the roles of graduates on industrial, environmental, social and economic aspects nationally and globally.

PEO = Program Educational Objective

13. Program Learning Outcomes (PLOs)

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

A. Fundamental Skills	
PLO1	apply acquired knowledge and understanding in various aspects of aquaculture;
PLO2	explore different issues and formulate credible strategies to increase aquaculture production in line with sustainable exploitation of aquatic resources;
PLO3	utilize information from secondary sources, and carry out independently any research work in the laboratory and field following the safety rules and regulations;
PLO4	collect, analyze and interpret required data and make decision for probable solution for any raised problem.
B. Social Skills	

PLO5	communicate and interact effectively for social, academic and professional purposes;
PLO6	demonstrate social values and practice professional ethics in research as well as other socio-economic works;
C. Thinking Skills	
PLO7	judge the veracity and value of scientific outcomes related to aquaculture science;
PLO8	To demonstrate sound analytical and critical thinking skills to solve emerging problems in profession and other spheres of life.
D. Personal Skills	
PLO9	demonstrate innovative ideas, credentials and intellectuals in all levels of responsibilities;
PLO10	exercise entrepreneurial and managerial skills in profession as well as other spheres of life;
PLO11	apply ICT skills for information management in professional and other activities of life.

PLO = Program Learning Outcome

14. Mapping Mission of the University with PEOs

Missions	UM1	UM2	UM3	UM4	UM5
PEOs					
PEO1	2	1	2	3	1
PEO2	2	3	2	3	2
PEO3	2	3	2	3	2
PEO4	1	3	2	3	3
PEO5	3	2	2	3	3
PEO6	1	2	3	1	2
PEO7	3	2	3	1	3

Level of Correlation: 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	PEO7
A. Fundamental Domain	PLO1	•	•	•	•	•	•
	PLO2		•	•	•		•
	PLO3	•	•	•	•		•

	PLO4	•		•	•			•	
B. Social Domain	PLO5	•				•	•	•	
	PLO6						•	•	
C. Thinking Domain	PLO7			•	•			•	
	PLO8	•			•	•		•	
D. Personal Domain	PLO9	•		•		•		•	
	PLO10	•	•	•	•	•		•	
	PLO11			•	•	•		•	

16. Mapping Courses with PLOs

Course Code and Course Title	PLO's										
	Fundamental Domain				Social Domain		Thinking Domain		Personal Domain		
	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8	PLO9	PLO10	PLO11
First Year First Term											
<u>Core Course(s)</u>											
0831 06 AQUA 5101	X	X	X	X		X	X	X		X	X
0111 06 RM 5102	X	X	X	X	X	X	X	X	X	X	X
0831 06 AQUA 5103	X	X	X	X	X		X	X		X	X
<u>Optional Course(s)</u>											
0831 06 AQUA 5105	X	X	X			X	X	X	X	X	X
0831 06 AQUA 5107	X	X	X					X		X	X
0831 06 AQUA 5109	X	X	X	X				X			X
0831 06 AQUA 5111	X	X	X		X			X		X	X
First Year Second Term											
<u>Core Course(s)</u>											
0831 06 AQUA 5201	X	X	X	X	X		X		X	X	X
0111 06 RM 5202	X	X	X	X	X	X	X	X	X	X	X
0831 06 AQUA 5203	X	X	X			X	X	X	X	X	X
0831 06 AQUA 5204	X	X	X	X	X	X	X	X	X	X	X
<u>Optional Course(s)</u>											
0831 06 AQUA 5205	X	X	X	X	X			X			X
0831 06 AQUA 5207	X	X	X				X	X	X	NN	X
0542 06 STAT 5209	X	X	X	X				X	X		X
0831 06 AQUA 5211	X	X	X		X		X		X		X

Second Year First Term											
<u>Core Course(s)</u>											
0831 06 AQUA 6102	X	X	X	X	X	X	X	X	X	X	X
0831 06 AQUA 6104	X	X	X	X	X	X	X	X	X	X	X

OUTCOME-BASED CURRICULUM

PART-B

17. Structure of the Curriculum

a) Duration of the Program	1.5 Years	03 Terms
b) Admission Requirements	The applicants having Bachelor of Science in Fisheries or equivalent degree from recognized university (home and abroad) 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	The total minimum credit requirement=40 in which minimum course work (major)=20, GED=04 and Dissertation=16	
c2) Available Credits	58	
d) Total Class Weeks in a Term ¹	14	
e) Minimum CGPA Requirements for Graduation	2.50	
f) Maximum Academic Years of Completion	05	

Term Duration ¹				
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	1	3	7
	Sessional	2	4	
Core/Compulsory Courses	Theory	4	12	14
	Sessional	1	2	
Optional/Elective Courses	Theory	7	21	21
	Sessional			
Capstone Courses***	Sessional	2	16	16
Total		17	58	58

** 12.1% from GED courses

*** Thesis, project, internship etc. courses

g2) Category of Courses

Area	Course Type	Course Title	Credits
General Education (GED) Courses	Theory	01. Applied Statistics	3
	Sessional	01. Seminar-I: Research Methodology 02. Seminar-II: Data Management and Analysis	4
Core/ Compulsory Courses	Theory	01. Advanced Freshwater Aquaculture 02. Fish Feed and Nutrition 03. Coastal Aquaculture and Mariculture 04. Aquatic Health Management	12
	Sessional	01. Seminar -III:	2
Optional/ Elective Courses	Theory	01. Brood Management and Breeding Technique 02. Live Food in Aquaculture 03. Integrated Aquaculture 04. Fish Hatchery and Farm Design 05. Aquaculture and Environment 06. Organic Aquaculture 07. Livelihoods in Aquaculture	21
	Sessional		
Capstone Courses***	Sessional	01. Dissertation Part I 02. Dissertation Part II	16
Total			58

*** Thesis, project, internship etc. courses

18. Year/Term-wise Distribution of Courses

First Year First Term						
Course Code	Course Title	Course Status	Contact Hours/Week		Credits	Prerequisites
			Theory	Sessional		
0831 06 AQUA 5101	Advanced Freshwater Aquaculture	Core	3.0	-	3.0	None
0111 06 RM 5102	Seminar–I: Research Methodology	Core		3.0	2.0	None
0831 06 AQUA 5103	Fish Feed and Nutrition	Core	3.0	-	3.0	None
0831 06 AQUA 5105	Brood Management and Breeding Technique	Optional	3.0	-	3.0	None
0831 06 AQUA 5107	Live Food in Aquaculture	Optional	3.0		3.0	None
0831 06 AQUA 5109	Integrated Aquaculture	Optional	3.0		3.0	None
0831 06 AQUA 5111	Fish Hatchery and Farm Design	Optional	3.0		3.0	None
Total	Core Courses: Theory-02, Sessional-01; Optional Courses: Theory-04, Sessional-0; Capstone Courses: Theory-0, Sessional-0		18.0	3.0	20.0	-
			21.0			
First Year Second Term						
Course Code	Course Title	Course Status	Contact Hours/Week		Credits	Prerequisites
			Theory	Sessional		
0831 06 AQUA 5201	Coastal Aquaculture and Mariculture	Core	3.0	-	3.0	None
0111 06 RM 5202	Seminar–II: Data Management and Analysis	Core		3.0	2.0	None
0831 06 AQUA 5203	Aquatic Health Management	Core	3.0	-	3.0	None
0831 06 AQUA 5204	Dissertation Part I	Capstone		8.0	4.0	None
0831 06 AQUA 5205	Aquaculture and Environment	Optional	3.0	-	3.0	None
0831 06 AQUA 5207	Organic Aquaculture	Optional	3.0		3.0	None
0542 06 STAT 5209	Applied Statistics	Optional	3.0		3.0	None
0831 06 AQUA 5211	Livelihoods in Aquaculture	Optional	3.0		3.0	None
Total	Core Courses: Theory-02, Sessional-01; Optional Courses: Theory-04, Sessional-0; Capstone Courses: Theory-0, Sessional-01		18.0	11.0	24.0	
			29.0			
Second Year First Term						

Course Code	Course Title	Course Status	Contact Hours/Week		Credits	Prerequisites
			Theory	Sessional		
0831 06 AQUA 6102	Seminar –III:	Core		3.0	2.0	None
0831 06 AQUA 6104	Dissertation Part II	Capstone		24.0	12.0	None
Total	Core Courses: Theory-0, Sessional-01; Optional Courses: Theory-0, Sessional-0; Capstone Courses: Theory-0, Sessional-01		0.0	27.0	14.0	
			27.0			

19. Course Description

First Year First Term

Course Code: 0831 06 AQUA 5101	Year: First	Term: First
Course Title: Advanced Freshwater Aquaculture		
Course Status: Core		
Credit: 3.0		
Prerequisite(s): None		
Rationale	Bangladesh is endowed with vast freshwater bodies harbouring diverse freshwater species potential for aquaculture. This course is designed to bestow students advanced knowledge of farming practices of different commercially important freshwater species.	

Course Contents		CLOs
Section A		
1	Concept, present status, prospects and challenges of freshwater aquaculture (global and Bangladesh perspective); commercially important freshwater species; aquaculture production systems; recent advances in freshwater aquaculture production systems.	1
2	Aquaculture Management: Importance and procedure of pond preparation; fingerling/boat-larvae selection and transportation, acclimatization/conditioning, stocking, feed and feeding strategy, sampling and health check, safe harvesting and marketing.	2
3	Culture practice of commercially important carps (Indian major and exotic carps): Polyculture, Integrated culture, carp fattening, pre-stocking, stocking, feed and feeding, farm hygiene, water quality and health/disease management.	2
4	Culture practices of commercially important Catfishes, Tilapia, Koi, Chital (Clown featherback), Foli (Bronze featherback), Small Indigenous Species (SIS), Snakeheads, crab and Eel: species selection, fry/fingerling release technique (acclimatization/conditioning), pond preparation and management, feeding, health and harvesting.	2
5	Culture technique of <i>Macrobrachium Rosenbergii</i> : status and advances of prawn farming technologies, PL selection, transportation and acclimatization/conditioning, nursery and pond preparation, nursing technique, over wintering, stocking, feeding strategy, water quality and health/disease management; challenges and future prospects of prawn farming	2
6	Culture practices of commercially important non piscine species: crocodile, turtle, frog, freshwater mussel; pearl culture procedure in freshwater mussel.	2
7	Ornamental fish culture: Introduction, present status, origin of species, sources of fry/fingerling, suitable ornamental fish for home aquaria, feeding and health management of fish in home aquaria/recreational pool and their accessories, aquarium business and export potential.	3
Section B		CLOs
8	Cage and pen culture: Site selection, design and construction of cages and pens, species selection, stocking, feeding, health management and harvesting.	4
9	Recirculating aquaculture system (RAS): Introduction to RAS and its advantages and disadvantages, culture units and system design, pre-stocking and stocking management, waste management and disposal, mechanical filters, biofilters, biomedica and biofiltration, aeration, system monitoring, management, control and operations, fish health management considerations and harvesting.	5
10	Biofloc production systems for freshwater species: Concept of Biofloc	5

	Technology(BFT), history, definition of biofloc, composition and nutritional value of bioflocs, advantages and challenges of BFT, outdoor pond and indoor tank, suitable freshwater culture species, site selection and farm design, production system requirements, probiotics and its application in BFT, understanding C/N ratio and microbial process, system treatment and preparation, stocking, water quality management, aeration, feeding and nutrition management, waste treatment and disposal, health/disease and bio-security, harvesting.	
11	Aquaponics: Concept and history, types of aquaponics and their advantages and disadvantages, mechanical filtration, biofiltration, and hydroponics unit, construction materials, component ratios environmental parameter management, fish and plant species selection, plant environment and resolve plant nutrient deficiency, fish health and management.	5
12	Freshwater aquaculture farm operation and entrepreneur development: Commercially important freshwater aquaculture species selection, production system and technology wise commercial farm operation, managing the business, the secret of business success, setting goals for business management decisions, marketing and economics of freshwater fish farm, farm data management (preservation and analysis of data from pre-stocking to harvesting), human resources, business managers of tomorrow, challenges and sustainability.	6

Course Learning Outcomes (CLOs)	Upon completion of this course the students will be able to:		Mapping with PLOs
	CLO1	discuss the recent advances, prospects and challenges of freshwater aquaculture;	
CLO2	carry out farming of commercially important fin- and shell-fishes;		PLO1, PLO2, PLO3, PLO4, PLO8, PLO11
CLO3	demonstrate ornamental fish culture.		PLO1, PLO2, PLO3,
CLO4	discuss different open water freshwater fish culture techniques;		PLO1, PLO2, PLO7
CLO5	understand, design and operate RAS, Biofloc and aquaponics production systems with freshwater aquaculture species;		PLO2, PLO3, PLO6, PLO7, PLO10
CLO6	manage critically aquaculture farm for developing aqua entrepreneurship.		PLO3, PLO4, PLO8, PLO10, PLO11

Mapping CLOs with the Teaching-Learning and Assessment Strategy

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

Learning Materials

Recommended Readings	
	1. Pillay, T.V.R. 2005. AQUACULTURE: Principles and Practices. Fishing News Books. 2 nd edition.
	2. Edwards, P., Little, D.C. and Demain, H. (eds.). 2002. Rural Aquaculture. CABI Publishing, U.K.

