

CURRICULA AND COURSE PROFILE
(FOR AFFILIATED COLLEGES AND INSTITUTIONS)

B. Sc. Fisheries (Honours) DEGREE



**Department of Fisheries, Faculty of Agriculture,
University of Rajshahi, Rajshahi-6205**

SYLLABUS
Department of Fisheries
Faculty of Agriculture,
University of Rajshahi
Curriculum for B. Sc. Fisheries (Honours)
Session 2020-2021

The B.Sc. Fisheries (Honours) degree is an integrated course of four academic years (four levels, eight semesters) will consist of Fisheries and relevant courses such as Biochemistry, Statistics, Sociology, Economics and Geography. It covers a total of 158 credits of which 36 credits in Level-1(Semester 1 and 2),45 credits in Level-2(Semester 3 and 4), 46 credits in Level-3 (Semester 5 and 6) and 31 credits in Level-4 (Semester 7 and 8).The 8th semester of Level-4is internship semester consists of 10 credits(including 1 credit for In Plant Attachment;2 credits for Job Oriented Course,JOC;1credit for Excursion; 2 credits for Aquaculture Practical Experience, APE;3 credits for Research Work and 1 credit for Fisheries Extension Field Trip).

The programme of study for the degree of B.Sc. Fisheries (Honours) will extend over a minimum period of four academic years. The degree will be completed within a maximum period of six academic years from the date of admission. No student will be allowed to readmit more than two times and stay for more than three academic years/levels in each of the 1st (Semester 1 and 2), 2nd (Semester 3 and 4), 3rd (semester 5 and 6) and 4th Level (Semester 7 and 8)of the programme.

The final examinations both of the Semester 1 and 2 of Level-1covers 6 theoretical and 6 practical and viva-voce courses. Semester 3of Level-2 covers 7 theoretical and 7 practical and viva-voce courses and Semester 4 of Level-2 covers 8 theoretical and 8 practical and viva-voce courses. Semester 5 of Level-3covers 8 theoretical and 7 practical and viva-voce courses and Semester 6 of Level-3covers 8 theoretical and 7 practical and viva-voce courses. The Semester 7of Level-4 covers 7 theoretical and 7 practical and viva-voce courses; and Semester 8 of Level-4 covers 6 internship courses. Semester final results will be published in GPA out of 4 on the basis of all courses and final results for the B.Sc. Fisheries (Honours) degree will be published in CGPA out of 4 on the basis of all semester final examinations. Grades will be awarded in accordance with provisions shown in the table as -

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

Less than 40%	F	0.00
Incomplete**	I	-

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

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

In order to be eligible for promotion from one semester to the next higher semester, a candidate must secure at least 2.00, 2.25, 2.50 GPA in each of his/her Level-1 (Semester 1 and 2), Level-2 (Semester 3 and 4), and Level-3 (Semester 5 and 6) examinations respectively and at least 80% credit. A student who has failed to obtain required GPA in a semester final examination for his/her promotion must be given up to 0.09 point with his/her obtained GPA for the fulfillment of required GPA and "Promotion under condonation rule" must be mentioned with red colour ink with star (*) marks in Remarks column on tabulation/result sheet.

A student who has obtained F grade in maximum two courses or I grade in one course and/or F grade in one course at any Semester of Level 1, 2 and 3 examinations may be allowed to register for improvement of courses in the next semester/level students. He/she has to clear F grade and/or I grade in the next two semesters/levels examinations after publication of results. In order to qualify for the B.Sc. Fisheries (Honours) degree, a candidate must have to obtain a minimum CGPA of 2.50 and earn Total credit point (TCP) of 158.

Two class tests of each theoretical course will be held at end of 6th and 13th week respectively according to the class test routine decided by the relevant examination committee on the basis of the academic calendar. Marks along with the evaluated script (errors must be marked) of class test I and II will be shown to the students of same course in 8th and 15th week orderly and then the finalized marks of class test will be sent to controller of examination as well as chairman of the relevant examination committee within the mentioned weeks. Percentage of class attendance will be submitted to the Chairman of the department for official works.

Marks of class attendance will be submitted to the Chairman of the relevant examination committee and controller of examination.

Semester final examinations will be held after the 17th week of each semester. At least 2 theoretical (written) examinations will be held in a week. Detailed schedule of each semester is given below -

Weeks (January-June/July-December)	1-6	7-8	9-13	14-15	16-17	18-21	22-24	25-26
Class (1st term)								
Class test - I (Theoretical) and result								
Class (2nd term)								
Class test - II (Theoretical) and result								
Semester final examination preparation period								
Examination (Theoretical (Written))								
Examination (Practical and Viva-voce)								

Result Preparation / Semester Interval								
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The theoretical examinations will include all the theory courses and the practical and viva-voce examinations will include laboratory and field based practical and viva-voce courses. Academic committee of the Department of Fisheries will decide the distribution of marks for each course as well as semester for all levels. A total of 100 marks {Written: 70 + Class test: 20 (10+10) + Attendance: 10 (5+5)} may be allotted for a full unit (Credit 2) theoretical course. A total of 100 marks (Attendance: 10 + Class record/field report: 10 + Practical: 60 (field report/ Experiment/ Dissection/ Calculation/ Presentation/Spotting, etc) + Viva-voce: 20) may be allotted for a half unit (Credit 1) practical course. Written examination duration will be 3 hours and 6 questions to be set, 5 to be answered for a full unit (Credit 2) theoretical course. Class test duration will be 30 minutes and 20-30 short type questions (Define/example/True or false (including making true, if false)/Fill in blanks/MCQ/Quiz etc.) to be set, all to be answered for a full unit (Credit 2) theoretical course. Practical and viva-voce examination duration will be 6 hours for a half unit (Credit 1) practical and viva-voce course.