	<p>3. Barnabe, G. 1990. Aquaculture Vol. 2. Ellis Horwood Limited, England. 506 pp.</p> <p>4. Landau, M. 1991. Introduction to aquaculture. John Wiley & Sons, Inc. Canada. 440 pp.</p> <p>5. Muir, J.F. and Roberts, R.J. (eds.). 1982. Recent advances in aquaculture, Vol. I, II, III, and IV. Croon Helm. London.</p> <p>6. John S. Lucas, Paul C. Southgate, Craig S. Tucker. (eds.). 2018. Aquaculture: Farming Aquatic Animals and Plants, 3rd Edition. Wiley-Blackwell, 664 pp.</p> <p>7. Beveridge, M. C.M.. 2004. Cage Aquaculture, 3rd Edition. Wiley-Blackwell, 380 pp.</p> <p>8. Engle, C. 2020. Aquaculture Businesses:A Practical Guide to Economics and Marketing. 5m Publishing.</p>
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Course Code: 0111 06 RM 5202	Year: First	Term: First
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Course Title: Seminar–I: Research Methodology

Course Status: Core

Credit: 2.0

Prerequisite(s): None

Rationale	This course is intended to expose post-graduate students to a broad range of environmental and occupational research, practice, and policy areas in order to assist them with career exploring and planning within the Fisheries major. To learn, practice, and critique effective scientific seminar skills. Students develop presentation skills that will be essential during their entire professional careers. These skills will improve as students respond to critical feedback, and seek to make scientific information understandable to scientists, peers, and the general public.
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Course Contents		CLOs
1	General Aspects of Oral Presentation: Presented at level that is appropriate to the audience; clear and informative visual aids (simple, sufficient time).	1, 2, 3,7
2	Introduction: Overview of problem area provided; unfamiliar terms introduced; appropriate literature abstracted and presented clearly; research hypothesis of the study identified.	4
3	Methods: Brief overview of the equipment and materials used, and how obtained; brief overview of the experimental design used and any other parts of the methods employed; materials and/or equipment described; procedures followed to conduct the experiment presented.	5
4	Results: Anticipated and actual results reported; statistics clearly presented.	6
5	Discussion: Implications if the hypothesis is supported clearly stated; implications if the hypothesis is not supported clearly stated; limitations of your study discussed; future research addressed.	2,4,6
6	Questions: Demonstrated knowledge of the material; poised and confident, but no bluffing; answered the question(s) asked (asked for clarification or restatement of the question).	1,4,5, 6,7

Course Learning Outcomes (CLOs)	Upon completion of this course the students will be able to:		Mapping with PLOs
	CLO1	communicate science in a 30-40 minute oral scientific presentation;	PLO1, PLO5, PLO11
	CLO2	understand and critique scientific presentations;	PLO1, PLO2, PLO5, PLO7, PLO8

	CLO3	create and implement a career plan to prepare for their identified career goals;	PLO2, PLO3, PLO6, PLO9, PLO10, PLO11
	CLO4	identify actions to take in areas of fisheries science education, including research, and internship / experiential learning;	PLO2, PLO3, PLO8, PLO9
	CLO5	understand workplace expectations, communicate professionally, and identify and solve workplace conflicts;	PLO3, PLO5, PLO7, PLO8, PLO9, PLO10
	CLO6	understand the different types of interview questions and craft focused answers in response;	PLO2, PLO3, PLO4, PLO5, PLO7, PLO8, PLO9, PLO10
	CLO7	construct a professional network.	PLO2, PLO5, PLO6, PLO8, PLO10, PLO11

Mapping CLOs with the Teaching-Learning and Assessment Strategy

CLOs	Teaching-Learning Strategy	Assessment Strategy
CLO1	Group discussions, short lectures, strong student involvement	Presentation
CLO2	Group discussions, guest panelists, strong student involvement	Presentation
CLO3	Group discussions, guest panelists, strong student involvement	Presentation
CLO4	Group discussions, guest panelists, strong student involvement	Presentation
CLO5	Group discussions, guest panelists, strong student involvement	Presentation
CLO6	Group discussions, guest panelists, strong student involvement	Presentation
CLO7	Group discussions, guest panelists, strong student involvement	Presentation

Learning Materials

Recommended Readings	<ol style="list-style-type: none"> 1. Bennett, B. 2001. The three P's of scientific talks: Preparation, practice, and presentation. Society for Economic Botany Newsletter. 15: 6-9. 2. Jan Recker. Scientific Research in Information Systems. A Beginner's Guide. Springer International Publishing. 2013. P.164. ISBN 978-3-642-30048-6. 3. David Hitchcock. Patent searching made easy: how to do patent searches on the internet & in the library. 4. Sixth edition. Berkeley, CA: Nolo, April 2013 p.257. ISBNs: 9781413318722, 141331872X, 9781413318739. 5. Yvonne N. Bui. How to Write a Master's Thesis. Third Edition. SAGE publications, Inc. 2020. P.298. ISBN-13: 978-1506336091, ISBN-10: 1506336094.
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Course Code: 0831 06 AQUA 5103	Year: First	Term: First
Course Title: Fish Feed and Nutrition		
Course Status: Core		
Credit: 3.0		
Prerequisite(s): None		
Rationale	Bangladesh has now secured position in the top aquaculture producing countries. This course offers basis of fish nutrition; advance knowledge in nutritional requirement and biosynthesis processes of nutrients. It also impacts students beyond the conventional feed production and feeding management.	

Course Contents		CLOs
Section A		
1	Nutritional requirement of farmed finfish and shellfish: broodstock, larval and grow out nutrition; factors affecting nutritional requirements.	1
2	Digestibility and absorption: Digestive enzymes and their role; digestibility determination; factors affecting digestibility; digestibility in finfish and shellfish.	2
3	Nutritional energetic: bioenergetics; description of bioenergetic model; quantification of energy demand in fish; energy requirements of various commercially important finfish and shellfish.	2
4	Metabolism of nutrients: metabolic pathways and biosynthesis; factors regulating these pathways and processes.	2
5	Live food: nutritive value and their role in aquaculture.	
6	Formulated feed: importance and usage in aquaculture; types of feed; sinking fish and shrimp feeds, floating fish feeds.	3
Section B		CLOs
7	Feeding management:: growth and relative factors in relation to feed ration; feeding rate, feed frequency, Feed Conversion Ratio(FCR), Protein Efficiency Ratio(PER), under feeding and over feeding, feed cost management, restricted feeding and compensatory growth; feed dispensing method and devices.	5
8	Feed formulation: methods of feed formulation- conventional and modern (using various software); Factors affecting formulations (e.g: financial aspects, species, culture system etc).	4
9	Feed ingredients, quality & availability: Conventional and unconventional feed ingredients; nutrition and energy sources; evaluation of ingredient quality- proximate composition, amino acids and fatty acids profile, anti-nutritional factors etc.; seasonal & geographical considerations for economic benefits.	4
10	Feed additives: Types; function; and specific use for economic and quality fish and shellfish production.	4
11	Feed mill and nutrition laboratory management: basic civil, mechanical & electrical issues to produce feeds; power & fuel consumption and alternative power sources; basic concepts to devices like auto dosing, hammer mill/ pulverizer, mixture, conditioner, pellet press/ extruder, cooler/ drier, packer etc; impacts of moisture, heat, particle size etc. Modern equipments (NIR, spectrophotometer, auto N digestion & distillation etc) and test of proximate components (ca, p, npn, energy, toxicity, salt etc); feed storage system and feeding data storage and analysis.	7
12	Aqua feed production in Bangladesh: economics, prospects and constraints; legislations.	6

Course Learning Outcomes (CLOs)	Upon completion of this course the students will be able to:		Mapping with PLOs
	CLO1	have good understanding of nutritional requirement of fish and shellfishes;	
CLO2	gain advance knowledge in food and feed digestive and metabolic pathways for fish;		PLO3, PLO4
CLO3	discuss significance and type of food and feed in aquaculture;		PLO1, PLO2, PLO3
CLO4	gain knowledge in feed ingredients and formulation processes.		PLO3, PLO4
CLO5	perform feeding management in aquaculture systems;		PLO3, PLO11
CLO6	get insight into aqua feed production, process flow, system loss, cost management and related challenges;		PLO2, PLO3, PLO4, PLO10, PLO11
CLO7	know how to operate feed mill; ensure nutritional safety during production; manage standard operational procedure (SOP) of feed		PLO3, PLO5, PLO7, PLO8, PLO11

	mill, finished goods storing & disposal.	
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Mapping CLOs with the Teaching-Learning and Assessment Strategy

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

Learning Materials

Recommended Readings	<p>1. Halver, J.E. and Hardy, R.W. (ed). 2002. Fish Nutrition. 3rd Edition. Academic Press, an imprint of Elsevier Science, San Diego, California Hopher, B. 1988. Nutrition of pond fishes. Cambridge University Press, Cambridge, U.K. 38 pp.</p> <p>2. Tytler, P. and Calow, P. (eds.). 1985. Fish Energetic New Perspectives. Croom Helm. London.</p> <p>3. National Research Council (NRC) 2011. Nutrient requirements of fish and shrimp. The National Academies Press, Washington, D.C. 376 pp.</p>
Supplementary Readings	<p>1. New, M.B. 1987. Food and feeding of fish and shrimps. ACDP/REP/87: 26, UNDP/FAO, Rome, 275 pp.</p> <p>2. Tacon, A.G.J. 1993. Standard methods for the nutrition and feeding of farmed fish and shrimp. Vol. 1, the essential nutrients, 117 pp; Vol. II, Nutrient sources and compositions, 129 pp; Vol III, Feeding methods, 208 pp. Argent Denier Attires Press, Red Mooned, Washington.</p>

Course Code: 0831 06 AQUA 5105	Year: First	Term: First
Course Title: Brood Management and Breeding Technique		
Course Status: Optional		
Credit: 3.0		
Prerequisite(s): None		
Rationale	Aquaculture has a great contribution to national GDP and socioeconomic condition of Bangladesh. Brood Management and breeding Techniques are important issues in aquaculture of Bangladesh. This course offers basis of fish brood management and breeding programs of commercially important aquaculture species.	

Course Contents		CLOs
Section A		
1	Brood management: Introduction, prospects and challenges, selection criteria.	1
2	Fish Domestication: Introduction, Importance, Domestication and captive rearing, Selective breeding, Behavioural responses to domestication and selective breeding, Prerequisites for a Breeding Program.	1
3	Reproduction: Introduction, sexuality of fishes, sexual dimorphism, reproductive cycle, reproductive strategies (Inbreeding, Crossbreeding, Pure breeding), fecundity and spawning, courtship and reproduction, style of reproduction, use of androgenesis, gynogenesis and triploidisation	1,2
4	Mating Design: Introduction, Mass Spawning, Single Pair Mating, Nested Mating Design, Factorial Mating, Connectedness.	2
5	Genotype–Environment Interaction: Introduction, Estimates of Genotype–Environment	1,2

	Interactions.	
6	Undesirable Side Effects in Breeding Programs: Introduction, Correlated Effects, Breeding Goal May Change, Disease Prevention, Genotype–Environment Interaction, Increase of Inbreeding.	1,2
7	Economic Benefits of Breeding Programs: Introduction, Cost of Broodstock Production, Cost of Running a Breeding Program, Economic Benefit of Breeding Programs, Relative Contribution of Selection and Feed Regimes to Performance, Who Benefits from Genetic Improvements? The Animal, The Farmer, Ownership of Genetically Improved Material.	3
Section B		CLOs
8	Brood management and breeding technique of Indian major carps, major exotic species and major small indigenous fish: Brood pond preparation; water parameters of brood pond; sources and selection of brood, breeding seasonality; feed and feeding; health care; brood capture and transportation, procedure of artificial spawning, incubation techniques, larval rearing and management.	4,5,6
9	Brood management and breeding technique of major cat fishes: Prospects and challenges, brood pond preparation; water parameters of brood pond; sources and selection of brood, breeding seasonality; feed and feeding; health care; brood capture and transportation, artificial breeding procedure, incubation, larval rearing and management.	4,5,6
10	Brood management and breeding technique of Hilsa: Prospects and challenges, status of culture and breeding of Hilsa, research gap in Hilsa culture and breeding, brood pond preparation; water parameters of brood pond; sources and selection of brood, breeding seasonality; feed and feeding; health care; brood capture and transportation identification of male and female brood, procedure of artificial breeding, incubation, larval rearing and management.	4,5,6
11	Brood management and breeding technique of Sea-bass, mullet : Prospects and challenges, status of culture and breeding worldwide, breeding traits (sexual maturity, fecundity and spawning, embryonic development), broodstock development, broodstock maintenances, food and feeding for broods, selection of spawners, care of spawners, artificial spawning of seabass, eggs collection and incubation, larval rearing and feeding.	4,5,6
12	Brood management, breeding and larval rearing of crustaceans e.g. shrimp, freshwater prawn, crab.): Prospects and existing problems, brood pond preparation; water parameters; sources and selection of brood, breeding seasonality; feed and feeding; comparative nutritional requirements between fish and crustaceans; health care brood capture and transportation identification of male and female brood, procedure of artificial breeding, incubation techniques, larval rearing and management.	4,5,6
13	Breeding and seed rearing of major molluscs species: Prospects and challenges; brood pond preparation; sources and selection of brood; brood capture and transportation; brood management; breeding seasonality; feed and feeding; procedure of artificial spawning, incubation techniques, larval rearing and management.	4,5,6

Course Learning Outcomes (CLOs)	Upon completion of this course the students will be able to:		Mapping with PLOs
	CLO1	carry out fish brood selection and domestication;	PLO1, PLO2, PLO3, PLO9
CLO2	make breeding programs and mating design;	PLO1, PLO8, PLO10, PL11	
CLO3	perform economic analysis of breeding programs;	PLO2, PLO10, PLO6	
CLO4	gain knowledge in brood management of different fishes and shell fishes;	PLO1, PLO2, PLO3,	
CLO5	conduct breeding techniques of different fishes and shellfishes;	PLO1, PLO2, PLO8, PL10	

	CLO6	run through larval rearing of commercially important fish and shellfishes.	PLO2, PLO3, PLO7, PLO11
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Mapping CLOs with the Teaching-Learning and Assessment Strategy

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

Learning Materials

Recommended Readings	
	<ol style="list-style-type: none"> 1. Bromage, N.R. and Roberts, R.J. (eds.). 1995. Broodstock Management and Egg and Larval Quality. Blackwell Science Ltd. 2. Chattopadhyay Nihar Ranjan. 2016. Induced Fish Breeding, 1st Edition: A Practical Guide for Hatcheries. Academic Press. 3. Gjedrem, T. and Baranski, M. 2010. Selective Breeding in Aquaculture: an Introduction. Springer Science & Business Media, 221 pp. 4. Huet, M. 1994. Text Book of Fish Culture : Breeding and Cultivation of Fish. 2nd Edition, Fishing News Books. 5. Jerry et al. 2014. Biology and Culture of Asian Seabass <i>Lates calcarifer</i>, CRC Press, Taylor & Francis Group, Boca Raton, London-New York 6. Kungvankij et al. 1985. Training Manual Biology and Culture of Seabass (<i>Lates calcarifer</i>) Published by FAO, Network Of Aquaculture Centres In Asia, Bangkok, Thailand 7. Kungvankij, P., Tior, L.B. Jr., Pudadera, B.J. Jr., Potestas, I.O., Corre, K.G., Borlongan, E., Talean, G.A., Bustilo, L.F., Tech, E.T., Unggui, A. and Chua, T.E. 1989. Shrimp Hatchery Design, Operation and Management. Aquaculture Extension Manual No. 14. Aquaculture Department, Southeast Asian Fisheries Development Center. Network of Aquaculture Centres in Asia, Thailand. 8. Liao I.C., Huang Y.S. Methodological approach used for the domestication of potential candidates for aquaculture. Recent advances in Mediterranean aquaculture finfish species diversification. Zaragoza : CIHEAM, 2000. p. 97-107 (Cahiers Options Méditerranéennes; n. 47) 8. Mhd Ikhwanuddin and Ambok Bolong Abol-Munafi, 2016. Fish and Shellfish Domestication and Stock Enhancement: Current Status and Future Directions. Asian Journal of Scientific Research, 9: 167-170. 9. Moretti et al. 1999. Manual on Hatchery Production of Seabass and Gilthead Seabream, Published by Food and Agriculture Organization of the United Nations, Rome, 1999 10. Pillay, T.V.R. 1990. AQUACULTURE: Principles and Practices. Fishing News Books. 11. Price, C.R. 1989. A guide to carp culture in Bangladesh. Institute of Aquaculture Publications, University of Stirling, Scotland. 12. Shelley, C. and Lovatelli, A. 2011. Mud crab aquaculture—a practical manual. FAO, Fisheries and Aquaculture Technical Paper. No. 567. Rome, FAO, 78 pp 13. Thomas, P.C. 2003. Breeding and seed production of fin fish and shell fish. Daya Publishing House.

Course Code: 0831 06 AQUA 5107	Year: First	Term: First
Course Title: Live Food in Aquaculture		
Course Status: Optional		
Credit: 3.0		
Prerequisite(s): None		
Rationale	Aquaculture of Bangladesh is rapidly expanding with new candidate species. Seed production is the prerequisite for their culture. In seed production, live food is indispensable in larval rearing. This course is designed to provide students knowledge of significance of live food in fish and shellfish larval rearing and as food for adult shellfish, as well as to provide advance knowledge of live food production and management.	

Course Contents		CLOs
Section A		
1	Live foods: types of live food used in aquaculture; Scope and importance of live food in aquaculture.	1
2	Micro-algae culture: types; physical and chemical condition; growth dynamics; isolation, culture techniques and maintaining of cultures; contamination and treatments.	2,3
3	Rotifers culture: bio-ecological features; general culture practices; harvesting; nutritional value; enrichment techniques; use of resting eggs.	2,3
Section B		CLOs
8	<i>Artemia</i> : use of cyst; hatching and decapsulation of cysts, use of nauplii; harvesting, storage, nutritional quality.	4,5
9	Production and use of <i>Artemia</i> : nutritional properties; culture techniques, enrichment, control of infections, harvesting, processing and production cost.	4,5
10	Copepods: wild collection; biometrics; nutritional quality; culture techniques; mesocosm systems.	5
11	Daphnia and Moina: bio-ecological features; feeding, nutrition and nutritional value; mass culture; uses.	5
12	Other live food organisms: Culture and use nematodes, earthworms, etc.	5

Course Learning Outcomes (CLOs)	Upon completion of this course the students will be able to:		Mapping with PLOs
	CLO1	discuss scope and importance of live food in aquaculture;	
CLO2	confer the suitable parameters for micro-algae and rotifer culture;		PLO1, PLO2, PLO3, PLO11
CLO3	carry out micro-algae and rotifer culture.		PLO1, PLO2, PLO3
CLO4	get insight into the importance of zooplankton including <i>Artemia</i> used in aquaculture;		PLO1, PLO2, PLO3
CLO5	accomplish culture of <i>Artemia</i> , Copepod, Daphnia, Moina, nematodes, earthworms being used in aquaculture system.		PLO2, PLO3, PLO8, PLO10

Mapping CLOs with the Teaching-Learning and Assessment Strategy

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

Learning Materials

Recommended Readings
<ol style="list-style-type: none"> 1. Lavens, P. and Sorgeloos, P. (eds.). 1996. Manual on the production and use of live food for aquaculture. FAO Fisheries Technical Paper-361, FAO, Rome. 2. Mike Hellweg. 2008. Culturing Live Foods: A Step-by-Step Guide for Culturing One's Own Food for the Home Aquarium. 3. Kar, D. 2007. Fundamentals of limnology and aquaculture biotechnology. Day Publishing House, Delhi, pp. 1-608. 4. Zheng Zhong et al. 1984. Marine Planktology. China Ocean Press, Beijing, pp. 1-454. 5. Davis, C. C. 1955. The marine and freshwater plankton. Michigan State University Press, pp. 1-562. 6. Shephard, C. J. and Bromage, N.R. (eds.). 1992. Intensive fish farming. Blackwell Science Ltd., pp. 1-404. 7. Barnabe, G. 1990. Aquaculture Vol. 1 Ellis Horwood Limited, England. 8. Gerking, S.D. 1994. Feeding ecology of fish. Academic Press, Inc., pp. 1-415.

Course Code: 0831 06 AQUA 5109	Year: First	Term: First
Course Title: Integrated Aquaculture		
Course Status: Optional		
Credit: 3.0		
Prerequisite(s): None		
Rationale	Aquaculture is the fastest growing and major source of global food production. This course will give an overview of the current integrated aquaculture production system and also on management and development on integrated aquaculture.	

Course Contents		CLOs
Section A		
1	Principle and concepts of integrated aquaculture system (IAS); historical overview of IAS.	1
2	Multi-trophic dynamics in integrated aquaculture; Scope of integration of the farming components: advantages and disadvantages.	
3	Major IAS: Types of integrated farming. Suitable species, criteria for the selection of ponds/plots, fish species and farming components for different types of integrated farming.	2
4	Traditional IAS: rice-fish; horticulture-Fish, cattle-Fish, poultry-Fish, duck-Fish, grass-fish, water hyacinth-fish.	2
5	Recent Integrated culture system: IMTA, Aquaponic, wastewater-fed Aquaculture.	2
Section B		CLOs
6	Techniques of pond/plot preparation for different types of integrated farming. Pre-stocking and stocking management of the integrated farms; post-stocking management of the integrated farms.	4
7	Cost-benefit aspects of integrated farming: economic and market considerations.	5

8	Environmental and public health considerations: feed and fertilized inputs; pollution and disease risks; alien species invasion.	5
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Course Learning Outcomes (CLOs)	Upon completion of this course the students will be able to:		Mapping with PLOs
	CLO1	get insight into the scope and importance of integrated aquaculture;	
CLO2	discuss different types of integrated aquaculture;		PLO1, PLO2, PLO3, PLO11
CLO3	select suitable places, species and farming components for integrated aquaculture;		PLO2, PLO3, PLO4, PLO8
CLO4	practice and manage different integrated aquaculture systems;		PLO2, PLO3, PLO4, PLO8
CLO5	determine cost-benefit analysis of different integrated aquaculture systems and its environmental and health concern.		PLO2, PLO3, PLO11

Mapping CLOs with the Teaching-Learning and Assessment Strategy

CLOs	Teaching-Learning Strategy	Assessment Strategy
CLO1	Lecture	Final Exam
CLO2	Lecture and demonstration	Assignment, Final Exam
CLO3	Group Discussion	Class test, Final Exam
CLO4	Problem based learning	Class test, Final Exam
CLO5	Lecture	Class test, Final Exam

Learning Materials

Recommended Readings
<ol style="list-style-type: none"> 1. Jude Nnaji. 2011. Integrated Fish Farming Systems: Basics, Concepts and Practice. 2. Pillay, T. V. R., & Kutty, M. N. (2005). Aquaculture: principles and practices (No. Ed. 2). Blackwell publishing. 3. Phillips, B. F., & Pérez-Ramírez, M. (Eds.). (2017). Climate Change Impacts on Fisheries and Aquaculture, 2 Volumes: A Global Analysis (Vol. 1). John Wiley & Sons. 4. Stickney, R. R. 1994. Principles of Aquaculture. John Wiley & Sons, INC. New York 5. Landau, M. 1992. Introduction to aquaculture. John Wiley & Sons, New York.

Course Code: 0831 06 AQUA 5111	Year: First	Term: First
Course Title: Fish Hatchery and Farm Design		
Course Status: Optional		
Credit: 3.0		
Prerequisite(s): None		
Rationale	Aquaculture has substantial contribution to global food production, food security and income generation. In aquaculture, hatcheries and farms are indispensable components; management of hatchery and farms is crux issues in sustainable aquaculture. This course offer students knowledge of hatchery and farms layout as well as management and development of fish hatcheries and farms.	