Attendance marks will be allotted based on the following table -

Earned Percentage*	Full unit (Credit 2) theoretical course	Half unit (Credit 1) practical and Viva-voce course
90-100	10	5
80-89	8	4
70-79	6	3
60-69	4	2
less than 60%	0	0

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

In order to be eligible for taking up the B. Sc. Fisheries (Honours) examinations, a candidate must have pursued a regular course of study by attending not less than 75% of the total number of classes held (theoretical and practical classes). The academic committee of the department on special grounds and on such documentary evidence may condone the cases of shortage of attendance not below 60%. A candidate appearing at the examination under the benefit of this provision will have to pay in addition to the examination fees, the requisite fee prescribed by the syndicate for the purpose. Candidates having less than 60% attendance will not be allowed to fill up the examination form.

A candidate failed to appear at the examination or pass the examination, may on the approval of the department be readmitted to the immediate following session in the first, second, third or fourth year/level of the programme. A readmitted candidate will have to reappear at all course examinations.

A promoted student earning a GP less than 2.75 (Letter Grade B⁻) in individual courses will be allowed to improve the grade on the courses, not more than two courses (including F or I grade) of in Semester 1, 2, 3, 4, 5, and 6 of Level 1, 2 and 3 examinations or their equivalent courses (in case of changes in the syllabus), defined by the departmental academic committee, through the regular examination of the immediate following semester/level. No improvement will be allowed in practical and Viva-voce courses and class test/excursion/thesis/dissertation/project as well as similar works. If a candidate fails to improve his/her course grade, the previous grade will remain valid. If a readmitted candidate fails to appear at the class test/attendance/field report/excursion/thesis/dissertation/project as well as similar works, his/her previous marks/grades will remain valid.

A candidate obtaining a GP of less than 2.75 (Letter Grade B⁻) in some courses at the end of Level 4 (Semester 7) examination, will be allowed to improve his/her Letter Grade, on up to a maximum of two courses of the Level 4

(Semester 7) examinations in the immediate next regular examinations after publication of his/her result within six academic years after his/her date of admission in 1st academic year. In case of a result improvement, the year of examination and "Result improvement" must be mentioned. No improvement will be allowed in practical and Viva-voce courses and class test/ attendance/ field report/ excursion/ thesis/ dissertation/ project as well as similar works. If a candidate fails to improve GP as well as Letter Grade, the previous results will remain valid.

A candidate failed to obtain required GPA (i) for promotion in Level 3 (Semester 5 and 6) examinations within 4 (four) academic years; in case of readmission in Level 3 (Semester 5 and 6) examinations in 5 (five) academic years, with no readmission in Level 3 course year from the date of admission, or(ii) a minimum Total Credit Point (TCP) 155 out of 172 and a minimum CGPA 2.00 will be required for the pass degree. Candidates failing to earn the semester wise required GPA after completing regular examinations and subsequently failed again after taking readmission in 1st, 2nd or 3rd Level will be dropped out from the programme.

For admission to B. Sc. Fisheries (Honours) semester final examinations, a candidate will have to submit his/her application in the prescribed form together with certificates of attendance and fulfill all other conditions prescribed by the University. The application will be submitted through the chairman of the department and provost of the Hall concerned so as to reach the Controller of Examinations at least a week before the date fixed for the commencement of the examination. The medium of answers in the examination of all courses will be either English or Bengali. However, a mixing of English and Bengali will never be allowed in answer script.

DETAILED BREAK UP OF COURSES

B. Sc. Fisheries (Honours) Level-1 Semester-1 (January-June), 2020

Theory		
Course Code	Course Title	Credit
FHT-1101	Introduction to Fisheries Resources	2
FHT-1102	General Ichthyology – I	2
FHT-1103	Fisheries Zoology	2
FHT-1104	Freshwater Ecology	2
FHT-1105	General Microbiology	2
FHT-1106	Biochemistry – I	2
Total		12
Practical and Viva-voce		
Course Code	Course Title	Credit
FHP-1111	Practical and viva-voce on Introduction to Fisheries Resources	1
FHP-1112	Practical and viva-voce on General Ichthyology - I	1
FHP-1113	Practical and viva-voce on Fisheries Zoology	1
FHP-1114	Practical and viva-voce on Freshwater Ecology	1
FHP-1115	Practical and viva-voce on General Microbiology	1
FHP-1116	Practical and viva-voce on Biochemistry - I	1
Total		6
Grand Total		18

B. Sc. Fisheries (Honours) Level-1 Semester-2 (July-December), 2020

Theory		
Course Code	Course Title	Credit
FHT-1201	Developmental Biology	2
FHT-1202	General Ichthyology -II	2
FHT-1203	Fundamentals of Aquaculture	2
FHT-1204	Coastal and Marine Ecology	2
FHT-1205	Fisheries Microbiology	2
FHT-1206	Biochemistry-II	2
Total		12
Practical and Viva-voce		
Course Code	Course Title	Credit
FHP-1211	Practical and viva-voce on Developmental Biology	1
FHP-1212	Practical and viva-voce on General Ichthyology - II	1
FHP-1213	Practical and viva-voce on Fundamentals of Aquaculture	1
FHP-1214	Practical and viva-voce on Coastal and Marine Ecology	1
FHP-1215	Practical and viva-voce on Fisheries Microbiology	1
FHP-1216	Practical and viva-voce on Biochemistry - II	1
Total		6
Grand Total		18

At the end of Level -1

		Level-1		Total
Semesters		1	2	
Number of Completed Courses	Theoretical	6	6	12
	Practical	6	6	12
	Total	12	12	24
Earned Credits	Theoretical	12	12	24
	Practical	6	6	12
	Total	18	18	36

B. Sc. Fisheries (Honours) Level-2 Semester-3 (January-June), 2021

Theory		
Course Code	Course Title	Credit
FHT-2301	Fish Physiology	2
FHT-2302	Molecular Biology and Histology	2
FHT-2303	Fish Behaviour	2
FHT-2304	Fisheries Systematics	2
FHT-2305	Physico-chemical Limnology	2
FHT-2306	Fish Nutrition-I	2
FHT-2307	Fish Parasitology	2
Total		14
Practical and Viva-voce		
Course Code	Course Title	Credit
FHP-2311	Practical and viva-voce on Fish Physiology	1
FHP-2312	Practical and viva-voce on Molecular Biology and Histology	1
FHP-2313	Practical and viva-voce on Fish Behaviour	1
FHP-2314	Practical and viva-voce on Fisheries Systematics	1
FHP-2315	Practical and viva-voce on Physico-chemical Limnology	1
FHP-2316	Practical and viva-voce on Fish Nutrition-I	1
FHP-2317	Practical and viva-voce on Fish Parasitology	1
Total		7
Grand Total		21