Course Contents		CLOs
Section A		
1	Introduction to fish hatchery: definition, present status, prospects and challenges; recent advances in hatchery systems; characterization and categories of hatchery production systems; calculating size of a hatchery; differences in shellfish and finfish hatcheries; social, economic, technical and legal considerations for establishing hatchery.	
2	Construction and design of freshwater finfish hatchery: planning for carp hatchery construction and site selection; essential components, requirements and structural features of brood fish ponds and other ponds; placement of ponds; nursery facilities; biological considerations, artificial reproduction strategy and facilities; drainage engineering; water supply and filtration systems; tanks and hatching jars; supplies and equipments.	1
3	Construction and design of marine finfish hatchery: introduction; environmental and socio-economic aspects; size of the hatchery; site selection; hatchery layout and design; quarantine facility; different components/units.	1
4	Hatchery design of major crustaceans: components; size of hatchery; suitable site selection-basic criteria, water supply and other criteria; facility design-the hatchery building, floor, drainage, filtration units, aeration system, electrical system; tanks-holding tanks, maturation tanks, hatching and spawning tanks, larval rearing tanks, nursery tanks, brine and freshwater storage tanks, mixing tanks; live food culture unit; <i>Artemia</i> incubator; water pumps and distribution; equipments.	1
5	Bio-security considerations in hatchery systems: concept and basics; benefits of employing bio-security in hatchery systems; common issues in hatchery bio-security; process, facilities and requirements for bio-security in hatchery; appropriate hatchery design for bio-security; proper treatment and disposal of hatchery wastewater and solid waste.	2
Section B		CLOs
8	Introduction to fish farm: scope and importance; characterization and categories of fish farm production systems-land based, water based and specialized systems; recent advances in farm systems; socio-economic and legal consideration for a commercial fish farm; production size of farms; criteria for a model fish farm.	3
9	Site selection for fish farm establishment: basic considerations; basic principles of arrangement; technical, topological, hydrological and meteorological history; soil and water quality data.	3
10	Planning and designing fish farm: type of fish farm; scale of production; farm layout-nursery, grow-out unit, cages, raceways, biofloc tank system, RAS etc; fish pond arrangements.	4
11	Fish farm engineering and construction: design wise farm component specification; construction of pond dams and dykes, monk and open sluices, spillways, feeder canals, water supply and drainage system, drain ditch, internal pond drains and harvesting pits; tank and cage culture unit construction and arrangements, pumps and its installation; aeration and oxygenation, types of blowers, aerators; feed storage room and feeders setup.	4
12	Bio-security in fish farm and waste water treatment: bio-security in fish farm; sterilization and disinfection of farm units and equipments; farm wastage and management; waste water and solid waste treatment.	5
13	Entrepreneur development with fish hatchery and farm production: commercially important potential species selection for hatchery and farm use; farm and hatchery management; managing the business; the secret of business success; setting goals for business management decisions; market considerations and economics of different production systems; human resources, business managers of tomorrow, challenges and	6

sustainability.

Course Learning Outcomes (CLOs)	Upon completion of this course the students will be able to:		Mapping with PLOs
	CLO1	design and construct fish and shellfish hatchery;	
CLO2	get insight into biosecurity concepts, concerns and management in fish and shellfish hatchery construction;		PLO1, PLO2, PLO3, PLO5, PLO11
CLO3	select suitable places for designing fish and shellfish farms;		PLO1, PLO2, PLO3
CLO4	execute construction of design fish and shellfish farms;		PLO1, PLO2, PLO3
CLO5	apply biosecurity management in fish and shellfish farms;		PLO1, PLO2, PLO3, PLO5
CLO6	develop entrepreneurship with fish and shellfish hatchery and farm.		PLO2, PLO3, PLO8, PLO10, PLO11

Mapping CLOs with the Teaching-Learning and Assessment Strategy

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

Learning Materials

Recommended Readings
<ol style="list-style-type: none"> 1. Gary A. Wedemeyer, editor. 2002. Fish Hatchery Management, 2nd Edition. Published by American Fisheries Society, pp 751. 2. Gray, C. W. 1990. A guide to shrimp and prawn hatchery techniques in Bangladesh. BAFRU, IOA, University of Stirling, Scotland, UK. 3. Jhingran V. G. and Pullin R. S. V. (1985). A Hatchery Manual for the Common, Chinese and Indian Major Carps. Asian Development Bank and International Center for Living Aquatic Resources Management, Philippines. 4. Lawson, T. B. 1995. Fundamentals of Aquacultural Engineering. Chapman and Hall, New York, U.S.A. 5. Nandlal, S., and Pickering, T. 2005. Freshwater prawn <i>Macrobrachium rosenbergii</i> farming in Pacific Island countries. Volume one. Hatchery operation. Noumea, New Caledonia: Secretariat of the Pacific Community. 6. New M. B. 2002. Farming freshwater prawns: A manual for the culture of the giant river prawn (<i>Macrobrachium rosenbergii</i>). Fisheries Technical Paper-428, Food and Agriculture Organization of the United Nations. 7. Osborn P. E. Design of a freshwater fish hatchery for small fish farmers. FAO/UNDP Brackishwater Aquaculture Development and Training Project Manila, Philippines 8. Rafiqul Chowdhury R., Bhattacharjee H. and Angell C. 1993. A Manual for Operating a Small-scale Recirculation Freshwater Prawn Hatchery. Bay of Bengal Programme, Madras, India 9. Woynarovitch, E. 1975. Fish Ponds and their Construction: Elementary Guide to Fish Culture in Nepal, FAO, Rome, Italy.

First Year Second Term

Course Code: 0831 06 AQUA 5201	Year: First	Term: Second
Course Title: Coastal Aquaculture and Mariculture		
Course Status:		
Credit: 3.0		
Prerequisite(s): None		
Rationale	Bangladesh is endowed with brackish and marine water bodies which are highly diverse in species of which many species are potential for aquaculture. This course is designed to provide advanced knowledge of farming practices of different commercially important brackish and marine water species.	

Course Contents		CLOs
Section A		
1	Introduction to coastal aquaculture and mariculture: Concepts of coastal and marine aquaculture; recent trends over the world; global, regional and national importance; fish group (i.e. family/class/) –wise production trend; potential candidate species; different farming systems; potential of coastal aquaculture and mariculture in Bangladesh.	1
2	Culture practices of penaeid shrimps: Farming technologies, production cycle; site selection, pond preparation, nursery operation; PL transportation and releasing method, on-growing techniques: extensive, semi-intensive, intensive, super-intensive water quality management, feeding management; health and disease management, harvesting and data collection, storage and analysis; potentials and challenges of penaeid shrimp farming in Bangladesh.	2
3	Farming systems of marine fin-fishes: Sea-bass, mullet, milk fish, <i>Mystus gulio</i> , flat fish, yellow tail fish.	2
4	Culture practice of molluscs: Mussel, edible and pearl oyster, clams, scallops, abalone, and cuttlefish.	2
5	Some Non-Piscine species culture: Crab fattening and culture; culture of lobsters, cray fish, sea-turtle, sea cucumber, sea urchin and pearl.	2
6	Seaweed farming: Site selection, species selection, preparation and management, economic potentials and sustainability, commercial uses and exploration of national and international markets.	2
7		
Section B		CLOs
8	Blue economy: Concepts, blue economy and SDG's; sustainable use of marine fisheries resources; marine systems of Bangladesh, blue economy and aquaculture.	3
9	Aqua/bio mimicry: Aqua mimicry/Bio mimicry concept, pond preparation, carbon source preparation and use, aeration systems, shrimp toilet, bottom clean system; feeding management; health care, harvesting.	4
10	Fish and crustacean culture with biofloc and RAS: Potential cultivable species, culture units/system preparation, stocking, water and feeding management, aeration, bio-security and healthcare, harvesting.	4
11	Integrated Multitrophic Aquaculture (IMTA): Concept of IMTA, terminology and related approaches, central theme and importance of IMTA, planning and management, operation and maintenance, development of offshore IMTA, technology, possibility and constraints, economics.	4
12	Entrepreneurship with coastal and marine aquaculture production system: Commercially important potential species, commercial aquaculture farm management, market considerations and economics of different production systems.	5

Course Learning Outcomes (CLOs)	Upon completion of this course the students will be able to:		Mapping with PLOs
	CLO1	understand the recent advances, prospects and challenges of brackish and marine water aquaculture;	PLO1, PLO2
	CLO2	carry out practices of commercially important brackish and marine water fish and shellfishes;	PLO1, PLO2, PLO3, PLO4, PLO5, PLO7, PLO9
	CLO3	know the scope of mariculture for accelerating blue economy in Bangladesh;	PLO1, PLO2
	CLO4	get insight about the advanced sustainable technology and its application for sustainable aquaculture;	PLO1, PLO2, PLO3, PLO4
	CLO5	confer entrepreneurship and business management of brackish and marine water aquaculture.	PL10, PLO11

Mapping CLOs with the Teaching-Learning and Assessment Strategy

CLOs	Teaching-Learning Strategy	Assessment Strategy
CLO1	Discussion	Final Exam
CLO2	Lecture, video tape and field visit	Class test, Final Exam
CLO3	Lecture	Final Exam
CLO4	Lecture, demonstration and video tape	Class test, Final Exam
CLO5	Lecture and enquiry based learning	Assignment, Presentation, Final Exam

Learning Materials

Recommended Readings	<ol style="list-style-type: none"> 1. Athithan S. 2020. Coastal Aquaculture and Mariculture. 2. Pillay, T.V.R. 2005. AQUACULTURE: Principles and Practices. Fishing News Books. 2nd edition. 3. Tucker Jr., John W. 1998. Marine Fish culture. Springer. 4. Muir, J.F. and Roberts, R.J. (eds.). 1982. Recent advances in aquaculture, Vol. I, II, III, and IV. Croon Heln. London. 5. Novey, J. and Moore, J. 1983. CRC hand book of mariculture, Vol. 1. Crustacean Aquaculture. 6. Lee, D.O'C. and Wickins, J. F. 192. Crustacean Farming. Blackwell Scientific Publications, Oxford. 7. Imai, T. (ed.). 1987. Aquaculture in shallow Seas: progress in shallow sea culture. A.A.Balkema/Rotterdam. 8. The blue economy. 2017 International Bank for Reconstruction and Development/The World Bank 1818 H Street NW Washington DC 20433 Telephone: 202-473-1000 Internet: www.worldbank.org
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Course Code: 0111 06 RM 5202	Year: First	Term: First
Course Title: Seminar–II: Data Management and Analysis		
Course Status: Core		
Credit: 2.0		
Prerequisite(s): None		

Rationale	The course intends to provide students advance knowledge and hand-on experience on assembling, analysis and presentation of data obtained from the primary research and secondary studies of fisheries, aquaculture, and other aquatic resources.
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Course Contents		CLOs
1	Introduction: Statistics in biological sciences, types of data, data sources, accuracy, precision, errors and their sources, error minimization and separation;	1,4
2	Sampling: Sample size estimation, types of sampling and its uses, sampling distribution;	2,3
3	Studies and experimental units: aquaculture; Genetics, Microbiology, aquatic resource management, coastal sciences;	1,2,3
4	Processing and presentation: Array Formation, Frequency Distribution/ Table, Graphic representation;	1,4
5	Data analysis: growth trend, feeding level determination, performance indicators, sensitivity, cash flow; sex determination, genotypic and allelic frequencies and estimation, effective breeding number, heritability, QTL, selection index, microbial count and growth curve.	1,3,4

Course Learning Outcomes (CLOs)	Upon completion of this course the students will be able to:		Mapping with PLOs
	CLO1	explain different types of data in relation to fisheries production and other aquatic resources;	PLO1, PLO3, PLO4, PLO7, PLO10
	CLO2	determine sample size and suitable sampling strategies;	PLO3, PLO4, PLO5, PLO7, PLO8, PLO9, PLO10, PLO11
	CLO3	design survey and experimental research works;	PLO2, PLO4, PLO5, PLO8, PLO9, PLO10, PLO11
	CLO4	analyze and present data.	PLO1, PLO3, PLO4, PLO6, PLO8, PLO9, PLO10, PLO11

Mapping CLOs with the Teaching-Learning and Assessment Strategy

CLOs	Teaching-Learning Strategy	Assessment Strategy
CLO1	Seminar, group discussion, video tape	Quiz, viva
CLO2	Seminar, problem based learning	Assignment
CLO3	Seminar, problem based learning	Assignment, viva
CLO4	Seminar, group discussion, video tape	Assignment, presentation

Learning Materials

Recommended Readings	
	1. Bhujel, R.C., 2009. <i>Statistics for aquaculture</i> . John Wiley & Sons.
	2. Kothari, C.R., 2004. <i>Research Methodology: Methods and techniques</i> . New Age International.
	3. Bhamrah, H.S., Sandhu, G.S. and Gupta, K.C. , 2006. <i>Research Techniques in Biological Science</i> . Dominant Publishers.
	4. Pillay, T.V.R., 1990. <i>Aquaculture Principles and Practices</i> (pp.575). Fishing News Books, University Press.