B. Sc. Fisheries (Honours) Level-2 Semester-4 (July-December), 2021

Theory		
Course Code	Course Title	Credit
FHT-2401	Aquatic Biodiversity and Conservation	2
FHT-2402	Biological Limnology	2
FHT-2403	Freshwater Aquaculture	2
FHT-2404	Aquatic Pollution and Toxicology	2
FHT-2405	Fishing Technology	2
FHT-2406	Fish Nutrition – II	2
FHT-2407	Fish Food Chemistry	2
FHT-2408	Biostatistics	2
Total		16
Practical and Viva-voce		
Course Code	Course Title	Credit
FHP-2411	Practical and viva-voce on Aquatic Biodiversity and Conservation	1
FHP-2412	Practical and viva-voce on Biological Limnology	1
FHP-2413	Practical and viva-voce on Freshwater Aquaculture	1
FHP-2414	Practical and viva-voce on Aquatic Pollution and Toxicology	1
FHP-2415	Practical and viva-voce on Fishing Technology	1
FHP-2416	Practical and viva-voce on Fish Nutrition - II	1
FHP-2417	Practical and viva-voce on Fish Food Chemistry	1
FHP-2418	Practical and viva-voce on Biostatistics	1
Total		8
Grand Total		24

At the end of Level -2

		Level-1		Level-2			
Semesters		1	2	3	4	Total	
Number of Completed Courses	Theoretical	6	6	7	8	27	
	Practical	6	6	7	8	27	
	Total	12	12	14	16	54	
Earned Credits	Theoretical	12	12	14	16	54	
	Practical	6	6	7	8	27	
	Total	18	18	21	24	81	

B. Sc. Fisheries (Honours) Level-3 Semester-5 (January-June), 2022

Theory		
Course Code	Course Title	Credit
FHT-3501	Fish Population Dynamics	2
FHT-3502	Fish Hatchery Management	2
FHT-3503	Coastal Aquaculture and Mariculture	2
FHT-3504	Fish Pathology and Immunology	2
FHT-3505	Fish Processing – I	2
FHT-3506	Oceanography	2
FHT-3507	Geographic Information System and Remote Sensing	2
FHT-3508	Rural Sociology	2
Total		16
Practical and Viva-voce		
Course Code	Course Title	Credit
FHP-3511	Practical and viva-voce on Fish Population Dynamics	1
FHP-3512	Practical and viva-voce on Fish Hatchery Management	1
FHP-3513	Practical and viva-voce on Coastal Aquaculture and Mariculture	1
FHP-3514	Practical and viva-voce on Fish Pathology and Immunology	1
FHP-3515	Practical and viva-voce on Fish Processing – I	1
FHP-3516	Practical and viva-voce on Oceanography	1
FHP-3517	Practical and viva-voce on Geographic Information System and Remote Sensing	1
Total		7
Grand Total		23

B. Sc. Fisheries (Honours) Level-3 Semester-6 (July-December), 2022

Theory		
Course Code	Course Title	Credit
FHT-3601	Principle of Fish Genetics	2
FHT-3602	Fish Stock Assessment	2
FHT-3603	Fisheries Resources Management	2
FHT-3604	Fish Feed Technology – I	2
FHT-3605	Fish Processing – II	2
FHT-3606	Fishery Byproducts Technology	2
FHT-3607	Fisheries Marketing	2
FHT-3608	Fisheries Economics	2
Total		16
Practical and Viva-voce		
Course Code	Course Title	Credit
FHP-3611	Practical and viva-voce on Principle of Fish Genetics	1
FHP-3612	Practical and viva-voce on Fish Stock Assessment	1
FHP-3613	Practical and viva-voce on Fisheries Resources Management	1
FHP-3614	Practical and viva-voce on Fish Feed Technology - I	1
FHP-3615	Practical and viva-voce on Fish Processing - II	1
FHP-3616	Practical and viva-voce on Fishery Byproducts Technology	1
FHP-3617	Practical and viva-voce on Fisheries Marketing	1
Total		7
Grand Total		23

At the end of Level – 3

		Level-1		Level-2		Level-3			
Semesters		1	2	3	4	5	6	Total	
Number of Completed Courses	Theoretical	6	6	7	8	8	8	43	
	Practical	6	6	7	8	7	7	41	
	Total	12	12	14	16	15	15	84	
Earned Credits	Theoretical	12	12	14	16	16	16	86	
	Practical	6	6	7	8	7	7	41	
	Total	18	18	21	24	23	23	127	

B. Sc. Fisheries (Honours) Level-4 Semester-7 (January-June), 2023

Theory		
Course Code	Course Title	Credit
FHT-4701	Genetics in Fish Breeding	2
FHT-4702	Fish Health Management and Pharmacology	2
FHT-4703	Aquaculture Engineering and Farm Management	2
FHT-4704	Fish Feed Technology – II	2
FHT-4705	Fish Inspection and Quality Control	2
FHT-4706	Fisheries Extension	2
FHT-4707	Research Methodology	2
Total		14
Practical and Viva-voce		
Course Code	Course Title	Credit
FHP-4711	Practical and viva-voce on Genetics in Fish Breeding	1
FHP-4712	Practical and viva-voce on Fish Health Management and Pharmacology	1
FHP-4713	Practical and viva-voce on Aquaculture Engineering and Farm Management	1
FHP-4714	Practical and viva-voce on Fish Feed Technology – II	1
FHP-4715	Practical and viva-voce on Fisheries Extension	1

FHP-4716	Practical and viva-voce on Fish Inspection and Quality Control	1
FHP-4717	Practical and viva-voce on Research Methodology	1
Total		7
Grand Total		21

B. Sc. Fisheries (Honours) Level-4 Semester-8 (July-December), 2023

Internship		
Course Code	Course Title	Credit
FHI-4801	In plant attachment	1
FHI-4802	Job Oriented Courses (JOC)	2
FHI-4803	Excursion	1
FHI-4804	Aquaculture Practical Experience	2
FHI-4805	Research Work	3
FHI-4806	Fisheries Extension Field Trip	1
Total		10

At the end of Level – 4

		Level-1		Level-2		Level-3		Level-4		
Semesters		1	2	3	4	5	6	7	8	Total
Number of Completed Courses	Theoretical	6	6	7	8	8	8	7	0	50
	Practical	6	6	7	8	7	7	7	6	54
	Total	12	12	14	16	15	15	14	6	104
Earned Credits	Theoretical	12	12	14	16	16	16	14	0	100
	Practical	6	6	7	8	7	7	7	10	58
	Total	18	18	21	24	23	23	21	10	158

Detailed Courses

B. Sc. Fisheries (Honours) Level-1 Semester-1 Examination, June 2020

Theoretical Courses

FHT-1101: Introduction to Fisheries Resources

Credits: 2

Full Marks: 100 (Theory 70, Class Test 20 and Attendance 10)

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

Course Objectives:

To provide knowledge on the fish, fishery, fisheries and aquaculture resources in Bangladesh.

Course Contents:

1. General concept of fish, shellfish, fishery, fisheries (science and sector), capture and culture fisheries, aquaculture, open water management, post harvest technology etc.
2. Classification of Fishes: Classification of fishes (Clupeiformes, Cypriniformes, Siluriformes, Perciformes and others) with special reference to freshwater bodies of Bangladesh.
3. Types and importance of fisheries resources: Physical, Biological and others fisheries resource.
4. Freshwater, Estuary and Marine water bodies of Bangladesh: Types, Characteristics, Importance.
5. Commercially important fish groups: Featherbacks, Eels, Shads, Milk fishes, Snakeheads, Carps, Barbs, Minnows, Catfishes, Perches, Mulletts, Gobies etc.
6. Commercially important shellfish groups: Prawn and Shrimps, Crabs, Turtles, Crocodiles etc.
7. Exotic fishes of Bangladesh: Origin, source, year of introduction, taxonomic position and identifying characteristics.
8. Threatened, Small Indigenous Species (SIS), Cultivable fish species, Ornamental fishes of Bangladesh.
9. Fisheries equipments (Crafts, Gears, etc.), Manpower (Scientific personnel, fishers, etc.), Cooperatives (GO, NGO etc.), Fisheries statistics etc.

Recommended books/ literatures:

1. The Fishes of India. F. Day, 1971. Today and Tomorrow Book Agency, New Delhi.
2. An Aid to the identification of the common Commercial fishes of India and Pakistan. K. S. Misra, 1962. Rec. Indian Mus., Vol. 57: 1-320.
3. Freshwater Fishes of Bangladesh (2nded.). A. K. AtaurRahman (2005). Zool. Soc. Bangladesh, Dhaka.
4. Fishes of the World. J. S. Nelson, 2006. John Wiley and Sons. New York, Toronto, Sydney.
5. Inland Fishes of India and Adjacent Countries. Vols. 1 and 2, P. K. Talwar and A. G. Jhingran (1991). Oxford and IBH Publ. Co. Calcutta, India.

6. Prawns and Prawn Fisheries of India. C. V. Kurian and V. O. Sebastian. (1982). Hindustan Publishing Corporation (India), Delhi-110007.

FHT-1102: General Ichthyology - I

Credit 2

Full Marks: 100 (Theory 70, Class Test 20 and Attendance 10)

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

Course Objectives:

To provide students with the knowledge of external morphology of fish especially the body forms along with the basic structure and function of different organ systems of fish.

Course Contents:

1. **External morphology:** body form, body coverings, appendages and openings.
2. **Integumentary System:** structure and function of skin; scales- structure, shape, types, derivatives, functions; other derivatives of skin- glands, dermal fin rays, flaps and barbels; colouration- colour patterns, sources of colour, functions of colouration in fishes.
3. **Circulatory system:** definition, branchial and pulmonary circulation, afferent and efferent branchial systems, open and closed circulation; lymph and lymphatic system.
4. **Respiratory system:** Gills and air-breathing organs and structure of respiratory organs.
5. **Excretory and osmo-regulatory system:** Classification, structures and functions.
6. **Reproductive and urinogenital system:** definition, types and sexual dimorphism.

Recommended books/ literatures:

1. Ichthyology, K. F. Lagler, J. E. Bardach, R. R. Miller and D. R. M. Passino (1977). John Wiley and Sons. New York.
2. Freshwater Fishery Biology. K. F. Lagler (1952), IOWA Press Inc. USA.
3. Reading in Ichthyology, M. S. Love and G. M. Cailliet (eds) (1979), Prentice –Hall of India Pvt. Ltd., New Delhi.
4. The Life of Fishes, N. B. Marshall (1965), Weidenfeid and Nicolson, London.
5. A Text Book of Fish Biology and Fisheries, Q. Bone and R. H. Moore (2008), Taylor & Francis Group, UK.
6. A Text Book of Fish Biology and Fisheries, S. S. Khanna and H. R. Singh (2006), Narendra Publishing House, Delhi-110006, India.
7. Anatomy and Physiology of Fishes, S. Kumar and M. Tembhre (1998), Vikas Publishing House Pvt. Ltd., India.
8. The Vertebrate Body, A. S. Romer (1949), W. B. Saunders Co., Philadelphia.
9. A Laboratory manual of Comparative anatomy of the Chordates, A. H. Stockard (1949), Edward Bros., Michigan.

10. The Ways of Fishes, L. P. Schultz and E. M. Stern (1949), D. Van Nostrand Co. Inc., New York.
11. An Introduction to the studies of Fishes, A. C. L. G. (1963), Today and Tomorrows Book Agency, New Delhi.
12. Comparative Vertebrate Anatomy, L. H. Hyman (1961), The Chicago Univ. Press, USA.
13. Function and gross Morphology in Fish, Y. G. Alevy (ed) (1969), Keter Press, Jerusalem.
14. Ichthyology, L. P. Poznanin (1977), Amerind Publishing Co. Pvt. Ltd., New Delhi, Bombay, Calcutta, New York.
15. Air-breathing Fishes of India, J. S. DattaMunshi and G. M. Hughes (1992), Oxford and IBH Publishing Co. Pvt. Ltd., New Delhi, Bombay, Calcutta.