Course Code: 0831 06 AQUA 5203	Year: First	Term: Second
Course Title: Aquatic Health Management		
Course Status: Core		
Credit: 3.0		
Prerequisite(s): None		
Rationale	Aquaculture and fisheries has become indispensable part of world economy; in Bangladesh, day-day aquaculture practices are being extended horizontally as well as vertically. Good health management of aquatic species is an important issue in sustainable aquaculture. This course is designed to provide knowledge of the health management strategies in aquaculture.	

Course Contents		CLOs
Section A		
1	Disease problems in aquaculture – World scenario with the emphasis on Bangladesh.	1
2	Abiotic and biotic factors in aquaculture: interaction, infection and disease. Roles in aquatic productivity and disease susceptibility.	2,3
3	Relationship among water quality, aquaculture and disease: water quality–aquatic animal health interactions, management and water quality, water quality–related stressors, water-quality management, water quality–disease relationship.	4
4	Management of bottom soil for improving water quality and pond productivity. Bottom soil, oxidation reduction at soil water interface, fertility, liming. Management of pond bottom after harvest.	5
Section B		CLOs
8	Nutrition and health: dietary components influencing fish health; feeding practice affecting fish health; effect of nutritional deficiencies; nutrition and stress; fish immunostimulation through dietary manipulation.	6
9	Prevention and control of pathogens in aquaculture: General considerations in prevention and control; drugs, pathogens and host mechanism of drug action; drug resistance.	6
10	Vaccination for sustainable aquaculture practice: Types; vaccines used in aquaculture. Advances in vaccine developed as a tool of good health management technique.	7
11	Advances in disease diagnosis procedure in aquaculture: Monitoring and clinical examination of microbes from healthy and diseased fish, Isolation and identification (histology, serology, and advances in molecular technology) for fish disease diagnosis.	8
12	Application of biosecurity protocols in aquaculture: General information, major goals, biosecurity in hatchery, farm and laboratory, biosecurity hazard.	8

Course Learning Outcomes (CLOs)	Upon completion of this course the students will be able to:		Mapping with PLOs
	CLO1	state the scope and importance of aquatic health management; concept of various diseases and their diagnostic and prevention technique as well as factors increased susceptibility to disease outbreaks;	PLO1
CLO2	point out host pathogen interaction, quorum sensing, host-specificity of pathogens;	PLO1, PLO2, PLO3	
CLO3	categorize different pathogen and their transmission techniques in fishes and shellfishes;	PLO1, PLO2, PLO3, PLO8	
CLO4	explain relationship among water quality and aquaculture performance and diseases;	PLO2, PLO3	

	CLO5	perform management of bottom soil for improving of water quality and pond productivity;	PLO1, PLO2, PLO3, PLO9, PLO11
	CLO6	know the nutritional diseases and act upon prevention and control strategies of microbes in aquaculture;	PLO1, PLO2, PLO3, PLO11
	CLO7	get insight into the aquatic health management through immune-stimulant and vaccination;	PLO1, PLO2, PLO6, PLO7
	CLO8	monitor and examine microbes from healthy and diseased fish.	PLO3, PLO8, PLO10, PLO11

Mapping CLOs with the Teaching-Learning and Assessment Strategy

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

Learning Materials

Recommended Readings	<ol style="list-style-type: none"> 1. BIRADAR R.S. et.al. 2011. Aquatic Resources and Health Management. 2. Noga E J. 1996. Fish disease. Diagnosis and treatment. Mosby-Year book Inc., St. Louis, Missouri. 367 p. 3. Ferguson, H.W. (ed) 2006. Systemic Pathology of fish: a text and atlas of normal tissues in teleosts and their responses in disease. Second Edition, Scotian Press, London. 4. Sindermann C J. 1990. Principal diseases of marine fish and shellfish Vol. I and Vol. II Ellis A E. 1988. Fish Vaccination Academic Press. 255p. 5. Anderson, D. P. (1981) Fish immunology, TFH. Publication (fourth series of diseases of fishes) 6. Bancroft, J. D. and Stevens. A. (1990) Theory and practice of histology techniques (3rd edition). Churchill living stone. Edinburgh. UK. 7. Bullock, G. L. (1980) The Identification of fish pathogenic bacteria, Bureau of sport fisheries and wildlife, U. S. A. 8. Bullock, G. L. Conroy D. A. and Snieszko S. F. (1980) Diseases of fishes. Edited by S. E. Snieszko and Herbert R. Axelvod. Book 2a Bacterial diseases of fishes TFH. publication.
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Course Code: 0831 06 AQUA 5204	Year: First	Term: Second
Course Title: Dissertation Part I		
Course Status: Capstone		
Credit: 4.0		
Prerequisite(s): None		
Rationale	This course is designed to provide the students an opportunity to conduct and write their thesis proposal.	

Course Contents		CLOs
1	This course serves as an introductory course in the dissertation methodology writing process. The focus of the course is to develop the MS student's dissertation proposal. The core objective of this course is to provide guidance and motivation to the MS student for their comprehensive understanding on the problem identification, literature review and methodology.	1,2,3,4,5

Course Learning Outcomes (CLOs)	Upon completion of this course the students will be able to:		Mapping with PLOs
	CLO1	Understand the clear concepts about their thesis;	PLO1, PLO2, PLO5, PLO7, PLO8, PLO10
CLO2	design and execute a meaningful research project that demonstrates spatial thinking and uses the knowledge and skills;	PLO2, PLO3, PLO5, PLO8, PLO9, PLO11	
CLO3	undertake the research process and be aware of research obligations and pitfalls;	PLO1, PLO3, PLO4, PLO6, PLO8, PLO9, PLO10, PLO11	
CLO4	articulate research or project objectives clearly, situate research within an academic or scholarly context; state claims and evidence clearly, assess validity of claims, evidence, outcomes, and results;	PLO2, PLO4, PLO5, PLO7, PLO8, PLO9	
CLO5	utilize the relevant software and bibliographic reference manager competently and efficiently to produce document that meet program requirements	PLO1, PLO3, PLO4, PLO6, PLO8, PLO9, PLO10, PLO11	

Mapping CLOs with the Teaching-Learning and Assessment Strategy

CLOs	Teaching-Learning Strategy	Assessment Strategy
CLO1	Demonstration, project, modular, group discussion, seminar, workshop,	Presentation and viva
CLO2	Demonstration, workshop, group discussion	Assignment
CLO3	Demonstration, workshop, group discussion	Presentation
CLO4	Seminar, group discussion	Presentation and viva
CLO5	Demonstration, workshop, group discussion	Assignment

Learning Materials

Recommended Readings

Course Code: 0831 06 AQUA 5205	Year: First	Term: Second
Course Title: Aquaculture and Environment		
Course Status: Optional		
Credit: 3.0		
Prerequisite(s): None		
Rationale	Aquaculture has substantial contribution to global food production, food security and income generation. The practices and management of aquaculture affects environment in milieu of habitat alteration and destruction, pollution, biodiversity loss, new production venture etc., and are to be executed in sustainable ways. This course is designed to provide the student concepts of sustainable aquaculture, good management practices and aquaculture legislations.	

Course Contents		CLOs
Section A		
1	Overview on sustainability in Aquaculture; Indicators for Sustainable Aquaculture.	1
2	Environment affecting aquaculture production: water quality, hydrodynamics, carrying capacity.	2
3	Aquaculture operation and environmental impacts: aesthetic, water column effects, sedimentary effects, aquatic weeds, effects on wild and native population, disease spread.	4
4	Sustainable aquaculture practice: native and exotic species, Sustainable feeds and feeding, clean production, Responsible health management; organic fish and shrimp culture.	3
5	Climate change and aquaculture: potential impacts; adaptation and mitigation.	4
Section B		CLOs
8	Environmental impact assessment (EIA): Guidelines and protocols- Modelling, GIS and related tools, Strategic EIA, SEA.	4
9	Issues of environmental monitoring and aquaculture: risk categories, analysis; general requirements of a monitoring survey; challenges for monitoring and regulation, regulation and enforcement of monitoring programmes.	5
10	Methods used in the environmental monitoring of aquaculture: Hydrographic analyses and other assessments, chemical analyses, benthic faunal analyses.	6
11	International legislation; national legislation –Bangladesh.	7
12	Best environmental practice (GAP, IMTA, BFT, Aqua/bio mimicry; RAS); ecosystem based approaches; aquaculture certification.	7

Course Learning Outcomes (CLOs)	Upon completion of this course the students will be able to:		Mapping with PLOs
	CLO1	confer principles of sustainable aquaculture.	PLO1, PLO2
CLO2	point out how environment influences aquaculture production as well as how aquaculture affects environments;	PLO1, PLO2	
CLO3	practice sustainable aquaculture approaches;	PLO1, PLO2, PLO3	
CLO4	perform environmental impact analysis;	PLO2, PLO3, PLO4	
CLO5	state environmental monitoring regulations and challenges;	PLO1, PLO2, PLO3, PLO11	
CLO6	carry out aquaculture monitoring programmes;	PLO1, PLO2, PLO3,	

		PLO5
	CLO7	discuss code of conduct in responsible aquaculture.
		PLO1, PLO2, PLO8, PLO11

Mapping CLOs with the Teaching-Learning and Assessment Strategy

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

Learning Materials

Recommended Readings	<ol style="list-style-type: none"> Hai, Faisal I., Visvanathan, Chettiyappan, Boopathy, Ramaraj (Eds.). 2018. Sustainable Aquaculture. Springer. Pillay, T.V.R. 2008. Aquaculture and the environment. 2nd edition Blackwell Publishing. Makinen, T. (ed.). 1991. Marine aquaculture and environment. NORAD. Odum, Fundamnetal of Ecology. New Delhi. Boyd, C.E. 1995. Bottom soils, sediments and pond aquaculture. Chapman & Hall, New York. Jana, B.B. and Webster, C.D. (eds.). 2005. Sustainable aquaculture: global perspectives. Atlantic Publishers & Distributors, New Delhi and Food products press, New York. Raizada, S., Srivastava, P.P. and Landge, A.T. (eds.). 2001. Summer school on Environmental impact assessment and management of coastal zone: an integrated approach. Central Institute of Fisheries Education, Mumbai.
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Course Code: 0831 06 AQUA 5207	Year: First	Term: Second
Course Title: Organic Aquaculture		
Course Status: Optional		
Credit: 3.0		
Prerequisite(s): None		
Rationale	Aquaculture affects environment in milieu of habitat alteration and destruction, pollution, biodiversity loss, etc. Without compromising ecosystems, aquaculture practice is an important consideration now-a-days; organic aquaculture is one approach which ensures minimum effect on ecosystem and good (apparently natural) food production. This course is designed to offer student knowledge of organic aquaculture concepts, practices and legislations.	

Course Contents		CLOs
Section A		
1	Definitions and concepts; principles of organic aquaculture.	1
2	Development of organic aquaculture; general standards for organic aquaculture production.	1,2
3	Current issues and future prospects of organic aquaculture.	1,2
4	Organic aquaculture: GAP, HACCP & Traceability.	1,2

5	Method of organic aquaculture; production unit setup.	1,2
6	Case studies: Organic aquaculture practices in the world; economic performance of organic aquaculture; scope of organic aquaculture in Bangladesh.	3
Section B		CLOs
8	Use of chemicals in aquaculture; chemicals permissible in organic aquaculture.	4
9	Organic aquaculture and environment- i.e. abiotic resources, biodiversity, and climate change.	4
10	International principles of organic aquaculture.	5
11	Organic aquaculture laws and regulation; certifications around the world.	5

Course Learning Outcomes (CLOs)	Upon completion of this course the students will be able to:		Mapping with PLOs
	CLO1	state principles of organic aquaculture;	
CLO2	confer organic aquaculture issues and prospects;		PLO1, PLO2, PLO11, PLO7
CLO3	illustrate organic aquaculture in the world;		PLO1, PLO2, PLO3
CLO4	determine interactive effects between organic aquaculture and environment;		PLO1, PLO2, PLO3, PLO8, PLO9
CLO5	get insight into rules and regulations for organic aquaculture.		PLO1, PLO2, PLO3, PLO9

Mapping CLOs with the Teaching-Learning and Assessment Strategy

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

Learning Materials

Recommended Readings	<ol style="list-style-type: none"> 1. Aarset, B., Beckmann, S., Bigne, J., Beveridge, M., Bjorndal, T., Bunting, M.J., McDonagh, P., Mariojouis, C., Muir, J.F., Prothero, A., Smith, A.P., Tveteras, R. & Young, J.A. 2000. Organic salmon: perceptions of consumer and interest groups p2. In R. Flos & Creswell (compilers) Responsible Aquaculture in the New Millennium. Abstracts of contributions presented at the International Conference AQUA 2000 held in Nice (France), 2-6 May 2000. European Aquaculture Society Special Publication No.2, Oostend, Belgium. 2. Lembo, Giuseppe, Mente, Elena (Eds.). 2019. Organic Aquaculture, Impacts and Future Developments. Springer 3. AFFA (Department of Agriculture, Fisheries and Forestry, Australia). 2001. Draft national standard for organic and biodynamic produce (available at www.affa.gov.au / corporate_docs/publications/pdf/quarantine/anprog/National_Standard_1st_draft_3rd_Edition_Sept_2001.pdf). 4. Alonso Villalón, N. 2002. First Spanish aquaculture certification includes sturgeon. The Organic Standard 12: 14-15.
Supplementary Readings	<ol style="list-style-type: none"> 1. Brister, D.J. & Kapuscinski, A. 2001a. Global rise of aquaculture: A trigger for organic and eco-labelling standards for aquatic animals. The Organic Standard 3: 7-11. 2. FAO/NACA/UNEP/WB/WWF. 2006. International Principles for Responsible Shrimp Farming. Network of Aquaculture Centres in Asia-Pacific (NACA). Shrimp Farming. Network of Aquaculture Centres in Asia-Pacific (NACA).

Course Code: 0542 06 STAT 5209	Year: First	Term: Second
Course Title: Applied Statistics		
Course Status: Optional		
Credit: 3.0		
Prerequisite(s): None		
Rationale	Bangladesh is endowed with fisheries resources and species suitable for aquaculture; accordingly academic, research and industrial programs in the field of fisheries and aquaculture science are carried out. This course is designed to provide fundamental concepts of data collection, arrangement, process, analysis, presentation and interpretation for understanding and development of any sector particularly of fisheries science.	

Course Contents		CLOs
Section A		
1	Brief outline of descriptive statistics: graphs; tables; measures of location; measures of variability.	1,2
2	Probability and distribution: generation and its application in fisheries; population and sample distribution- binomial, poisson, normal.	2,3
3	Categorical data analysis, count and percent data analyses, & non-parametric test.	
4	Research design: meaning & need of research design; different research designs.	3,4
5	Experimental design and analysis: Background, Complete Randomized Design (CRD); Randomized Complete Block Design (RCBD); Latin Square Design; Factorial experiments)	3,4
6	Sampling and simulation: sampling techniques; good sample design & different types.	3,4
Section B		CLOs
7	Chi-square analysis; analysis of variance (ANOVA); analysis of covariance (ANCOVA).	5
8	Multivariate analyses (PCA, CVA, RDA).	5
9	Correlation and regression: single and multiple analysis; coefficient; significance.	5
10	Generalized mixed models (liner and non-linear, zero-inflated, negative binomial).	5

Course Learning Outcomes (CLOs)	Upon completion of this course the students will be able to:		Mapping with PLOs
	CLO1	confer basic concepts of Statistics;	PLO1, PLO2, PLO3
CLO2	get insight into in-depth theoretical knowledge of Statistics;	PLO1, PLO2, PLO11	
CLO3	prepare research proposal, and design research activities;	PLO1, PLO4, PLO8, PLO9	
CLO4	state application of statistics in fisheries and aquaculture sector;	PLO1, PLO4, PLO8, PLO11	
CLO5	perform statistical analysis.	PLO1, PLO4, PLO8, PLO11	

Mapping CLOs with the Teaching-Learning and Assessment Strategy

CLOs	Teaching-Learning Strategy	Assessment Strategy
CLO1	Lecture	Final Exam
CLO2	Lecture and Enquiry based learning	Assignment, Final Exam
CLO3	Lecture and Group Discussion	Class test, Final Exam
CLO4	Problem based learning	Assignment, Final Exam
CLO5	Lecture and Group Discussion	Class test, Final Exam

Learning Materials

Recommended Readings	<ol style="list-style-type: none"> 1. Ajit Kumar Roy. 2008. Applied Bioinformatics, Statistics and Economics in Fisheries Research. Publisher :NIPA. 2. Bhujel, R.C. 2008. Statistics for Aquaculture. US Aquaculture Society, Willy-blackwell.USA. 224pp 3. Milton, S.J.; McTeer, P.M. and Corbet, J.J. 1977. Introduction to statistics. WCB/McGraw-Hill Companies, Inc. 4. Jayaraman, K. 1999. A statistical manual for forestry research. FAO, Bangkok. 5. Wonnacott, T.H. and Wonnacott, R. J. 1935. Introductory statistics (5th ed.). John Wiley & Sons, New York, pp. 1-711. 6. Ali, M.A. Theory of statistics. Vol. 2. Dhaka Book Mart, Dhaka.
Supplementary Readings	<ol style="list-style-type: none"> 1. Wonnacott, T.H. and Wonnacott, R. J. 1935. Introductory statistics (5th ed.). John Wiley & Sons, New York, pp. 1-711. 2. Ali, M.A. Theory of statistics. Vol. 2. Dhaka Book Mart, Dhaka.

Course Code: 0831 06 AQUA 5211	Year: First	Term: Second
Course Title: Livelihoods in Aquaculture		
Course Status: Optional		
Credit: 3.0		
Prerequisite(s): None		
Rationale	Aquaculture is one of the fastest growing food production sectors in the world. It has significant contribution in increasing fish production, and diversifying livelihood options of people involved in fisheries sector. This course is designed to offer students knowledge of different aquaculture systems and their role in livelihood of fish-stakeholders.	

Course Contents		CLOs
Section A		
1	Growth of global aquaculture; resilience of fish-stakeholders' livelihoods; poverty alleviation.	1
2	Sustainable livelihoods approach: Vulnerability, assets, strategies, outcomes.	1
3	Stakeholder analysis: key stakeholders, primary stakeholders and other stakeholders.	2,3
4	Social enterprise and private sector initiatives: community; transnational corporations and larger companies.	2,3
Section B		CLOs
5	Relationship between fish farmers' livelihoods assets, strategies and outcomes.	4
6	Aquaculture practices and people: level of involvement; employments.	4
7	Aquaculture value chain and income generation: aquaculture inputs; stakeholders' employment and incomes.	5
8	Women in aquaculture: level of involvement; empowerment; entrepreneurship.	6

Course Learning Outcomes (CLOs)	Upon completion of this course the students will be able to:	Mapping with PLOs
	point out aquaculture development and fish-stakeholders;	PLO1, PLO2
	make stakeholder categories;	PLO1, PLO2, PLO11
	perform stakeholder analysis;	PLO1, PLO2
	discuss aquaculture development and practices;	PLO1, PLO2, PLO5
	determine value chain analysis of aquaculture production systems;	PLO1, PLO2, PLO3

	CLO6	state the role of aquaculture in human asset development.	PLO1, PLO2, PLO5, PLO7, PLO9
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Mapping CLOs with the Teaching-Learning and Assessment Strategy

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

Learning Materials

Recommended Readings	<ol style="list-style-type: none"> 1. Jobling, M. S.W. Bunting: Principles of sustainable aquaculture. <i>Aquacult Int</i> 21, 1409–1411 (2013). https://doi.org/10.1007/s10499-013-9631-z 2. Olaganathan Rajee and Alicia Tang Kar Mun. 2017. Impact of aquaculture on the livelihoods and food security of rural communities. <i>International Journal of Fisheries and Aquatic Studies</i> 2017; 5(2): 278-283 3. Roslina, K. 2018. Contribution of Brackish and Freshwater Aquaculture to Livelihood of Small-Scale Rural Aquaculture Farmers in Kedah, Malaysia. <i>Pertanika J. Soc. Sci. & Hum.</i> 26 (3): 1301 - 1321 (2018).
Supplementary Readings	<ol style="list-style-type: none"> 1. Shrestha, M.K. and J. Pant (eds.) 2012. <i>Small-scale Aquaculture for Rural Livelihoods: Proceedings of the National Symposium on Small-scale Aquaculture for Increasing Resilience of Rural Livelihoods in Nepal.</i> Institute of Agriculture and Animal Science, Tribhuvan University, Rampur, Chitwan, Nepal, and The WorldFish Center, Penang, Malaysia. 191 p. 2. Ninawe, A. S., J. R. Dhanze and Rani Dhaze. 2018. <i>Aquaculture for Nutritional and Livelihood Security.</i> Narendra Publishing House; 1st edition (January 1, 2018).

Second Year First Term

Course Code: 0111 06 AQUA 6102	Year: Second	Term: First
Course Title: Seminar–III		
Course Status: Core		
Credit: 2.0		
Prerequisite(s): None		
Rationale	The course is designed to have insights into practical aspects of review and research works relate to their thesis works.	

Course Contents		CLOs
1	Oral Presentation: Scientific papers presented at a level that is appropriate to the audience; clear and informative visual aids (simple, sufficient time).	1, 2, 3
2	Introduction: Overview of problem area provided; unfamiliar terms introduced; appropriate literature abstracted and presented clearly; research hypothesis of the study identified.	4
3	Methods: Brief overview of the equipment and materials used, and how obtained; brief overview of the experimental design used and any other parts of the methods employed; materials and/or equipment described; procedures followed to conduct the experiment presented.	5
4	Results: Anticipated and actual results reported; statistics clearly presented.	6

5	Discussion: Implications if the hypothesis is supported clearly stated; implications if the hypothesis is not supported clearly stated; limitations of your study discussed; future research addressed.	4,7
6	Questions: Demonstrated knowledge of the material; poised and confident, but no bluffing; answered the question(s) asked (asked for clarification or restatement of the question).	6, 7

Course Learning Outcomes (CLOs)	Upon completion of this course the students will be able to:		Mapping with PLOs
	CLO1	communicate science in a 30-40 minute oral scientific presentation;	
CLO2	understand and critique scientific presentations;		PLO1, PLO2, PLO5, PLO7, PLO8
CLO3	create and implement a career plan to prepare for their identified career goals;		PLO2, PLO3, PLO6, PLO9, PLO10, PLO11
CLO4	identify actions to take in areas of fisheries science education, including research, and internship / experiential learning;		PLO2, PLO3, PLO8, PLO9
CLO5	understand workplace expectations, communicate professionally, and identify and solve workplace conflicts;		PLO3, PLO5, PLO7, PLO8, PLO9, PLO10
CLO6	understand the different types of interview questions and craft focused answers in response;		PLO2, PLO3, PLO4, PLO5, PLO7, PLO8, PLO9, PLO10
CLO7	construct a professional network.		PLO2, PLO5, PLO6, PLO8, PLO10, PLO11

Mapping CLOs with the Teaching-Learning and Assessment Strategy

CLOs	Teaching-Learning Strategy	Assessment Strategy
CLO1	Group discussions, short lectures, strong student involvement	Presentation
CLO2	Group discussions, guest panelists, strong student involvement	Presentation
CLO3	Group discussions, guest panelists, strong student involvement	Presentation
CLO4	Group discussions, guest panelists, strong student involvement	Presentation
CLO5	Group discussions, guest panelists, strong student involvement	Presentation
CLO6	Group discussions, guest panelists, strong student involvement	Presentation
CLO7	Group discussions, guest panelists, strong student involvement	Presentation

Learning Materials

Recommended Readings	
	<ol style="list-style-type: none"> 1. Kothari, C.R., 2004. <i>Research Methodology: Methods and techniques</i>. New Age International. 2. Bhamrah, H.S., Sandhu, G.S. and Gupta, K.C., 2006. <i>Research Techniques in Biological Science</i>. Dominant Publishers. 3. Yvonne N. Bui. <i>How to Write a Master's Thesis</i>. Third Edition. SAGE publications, Inc. 2020. P.298. ISBN-13: 978-1506336091, ISBN-10: 1506336094.