FHT-1103: Fisheries Zoology

Credit-2

Full Marks: 100 (Theory 70, Class Test 20 and Attendance 10)

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

Course Objectives:

To provide students with the knowledge of fisheries invertebrate and vertebrates with their general account including adaptation in aquatic life and their biological and commercial importance.

Course Contents:

1. Classification of important invertebrate phyla with special reference to fisheries organisms found in Bangladesh.
2. Classification of important vertebrate classes with special reference to fisheries organisms found in Bangladesh
3. Discussion on the following groups with special emphasis on morphology, mode of life, adaptation, biological and economic importance and distribution of protozoans, sponges, corals, annelids, aquatic arthropods, molluscs, echinoderms etc.
4. Discussion on the following groups with special emphasis on morphology, mode of life, adaptation, biological and economic importance and distribution of fishes, amphibian, reptiles, birds, mammals etc.

Recommended books/ literatures:

1. General Zoology, T. I. Storer and R. L. Usinger (1965), McGraw Hill Book Co., New York.
2. Text Book of Zoology, Vol. I and II (7th edn.), T. G. Parker and W. S. Haswell (1960), McMillan Co. Ltd., London.
3. The Invertebrate, Vol. I-VI, L. H. Hyman (1940), McGraw Hill Publi. Co., New York.
4. The Invertebrate Zoology, J. G. Engemann and R. W. Hagner (1981), McMillan Publ. Co., New York.

5. Invertebrate Structure and Function, E. J.W. Barrington (1979), John Wiley and Sons., New York.
6. A Biology of Crustacea, J. Green (1961), Quadrangle Books Inc.
7. Invertebrate Zoology, E. L. Jordan and P. S. Verma (1985), S. Chand and Co., Ramnagar, New Delhi.
8. The Mollusca, Vol. I – V, Karl M. Wilbur (1983), Academic Press, New York, London.
9. The Handbook on Freshwater Molluscs of India (1989), Zoological Survey of India, Calcutta.
10. Molluscan Fauna of the Bay of Bengal: Marine Molluscs, A. T. A. Ahmed (1990), Dhaka.

FHT-1104: Freshwater Ecology

Credit-2

Full Marks: 100 (Theory 70, Class Test 20 and Attendance 10)

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

Course Objectives:

To provide students with the knowledge of freshwater habitat and organism and the relationship between these.

Course Contents:

1. **Ecology and environment:** Concept of environment, definition and types of ecology, ecology as a science of environment, history of ecology, importance, scope and approaches to the study of ecology.
2. **Basic terminology related to ecology** (habitat, niche, ecosystem, food chain, food web, individual size and metabolism, law of thermodynamics, Liebig's law of minimum, Shelford's law of tolerance, energy flow, biogeochemical cycle, limiting factors, standing crop, carrying capacity, population, community, ecotone, edge species and edge effect etc.).
3. **Principles:** environmental principles and their application in the field of fisheries resource management.
4. **Freshwater environment:** Ecological classification of freshwater organisms; lakes, pools and other standing water bodies (lentic habitat); general models of production; running water (lotic habitat) communities; sources of food and energy flow in streams.
5. **Flood plains:** Ecosystem of flood plains, flood plain fisheries, modification of floodplain ecosystems, recommendations for the development of floodplain ecosystem.
6. Different aquatic habitats of Bangladesh (pond, river, beel, baor, jheel, daha, floodplain etc.).
7. **Degradations of aquatic environment:** causes, impact on aquatic resources.

Recommended books/ literatures:

1. Fundamentals of ecology by Odum, Eugene P. Philadelphia: W. B. Saunders Company, 1953. 383 P
2. Freshwater Ecology: concepts and environments by Walter, K., Dodds. Elsevier, India Pvt. Ltd., New Delhi, India.
3. Ecology of Running Waters. H. B. N. Hynes (1972). Liverpool Univ. Press.
4. Fisheries Ecology. T. 2. Pitcher and J. B. Hart (1982). Croom Helm.
5. The Life of Rivers and Streams. R. L. Usinger (1968). McGraw Hill Book Co. New York.
6. A Manual of Freshwater Ecology. R. Santharam, P. Velayutham and G. Jegatheesan (1989). Daya Publ. House, Delhi.
7. The Ecology of Tropical Lakes and Rivers. A. I. Payne. (1986). John Wiley and Sons. Chichester, New York, Toronto, Brisbane, Singapore.

FHT-1105: General Microbiology

Credit-2

Full Marks: 100 (Theory 70, Class Test 20 and Attendance 10)

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

Course Objectives:

To provide students with the knowledge of the morphology, structure, physiology and reproductive characteristics of microorganism, microbial growth patterns and the role of microorganism in food spoilage.

Course Contents:

1. **Introduction:** Definition of microbiology and microorganism; scope and history of microbiology, branches of microbiology; fisheries microbiology and its importance.
2. **Distribution and classification of microorganisms:** Ecological distribution of microorganism, background of microbial classification, general characteristics of prokaryotes and eukaryotes, classification of fungus and bacteria.
3. **Fungi (The eukaryotic microorganism):** Definition, morphology, physiological and cultural characteristics, reproduction, identification criteria of molds and yeast; characteristics of yeast and mold genera or groups important in food microbiology.
4. **Bacteria (The prokaryotic microorganism):** Definition, morphology, physiological and cultural characteristics, reproduction, growth curve of bacteria; characteristics and description of bacterial genera or groups important in food microbiology.
5. **Viruses (The sub-cellular microorganism):** Definition, structure, chemical composition, viral replication and important viruses.

6. **Aquatic microorganisms:** Definition, influencing factors and economic significance of aquatic microorganisms; general characteristics of aquatic bacteria, inland and marine waters bacteria.