Course Code: 0111 06 AQUA 6104	Year: First	Term: First
Course Title: Dissertation Part II		
Course Status: Capstone		
Credit: 12.0		
Prerequisite(s): None		
Rationale	This course is designed for advanced MS students to build on their research competencies from their methods courses. The purpose of this course is to get advanced MS students going on their dissertation proposal writing, and become competent in basic research designs, which entails making judgments about matching research designs to particular research problems.	

Course Contents		CLOs
1	Assessment of overall research.	1,3
2	Possible methodological means of investigation around research topic.	1,2,3
3	Construct a research question that can be empirically addressed during experiment.	1,2
4	Dissertation proposal, the course refreshes MS students on the basic concepts of research	1,3

Course Learning Outcomes (CLOs)	Upon completion of this course the students will be able to:		Mapping with PLOs
	CLO1	articulate research or project objectives clearly, situate research within an academic or scholarly context, state claims and evidence clearly, assess validity of claims, evidence, outcomes, and results;	PLO1, PLO2, PLO3, PLO5, PLO7, PLO8
	CLO2	narrate the research process clearly in the form of a formal multi-chapter master's thesis manuscript, structured according to the approved M.S. in Khulna University thesis style;	PLO2, PLO3, PLO4, PLO6, PLO7, PLO8, PLO9
	CLO3	describe master's research clearly and succinctly, in written and oral forms, to faculty, mentors, and potential sponsors.	PLO4, PLO5, PLO8, PLO9, PLO10, PLO11

Mapping CLOs with the Teaching-Learning and Assessment Strategy

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

Learning Materials

Recommended Readings

20. Grading and Evaluation

20.1.1 Grading Scale

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 project, thesis design, etc. course)	X	

20.1.2 Cumulative Grade Point Average (CGPA)

GPA will be calculated as per the standard practices at the undergraduate level of Khulna University. A student's performance will be evaluated in terms of three indices, viz. 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 up to date by the total completed credits. Thus a student who has earned 275 grade points in attempting 100 credits of courses would have an overall CGPA of 2.75. The students will be awarded the Degree with Distinction, if their CGPA is 3.75 or above.

20.1.3 Evaluation of Theory Courses

All theory courses will be evaluated out of 100 marks. The marks will be distributed as follows:

Attendance:	10 Marks
Continuous Assessments:	30-40 Marks
Term Final:	50-60 Marks
Total:	100 Marks

20.1.4 Evaluation of Sessional Courses

All sessional courses will be evaluated out of 100 marks. The marks will be distributed as follows:

Attendance:	10 Marks
Sessional Assessments:	60 Marks
Viva voce:	30 Marks
Total:	100 Marks

- (a) For both theory and sessional courses, attendance shall carry 10 marks and the basis for awarding marks will be as follows:

Attendance (%)	Marks
≥ 90	10
85 to < 90	9
80 to < 85	8
75 to < 80	7
70 to < 75	6
65 to < 70	5
60 to < 65	4
< 60	0

- (b) The continuous assessments (30 to 40 marks) for theory courses may be conducted in the form of written class examinations, assignments, home-works, presentations, quizzes, viva voce, mid-term, etc. For any theoretical course, there shall be at least four assessments. Section best (A & B) assessments shall be counted. A mid-term Examination may be taken if a Discipline/POE opts for it. The concerned Discipline will allocate marks for mid-term and continuous other evaluations in such a case. The course teachers must submit the continuous assessment and sessional assessment mark sheets to the Chair of the Examination Committee before the starting of the Term final examination.
- (c) The remaining 50 to 60 marks will be allocated for the term final examination.
- (d) A student who fails in any course(s) in the Term final examinations or who registered for the course(s) but did not sit for the examination, the concerned course(s) will be considered as retake course(s).
- (e) A student retaking theory course(s) for clearing/passing or improvement must appear at the mid-term (if any) and Term final examinations. A student may attend continuous assessments also on the written approval of the Discipline Head; otherwise, the marks of continuous assessments will be maintained from the student's previous records. The

marks of attendance will be carried forward from earlier Term. The obtained grade will be downgraded in case of retaking course(s).

- (f) Examination procedure related other guidelines of the latest ‘Ordinance for Undergraduate Examination’ of Khulna University will generally be applicable for the Master’s programs, if not conflicting with this Ordinance.

20.1.5 Evaluation of Viva Voce

A Discipline may include Viva Voce of 01/02 credit(s) at the end of each Term. The concerned Examination committee of that Term will conduct the viva and assess the students out of 100 marks.

20.1.6 Dissertation under Mixed-mode

- i) There will be two components of the Dissertation, namely Dissertation Part-I in one Term for proposal development, and Dissertation Part-II in another term for completing the Dissertation. The total credit for the Dissertation will be between **15 to 20 credits**. The credit allocation for proposal development and dissertation parts will be 3-5 credits and 12-15 credits, respectively.

- ii) A Dissertation (both proposal and Dissertation) will be evaluated out of 100 marks.

Marks distribution of Dissertation Part-I will be as follows:

- | | |
|-----------------------------|----------|
| a) Assessment of Supervisor | 30 marks |
| b) Proposal Presentation | 70 marks |

Marks distribution for Dissertation Part-II will be as follows:

- | | |
|-------------------------------|----------|
| a) Assessment of Supervisor | 20 marks |
| b) Dissertation Evaluation | 50 marks |
| c) Defense (Oral examination) | 30 marks |

- iii) Dissertation Part-I will usually commence in the Master’s first-year second-term and Dissertation Part-II in the second-year first-term (final Term).

- iv) The final evaluation of the Dissertation Part-II will be made at the end of the final Term. However, the evaluation of the Dissertation Part-I will be done in the corresponding Term.

- v) A student registered for Dissertation will undertake research work under the guidance of a supervisor and a co-supervisor (if necessary).

- vi) The research needs to be carried out in this University or at the appropriate place(s) approved by the Supervisor in consultation with the Discipline Head.

- vii) There shall generally be one Supervisor for each student, but a co-supervisor may also be appointed if needed. A teacher not below the rank of Assistant Professor will act as supervisor/co-supervisor. However, a Lecturer with MPhil/ Master's by Research/ Ph.D. degree is eligible to supervise/co-supervise a student. Co-supervision may also be allowed from other Disciplines of Khulna University/other universities or research institutes.
- viii) If a student has any grievance about a Supervisor, or if a Supervisor has any complaint against a student, s/he may inform the Discipline Head about the issue in writing. The Discipline will decide such matters.
- ix) Pursuant to the leave rules of Khulna University, a Supervisor can remain absent from Khulna University (not more than six months) while continuing as a Supervisor. The online defense may be arranged in such cases if deemed necessary. Otherwise, the Co-supervisor (if any) or any other competent person will act as the Supervisor as per the guideline of the concerned Examination Committee. This will be applicable for projects and internships also.
- x) Every student submitting a dissertation in partial fulfillment of the requirements of a degree will be required to appear at proposal presentation for Dissertation Part-I and defense board of Dissertation Part-II respectively on the dates fixed by the Discipline Head in consultation with the Supervisor(s). Such presentation and defense may be arranged online if deemed necessary to the concerned authority. A student must satisfy the examiners that s/he is capable of undertaking independent work and affording evidence of satisfactory knowledge related to the theory and techniques used in his/her research work.
- xi) A student must submit the required number of printed and soft copies of Dissertation Part-II in the approved format through the Supervisors to the Discipline Head by a date to be fixed by the Discipline. The Dissertation will not usually be considered for evaluation if the plagiarism detection system yields a similarity index of more than 25% (excluding bibliography/references, quotes, and small sources with source exclusion threshold of **ten-word** counts). This will be applicable to the dissertations written in English. The curriculum of the concerned program will provide a specific guideline on this issue.
- xii) Each student shall certify that the research work is his/her own and that the work was not submitted elsewhere for any other degree or diploma - the entire work has not been published as a monograph or a book before the Degree is awarded.
- xiii) If any change is required in the title/supervisor/co-supervisor/examiner/etc., the Discipline Head will send it to the BOAS through EC.

20.1.7 Project under Mixed-mode

(i) A student undertaking a project work will register 03-06 credits usually in the second-year first-term (final Term) under the guidance of a Supervisor. A teacher with MPhil/ Master's by Research/ Ph.D. degree can supervise a student. The project work should be carried out in this University or at the appropriate place(s) approved by the Supervisor in consultation with the Discipline Head.

(ii) A project will be evaluated out of 100 marks. Marks distribution of the project will be as follows:

Assessments of the Supervisor	20 marks
Project Report evaluation	50 marks
Defense (Oral examination)	30 marks

(iii) Final evaluation of the project report will usually be made at the end of the final Term for the student.

(iv) A student must submit the required number of printed and soft copies of the project report in the approved format through the supervisors to the Discipline Head by a date to be fixed by the Discipline. The project report will not usually be considered for evaluation if the plagiarism detection system yields more than 25% (excluding bibliography/references, quotes, and small sources with a source exclusion threshold of **ten-word** counts). This will be applicable to the reports written in English. The curriculum of the concerned program will provide a specific guideline on this issue.

(v) Each student shall certify that the research work is his/her own and that the work was not submitted elsewhere for any other degree or diploma - the entire work has not been published as a monograph or a book before the Degree is awarded.

20.1.8 Internship under Mixed-mode

(i) A student may be offered an internship usually in the second-year first-term (final Term). In such a case, the credit will be 03-06 Credits. There will be a Supervisor. A teacher with a post-graduate degree is capable of supervising an internship. The evaluation of the internship will be as follows:

a) Continuation of the work (by Supervisor)	20 marks
b) Report evaluation	50 marks
c) Defense (Oral examination)	30 marks

(ii) A student must submit the required number of printed and soft copies of the internship report in the approved format through the supervisors to the Discipline Head by a date to be fixed by the Discipline. The report will not usually be considered for evaluation if the plagiarism detection system yields more than 25% (excluding bibliography/references, quotes, and small sources with a source exclusion threshold of

ten-word counts). This will be applicable to the reports written in English. The curriculum of the concerned program will provide a specific guideline on this issue.

- (iii) Each student shall certify that the research work is his/her own and that the work was not submitted elsewhere for any other degree or diploma - the entire work has not been published as a monograph or a book before the Degree is awarded.

20.1.9 Master's by Research Program

- (i) The students under 'Master's by Research' program have to register for four parts of the Dissertation as follows:

Sl. No.	Course	Year	Term	Min. credit	Max. credit
1	Dissertation Part-I	1	1	8	10
2	Dissertation Part-II	1	2	10	15
3	Dissertation Part-III	2	1	12	15
4	Dissertation Part-IV	2	2	15	20

- (ii) A Dissertation (Part I-IV) will be evaluated out of 100 marks. Marks distribution of Dissertation Part-I, II, and III will be as follows:

- a) Assessment of Supervisor 30 marks
 b) Presentation 70 marks

- (iii) Marks distribution for Dissertation Part-IV will be as follows:

- Assessment of Supervisor 20 marks
 Dissertation Evaluation 50 marks
 Defense (Oral examination) 30 marks

- (iv) Usually research topic selection, title, rationale, objective, research question, literature review, sampling, research design, experiment, survey, data/information collection, analysis, result, discussion, policy implication, limitation, reference, annex, etc. related various issues will be covered (as applicable) under these four parts. The curriculum of the concerned program will provide a detailed description of coverage, objective, learning outcome, credit, etc., of these four parts.

- (v) A student registered for Dissertation will undertake research under the guidance of a Supervisor and a Co-supervisor (if necessary).

- (vi) The research needs to be carried out in this University or at the appropriate place(s) approved by the Supervisor in consultation with the Discipline Head.

- (vii) There shall normally be one Supervisor for each student, but a co-supervisor may also be appointed if needed. A teacher not below the rank of Assistant Professor will act as Supervisor/Co-supervisor. However, a Lecturer with MPhil/ Master's by Research/

Ph.D. degree is eligible to supervise/co-supervise a student. Co-supervision may also be allowed from other Disciplines of Khulna University/other universities or research institutes.

- (viii) If a student has any grievance about a Supervisor, or if a Supervisor has any complaint against a student, s/he may inform the Discipline Head about the issue in writing. The Discipline will decide such matters.
- (ix) Pursuant to the leave rules of Khulna University, a Supervisor can remain absent from Khulna University (not more than six months) while continuing as a Supervisor. The online defense may be arranged in such cases if deemed necessary. Otherwise, the Co-supervisor (if any) or any other competent person will act as the Supervisor as per the guideline of the concerned Examination Committee.
- (x) Final evaluation of the Dissertation Part-IV will be made at the end of the final Term. However, the Dissertation Part-I, II, and III will be evaluated in the corresponding terms.
- (xi) Every student submitting a dissertation in partial fulfillment of the requirements of a degree will be required to appear at a seminar presentation for Dissertation Part-I, II, and III and defense board for Dissertation Part-IV respectively on the dates fixed by the Discipline Head in consultation with the Supervisor (s). Such seminar presentation and defense may be arranged online if deemed necessary to the concerned authority. A student must satisfy the examiners that s/he is capable of undertaking independent work and affording evidence of satisfactory knowledge related to the theory and techniques used in his/her research work.
- (xii) After successfully completing the seminar and dissertation defense boards, the Chairman of the concerned boards shall arrange to send six-monthly progress reports for each student in each Term to the Dean for approval. Accordingly, the Dean will approve the progress reports and report to BOAS. Progress reports shall be submitted before the end of each Term, even if the Supervisor is on leave; otherwise, the student(s) shall not be allowed to register for the following Term.
- (xiii) A student must publish (or at least accepted for publication) an article/paper in a peer-reviewed journal or a peer-reviewed conference paper in order to complete 'Master's by Research' Degree.
- (xiv) A student must submit the required number of printed and soft copies of Dissertation Part-IV in the approved format through the supervisors to the Discipline Head by a date to be fixed by the Discipline. The Dissertation will not usually be considered for evaluation if the plagiarism detection system yields a similarity index of more than 25% (excluding bibliography/references, quotes, and small sources with source exclusion threshold of **ten-word** counts). This will be applicable to the dissertations

written in English. The curriculum of the concerned program will provide a specific guideline on this issue.

(xv) Each student shall certify that the research work is his/her own and that the work was not submitted elsewhere for any other degree or diploma - the entire work has not been published as a monograph or a book before the Degree is awarded.

(xvi) If any change is required in the title/supervisor/co-supervisor/examiner/etc., the Discipline Head will send it to the BOAS through EC.

20.1.10 Credit Requirement and Duration of the Program

The required credits and duration for Master's Programs are mentioned below.

Program type	Credit Requirement				Program Duration			
	Coursework (Min.)	Dissertation (Min.)	Dissertation (Max.)	Total (Min.)	Term (Min.)	Year (Min.)	Term (Max.)	Year (Max.)
Coursework	40	-	-	40	02	1.0	06	3.0
Mixed-mode (Dissertation)	20	15	20	40	03	1.5	06	3.0
Mixed-mode (Project)	20	3	6	40	03	1.5	06	3.0
Mixed-mode (Internship)	20	3	6	40	03	1.5	06	3.0
Research	-	45	60	45	04	2.0	06	3.0

The details of each Term Duration will be as follows:

Item	Duration
Teaching and continuous assessment/ Contact with Supervisor	14 weeks
Preparatory leave before: Final Examination/ Seminar/ Defense	02 weeks
Final Examination/ Seminar/ Defense	(Maximum) 04 weeks
Term Break	02 weeks
Total	22 weeks

20.1.11 Course Types

The courses included in the Master's curriculum may be divided into three groups as follows:

- (i) **Core Courses:** Core courses are obligatory for a degree.
- (ii) **Optional Courses:** Any other courses students may undertake to earn the Degree.
- (iii) **Major Courses:** A Discipline may offer courses from one or more major areas (if any), and after completing a certain number of credits from that area (as reported in the following table), a student can achieve a Master's degree with a major in a specified field, and that will be mentioned in the Transcript, e.g., MS in Agrotechnology

(Horticulture). The curriculum of the concerned program will provide a detailed description of such cases.

Credit Requirements for Offering Major

Program type	Min. credit requirement from major area*			
	Coursework (Min.)	Dissertation (Min.)	Dissertation (Max.)	Min. from Major Area
Coursework	20	-	-	20
Mixed-mode (Dissertation)	9	15	20	20
Mixed-mode (Project)	15	3	6	20
Mixed-mode (Internship)	15	3	6	20
Research	-	45	60	45

* For achieving a Master's degree with a major in a specified field under a mixed-mode or 'Master's by Research' scheme, the concerned dissertation must be directly linked with the 'major area' under consideration.

(iv) **Viva Voce:** A Discipline may include Viva Voce of 01/02 credit(s) at the end of each Term. The concerned Examination committee of that Term will conduct the viva and assess the students out of 100 marks.

(v) **Assignment of Credit:**

Theory Courses: For theory courses, one-hour face-to-face learning (e.g., lecture, tutorial, seminar) per week will be equivalent to one credit.

Sessional Courses: For sessional courses, 1.5-hour face-to-face learning (e.g., lab work, studio, fieldwork, or clinical work) per week is equivalent to 1.0 credit. For industrial/workplace learning, 2-hour learning per week is equivalent to 1.0 credit.

In addition to face-to-face and other means of learning, online teaching-learning might be exercised if deemed necessary to the Discipline/POE.

20.1.12 Course Registration

(i) Each student will get oneself registered with the University. S/he will fill in the course registration form in consultation with the Program Coordinator under the guidance of the Discipline Head. The Program Coordinator will verify the form and submit it to the Discipline Head for forwarding it to the Registrar's office. Such submission might be made online, when and where applicable. The Registrar's office will be responsible for its distribution to relevant authorities (Disciplines and the Controller of Examinations). Course registration will be permitted within five working days at the beginning of each Term. Late registration will be permitted up to the next five working days on payment of a late fee. Student(s) having outstanding dues to the University shall not be permitted to register.

- (ii) 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 enroll subject to the compliance with: (i) completion of prerequisite courses (if any) and (ii) maximum credit registration limit per Term. However, s/he may not choose to register the optional backlog/retake/re-retake courses first.
- (iii) 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 maximum credit registration limit per Term, and (v) the desired advance courses are offered by the Discipline/POE in the current Term. However, such an advance course registration option will not be applicable for capstone courses like Thesis/ Project/ Internship/ and so on.
- (iv) A student retaking/re-retaking the course will be awarded the immediate lower grade he/she obtains, and this grade will be shown and maintained on the Transcript.
- (v) A Discipline/POE will not continue an optional course if less than 30 percent of students (of total seats for that batch) register for that course within ten working days from the beginning of classes. The situation will be solved by dropping that optional course through applying article 10.3 of MS Ordinance by the next five working days. The Coordinator will maintain such records and act accordingly. However, the concerned Discipline/POE might relax this clause for only final term/year optional courses if it is deemed necessary (for example, the studentship will be toward termination or the student will have to wait for additional term/year if the considered optional course(s) are not offered).

20.1.13 Limits on the Credits to be taken in a Term

Discipline Head may allow a student to register up to a maximum of 25 credits if recommended by the Program Coordinator. However, there is no minimum credit limit per Term in Master's level study.

20.1.14 Course Adjustment Procedure

A student will have the option to add or drop course(s) from his/her registration list within fifteen working days from the beginning of classes. This can be done with the advice of the concerned Program Coordinator and consent of the Discipline Head. Adjustment of initially registered courses in any Term can be made by duly filling in the Adjustment Form. The Registrar's office will do the needful.

20.1.15 Withdrawal from a Term

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 for total withdrawal from the

Term within eight working days after the end of the Term Final Examination. However, s/he may choose not to withdraw from any sessional courses 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 Registrar. If a student is allowed to withdraw from a Term, he/she will have to register as fresh for the Term he/she has withdrawn. However, he/she may be allowed to register for backlog courses, if offered.

20.1.16 Absence in a Term

A student may be absent from continuous assessments (quizzes/class test/field works, etc.) during the Term. Such absences will naturally reduce points/marks, which count towards the final grade. Absence in the Mid Term (if any) and the Term Final Examination will result in 'F' grade. A student who has been absent for short periods, up to a maximum of three weeks due to illness, should request the Course Teacher or Program Coordinator to makeup continuous assessments immediately on returning to the class. A medical certificate should support such request from the Chief Medical Officer of Khulna University. The medical certificate issued by registered medical practitioners (with the registration number shown explicitly on the certificates) and endorsed by the Chief Medical officer of the University will also be acceptable only in those cases where the student has valid reasons for his absence from the University.

20.1.17 Special Term

Students having any retake/re-retake course(s) may apply for a special Term to complete the total required course (maximum 09 credits) in that Term. The special Term will be offered for the final term students who have retake/re-retake courses. The examination will start four (04) weeks after publication of the result and will continue not more than 2 (two) weeks. The marks of both attendance and continuous assessments will be carried over from the previous record.

20.1.18 Registration for Improvement

If any student gets a 'D' to 'C+' grade in any course, s/he may be allowed to repeat that course to improve the grade. The previous grade will be replaced from the grade sheet in such a case.

20.1.19 Backlog

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 to complete the Degree. If a student does not register for an offered Theory or Sessional course in his/her applicable Term (for example, '0541 12 Math 5101' course in his/her Master's first year first term, '0541 12 Math 5203' course in his/her Master's first year second term, '0541 12 Math 6104' course in his/her Master's second year first term), that course will be considered as a 'Backlog' course for

that student in the subsequent terms. If a student gets an 'F' grade in an Optional course, he/she may, subject to availability, choose to take an optional substitute course. In such a case, that substitute course will be deemed as a fresh course. In case of registering for a Backlog Theory or Sessional course, a student has to face/appear/attend 100 marks evaluation, like a fresh course.

20.1.20 Credit Transfer/ Credit Waiver

This ordinance permits credit transfer to facilitate educational mobility. That transfer of credit(s) may be inward or outward. In the case of outward credit transfer, a student of Khulna University has to apply to the Registrar through the Head of the Discipline/POE for getting a credit transfer certificate. The application must be supported by necessary documents, including a copy of the grade sheet(s). Accordingly, the Registrar will issue a credit transfer certificate mentioning the number of credits already completed at Khulna University.

In case of inward credit transfer, students from other Universities/ Institutions may apply to the Registrar of Khulna University for credit transfer. The application must be supported by necessary documents, including a copy of grade sheet(s) and curriculum. The Registrar's office will forward the application to the concerned Discipline/POE. A three-member committee headed by the Discipline Head and two senior most teachers will assess the application and recommend for approval to the Registrar. The maximum limit of credit transfer from other Universities/ Institutions will be less than or equal to 50 percent of the total credits required to complete the concerned Degree. The final transcript of such students will show only the number of credits transferred.

The same process may be applied for handling the credit waiver related applications. However, the maximum limit of inward credit waiver from other Universities/ Institutions should be less than or equal to 20 percent of the total credits required to complete the concerned Degree.

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,

$$\text{GPA} = \frac{\sum C_i G_i}{\sum C_i}$$

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:

$$\text{GPA} = \frac{3(4.0) + 3(3.0) + 3(3.75) + 2(3.25) + 1(3.5)}{3 + 3 + 3 + 2 + 1} = 3.52$$

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 20.1.1.

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 20.1.1.

20.6 Retake

Retake related issues are reported in section 20.1.

20.7 Grade Improvement

Grade improvement related issues are reported in section 20.1.

20.8 Dropout/Cancellation of Studentship

Dropout/Studentship cancellation related guidelines of the latest ‘Ordinance for Undergraduate Examination’ of Khulna University will generally be applicable for the Master’s programs, if not conflicting with this Ordinance.

20.9 Publication of Results

- (i) The Controller of Examinations will publish the result and preserve all the records for one year after the Degree is awarded. The result will be published subject to completing the required number of credits and fulfilling other requirements (for example, article/paper for ‘Master’s by Research’ mode students) within the stipulated time limit, as applicable.
- (ii) A student can have his/her results re-examined by applying to the Controller of Examinations within 30 working days from the date of publication of results. However, s/he has to pay a re-examination fee fixed by the concerned authorities. The Controller of Examinations will take necessary measures regarding the matter in consultation with the Chairman of the Examination Committee. Answer script re-scrutiny and result re-examination related rules of the latest ‘Ordinance for Undergraduate Examination’ of Khulna University will generally be applicable for the Master’s programs also.

20.10 Subsequent Ordinances

For related/relevant issues, which are not covered (or not cleared) here, provisions of the latest ‘Ordinance for Undergraduate Program’ and ‘Ordinance for Undergraduate Examination’ of Khulna University may be consulted and applied, if not conflicting with this Ordinance.