Recommended books/ literatures:

1. Microbiology - An introduction to proteasts, J. S. POINDEXTER
2. Food Microbiology. 3rd Edition, Frazier W. C. and D. C. Westhoff. 1990. McGraw Hill Book Co., New York, London. 502 pp.
3. A Text Book of Microbiology, Burrows.
4. Microbiology of Marine Food Products. Ward, D. R. and C. Hackney. 1991. Van Nostrand Reinhold, New York. 438 pp.
5. Introduction to Microbiology, Walter, McBee Temple.
6. Hand Book of Microbiology, P. S. Bisen and Kavita Berma.
7. Microbiology In "Fisheries Studies": Part-I. Mansur, M. A. 2010. Botomul (Publisher), Dhaka. 234-312 pp.
8. Practical food microbiology. Edited by Diane Roberts, Melody Greenwood. 3rd ed. 2003.
- 9.

FHT-1106: Biochemistry-I

Credit-2

Full Marks: 100 (Theory 70, Class Test 20 and Attendance 10)

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

Course Objectives:

To provide students with the knowledge of carbohydrate, protein, lipid and nucleic acids in life system.

Course Contents:

1. **Introduction of biochemistry:** Definition, importance and scope of biochemistry.
2. **Acid, base and buffer:** Ion product of water; acid, base, pH; pH indicators; buffer solution & buffer capacity.
3. **Cell:** Cell, sub-cellular particles and their functions,
4. **Carbohydrates:** Definition, composition, sources, function, classification, physical and chemical properties of carbohydrate; structural aspects and reactions of monosaccharides; structure, sources and properties of disaccharides, trisaccharides and polysaccharides
5. **Lipids:** Definition, classification, function of lipid; definition, types, nomenclature, chemical reactions of fatty acids; definition, structure and function of essential fatty acids; definition, structure and properties of triacylglycerol; purity tests of fats and oil; definition, types, structure and function of phospholipids; glycolipids, lipoprotein and steroids.

6. **Proteins:** Definition, classification, physico-chemical properties of proteins, amino acids as monomeric unit, their physico-chemical properties and structures, naturally occurring peptides, reaction used for sequence determination, structural organization of proteins, essential and non-essential amino acids; protein denaturation, fish proteins and its nature.
7. **Nucleic acid:** Definition, classification, occurrence, composition and biological function, structures and property of DNA, DNA as genetic material, types, functions and structure of RNA.

Recommended books/ literatures:

1. Outlines of Biochemistry, 5th edn., E. E. Con and P. K. Stumpf (1987), John Wiley and Sons, New York.
2. Text Book of Biochemistry, 2nd edn., A. I. Lehninger (1976), Worth Publi., New York.
3. Practical Biochemistry for Students, P. K. Talwar and A. G. Jhingran (1991), Laypec Brothers, New Delhi.
4. Biochemistry Laboratory Manual, F. M. Strong (1965), William C. Brown Co., Iowa.
5. Biochemistry, D. Voet and J. Voet (1990), John Wiley and Sons, New York.
6. Principles of Biochemistry, 6th edn., A. White, P. Handler and E. L. Smith (1976), McGraw Hill Co., New York.
7. Textbook of Biochemistry by Dr. K. Ram Babu, 2007. Virender Kumar Arya. AIT. B. S. Publishers, India.
8. A Textbook of Biochemistry by A. V. S. S. Rama Rao (1997). UBS Publishers Pvt. Ltd. Co. New Delhi.

Practical and Viva-voce Courses

FHP-1111: Practical and Viva-voce on Introduction to Fisheries Resources

Credit-1

Full marks: 100 (Class record: 10 + Practical: 60 + Viva-voce: 20 + Attendance: 10)

1. Study of identification and taxonomic position (PCOFG)) of fishes, shellfishes and other fisheries specimen collected from local fish market or local water bodies in fresh condition.
2. Survey of fishes, shellfishes and other fisheries items in local fish markets as well as aquarium fish shop.
3. Survey of commercially important groups of fishes, shellfishes and other fisheries items, fisheries equipments of a selected water bodies as well as fisheries hotspot.
4. Visit to local fisheries cooperatives (GO and NGO) to know about their activities in fisheries sector.

FHP-1112: Practical and Viva-voce on General Ichthyology - I

Credit-1

Full marks: 100 (Class record: 10 + Practical: 60 + Viva-voce: 20 + Attendance: 10)

1. Study of body form, appendages, openings, scales of cartilaginous and bony fishes.
2. Dissection and study of the blood circulatory system of cartilaginous and bony fishes.
3. Dissection and study of the urinogenital system of fishes.
4. Dissection and study of the respiratory organs of fishes.
5. Dissection and study of weberianossicle, ear stone etc.

FHP-1113: Practical and Viva-voce on Fisheries Zoology

Credit-1

Full marks: 100 (Class record: 10 + Practical: 60 + Viva-voce: 20 + Attendance: 10)

1. Study of museum specimen including identifying characteristics and taxonomic position (PCOFGS) of commercially important species under all invertebrate's phyla and vertebrate classes.
2. Morphological study of commercially important invertebrates. Such as - appendages of crustaceans, mollusk etc.; shell of mollusk;
3. Profile study of fisheries vertebrates found in Bangladesh.
4. Polarity and Cephalization, Planes, Symmetry, Metamerisis, Tagmatization of invertebrates and vertebrates.

FHP-1114: Practical and Viva-voce on Freshwater Ecology

Credit-1

Full marks: 100 (Class record: 10 + Practical: 60 + Viva-voce: 20 + Attendance: 10)

1. **Study of pond as lentic ecosystem:** Physical, chemical and biological factors (community composition and ecological classification).
2. **Field visit on river as a lotic ecosystem:** Physical, chemical and biological factors (community composition and ecological classification).
3. **Field visit on floodplain ecosystem:** Different components, factors, modifications.

FHP-1115: Practical and Viva-voce on General Microbiology

Credit-1

Full marks: 100 (Class record: 10 + Practical: 60 + Viva-voce: 20 + Attendance: 10)

1. Study of microscopes: Types, principles and operation.
2. General suggestions, safety and guideline of a microbiology laboratory.

3. Important terminology for exercises in the microbiological practical classroom.
4. Study of different sterilization techniques.
5. Study of culture media: Types, ingredients and preparation.
6. Culture of microorganisms: Broth, pour plate, spread plate, streak plate, slant, stab, swab and shake culture.

FHP-1116: Practical and Viva-voce on Biochemistry - I

Credit-1

Full marks: 100 (Class record: 10 + Practical: 60 + Viva-voce: 20 + Attendance: 10)

1. Study of different types of solution used in chemistry.
2. Preparation of standard solution and standardization of HCl.
3. Preparation of buffer solution and determination of its pH
4. Estimation of acetic acid from vinegar
5. Tests for carbohydrates, estimation of reducing sugar, preparation of starch and its determination.
6. Proteins colour tests, determination of isoelectric pH of protein, estimation of protein by Kjeldhal method.

B. Sc. Fisheries (Honours) Level-1 Semester-2 Examination, December 2020

Theoretical Courses

FHT-1201: Developmental Biology

Credits: 2

Full Marks: 100 (Theory 70, Class Test 20 and Attendance 10)

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

Course Objectives:

To provide students with the knowledge of developmental steps of early life of fish and shellfishes including spermatogenesis, embryonic development with the factors affecting their development.

Course Contents:

1. Background, pioneer, objective, expected outcome, importance and scope of the course.
2. **Gametogenesis:** Spermatogenesis and oogenesis, structure of sperm and ovum, egg types.
3. **Fertilization:** Types, events, polyspermy and monospermy, chemistry, significance.
4. **Principle of embryonic development:** zygote, cleavage patterns, blastulation, gastrulation, organogenesis and coelom formation, placentation
5. **Developmental biology of fishes:** Embryonic development, fry, juveniles, adults, sexual dimorphism, maturation stages, reproduction, fecundity, factors (internal and external) influencing breeding, breeding behaviour- colouration, courtship, size at recruitment and first maturity, gonadal length index and gonado-somatic index.
6. **Developmental Biology of shellfishes:** Commercially important crustacean species (shrimps, lobsters, crabs etc.) and molluscs (mussels, oysters, snails etc.).
7. **Food and feeding habits** of different life stages of fishes and shellfishes.
8. **Factors affecting the development** of fin fishes and shellfishes.

Recommended books/ literatures:

1. The Biology of the Mollusca, R. D. Purchon (1978), Pergamon Press, Sydney.
2. Reproductive Biology of Invertebrates: Mollusca. Vol. I-IV (1992), Edited by: K. G. Adiyodi and R. G. Adiyodi.
3. Snail, Flukes and Man, Edited by: S. Jairajpuri (1989), Zoological Survey of India.
4. Seashells, S. Peter Dance (1982), Hamlyn Paperbacks.
5. A Functional Biology of Marine Gastropods, R. G. Hughes (1986), Croom Helm.
6. Handbook Freshwater Molluscs of India, N. V. SubbaRao (1989), Zoological Survey of India, Calcutta, Government of India.
7. Freshwater Ostracoda, Z. S. Bronshtein (1988), Oxonian Press Ltd., New Delhi, Calcutta.
8. Crabs and Crab Fisheries of Sundarban, N. C. Nandi and S. K. Pramanik (1994), Hindustan Publishing Corporation, Delhi-110007.
9. Growth and Ecology of Fish Populations, A. H. Weatherly (1972), Academic Press, London, New York.

FHT-1202: General Ichthyology – II

Credits: 2

Full Marks: 100 (Theory 70, Class Test 20 and Attendance 10)

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

Course Objectives:

To provide students with the knowledge on different organ systems of fish along with the special organ systems used for their existence.

Course Contents:

1. Skeletal System: cartilage and bone; exoskeleton and endoskeleton; membranous skeleton; axial skeleton; appendicular skeleton; visceral skeleton; origin of limbs and girdles.
2. Muscular System: classification and muscle terminologies – skeletal muscles in head, trunk and tail, branchial musculature, eye muscles, median and paired fin musculatures, smooth muscles and cardiac muscles.
3. Digestive system: definition, alimentary tracts and modification and digestive glands.
4. Endocrine system: Type, origin, hormone secretion and action.
5. Nervous system: classification, brain and spinal cord, cranial and spinal nerves and autonomic nervous system.
6. Receptor organs: classification, structures and functions of important receptors.
7. Adaptive radiation in fishes with reference to special organs viz. poison glands, light organs, electric organs etc.

Recommended books/ literatures:

1. Ichthyology, K. F. Lagler, J. E. Bardach, R. R. Miller and D. R. M. Passino (1977). John Wiley and Sons. New York.
2. Freshwater Fishery Biology. K. F. Lagler (1952), IOWA Press Inc. USA.
3. Reading in Ichthyology, M. S. Love and G. M. Cailliet (eds) (1979), Prentice –Hall of India Pvt. Ltd., New Delhi.
4. The Life of Fishes, N. B. Marshall (1965), Weidenfeid and Nicolson, London.
5. A Text Book of Fish Biology and Fisheries, Q. Bone and R. H. Moore (2008), Taylor & Francis Group, UK.
6. A Text Book of Fish Biology and Fisheries, S. S. Khanna and H. R. Singh (2006), Narendra Publishing House, Delhi-110006, India.
7. Anatomy and Physiology of Fishes, S. Kumar and M. Tembhre (1998), Vikas Publishing House Pvt. Ltd., India.
8. The Vertebrate Body, A. S. Romer (1949), W. B. Saunders Co., Philadelphia.
9. A Laboratory manual of Comparative anatomy of the Chordates, A. H. Stockard (1949), Edward Bros., Michigan.

10. The Ways of Fishes, L. P. Schultz and E. M. Stern (1949), D. Van Nostrand Co. Inc., New York.
11. Studies on the Structures and development of vertebrate, Vols. I and II, E. S. Goodrich (1958), Dover Publ., New York.
12. An Introduction to the studies of Fishes, A. C. L. G. (1963), Today and Tomorrows Book Agency, New Delhi.
13. Comparative Vertebrate Anatomy, L. H. Hyman (1961), The Chicago Univ. Press, USA.
14. Function and gross Morphology in Fish, Y. G. Aleev (ed) (1969), Keter Press, Jerusalem.
15. Ichthyology, L. P. Poznanin (1977), Amerind Publishing Co. Pvt. Ltd., New Delhi, Bombay, Calcutta, New York.
16. Air-breathing Fishes of India, J. S. Datta Munshi and G. M. Hughes (1992), Oxford and IBH Publishing Co. Pvt. Ltd., New Delhi, Bombay, Calcutta.

FHT-1203: Fundamentals of Aquaculture

Credits: 2

Full Marks: 100 (Theory 70, Class Test 20 and Attendance 10)

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

Course Objectives:

To provide students with the knowledge of principles, systems and management of aquaculture.

Course contents:

1. **Introduction:** definition, potentials, scope, problems, risks and threats of aquaculture.
2. **Principles and concepts:** General principles of aquaculture; concept of monoculture, polyculture, composite culture; hatchery, nursery and grow out operation.
3. **System and advancements in aquaculture:** Extensive, semi-intensive and intensive culture; organic aquaculture, weed based aquaculture, carp fattening, region specific aquaculture, Biofloc aquaculture, RAS, sustainable aquaculture.
4. **Management practices in pond aquaculture** (pre-stocking, stocking and post-stocking measures emphasizing pond drying, pond liming, removal of aquatic weeds, removal of predatory and unwanted fishes/animals, pond fertilization, selection of species, supplementary feeding, sampling, partial harvesting and restocking, final harvest and marketing).
5. **Transportation of live fry and fingerlings and adult fishes:** Equipment, water quality, handling, loading and stocking, shipping, use of anesthetics and antiseptics during transportation.
6. **Common problems** found in aquaculture management (water quality, disease etc.) and their solution.

Recommended books/ literatures:

1. Training Manual for Extension Personnel on Low-cost Environment Friendly Sustainable Aquaculture Practices. Grover, J. H.; M. A. Islam; W. A. Shah, M. A. H. Rana and H. A. Chowdhury (2000). ICLARM- The World Fish Centre, Dhaka, Bangladesh.
2. Water Quality Management in Aquaculture, M. S. Rahman (1992), BRAC Prokashana.
3. A Manual of Freshwater Aquaculture, R. Santhanam, N. Sukumaran and P. Natarajan (1987), Oxford and IBH Publishing Co. Pvt. Ltd., New Delhi, Bombay, Calcutta.
4. Fish and Fisheries of India. V. G. Jhingran (1988). Hindustan Publ. Corp. Delhi.
5. Muir, J. F. and Roberts, R. J. (Eds.) Recent Advances in Aquaculture, Vol. I, II, III and IV, Croom Helm, London.
6. Pillay, T. V. R. 1994. Aquaculture Development: Progress and Prospect. Fishing News Books Black well Scientific Publications Ltd. Oxford.

FHT-1204: Coastal and Marine Ecology

Credits: 2

Full Marks: 100 (Theory 70, Class Test 20 and Attendance 10)

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

Course Objectives:

The students will be acquainted with the salient features of different types of coastal and marine ecosystems and the interactions among the living and nonliving components of the ecosystems.

Course Contents:

1. **Ecological dynamics :** a) Basic concept on the components of marine ecosystem, habitat and ecological niche, trophic level, food chain and food web, trophic structure and ecological pyramids, Production, decomposition and transformation of organic matter. b) Ecological cycle in the sea, major ecological feature of the sea.
2. **Estuarine ecosystem:** Definition, characteristics of estuary, classification of estuaries; Limiting Factors, Ecological classifications of estuarine organisms, Natural productivity and food production potential of Estuaries, Estuarine Food Web, Values of Estuaries, Human Impacts and Threats.
3. **Mangrove ecosystem:** Definition, Types of mangrove, Limiting factors and driving forces, Organisms associated to mangrove, Economic value of mangrove, Mangrove forest of Bangladesh, Cause and effects of mangrove destruction.
4. **Coastal ecosystems:** Definitions, Types, Limiting Factors and Driving Forces, Coastal/Brackish water Organisms, Inter-tidal Niche, Importance of Coastal Environment, Human Impacts and Threats, Coastal Areas of Bangladesh.
5. **Marine habitats:** Marine environment, classification of marine environment; coral reefs- definition, types of coral reef, fauna of coral reef, factors affect coral reformation, threaten factors of coral reefs, approaches of reef conservation and management.
6. **Marine ecosystem:** Definition, Types of marine ecosystem, limiting factors and driving forces of marine ecosystem, ecological classification of marine organisms.
7. **Intertidal ecosystem:** Intertidal rocky shores, Sub-tidal rocky shores, sandy beaches, and coastal upwelling systems.
8. **Marine communities:** Plant, animal and microorganism communities of abyssal, mid-depth pelagic, upper oceanic, inshore, pelagic, sublittoral, bottoms, sandy, rocky and muddy shores.
9. **Population ecology:** Concepts of population; population density rates natality; mortality, age distribution, biotic potential and environmental resistance, growth form, population dispersal and structure, Types of interaction between two species.

Recommended books/ literatures:

1. Mann, K.H. Ecology of Coastal Waters. Blackwell Science Inc., USA, 2000.
2. Levinton, J. *Marine Biology. Function, Biodiversity, Ecology*
3. Chapman, V.J. - Coastal ecosystems
4. Colinvaux - Ecology

5. Day, J.W. et. al - Estuarine ecology - A wileyintersincepubliscation. - John wiley and sons. New York, 1989.
6. Leivinton, J.S. - Marine Ecology- John wiley and sons Inc. New York. 1966.
7. Longhurst, A.R. - Analysis of marine ecosystems- Academic press, London, 1981.
8. Mac Arthur, R.I. Geographical ecology: Patterns in the distribution of species
9. Odum, E.P. Fundamental of ecology. Philadelphia, sunders college publishing house, New delhi.

FHT-1205: Fisheries Microbiology

Credits: 2

Full Marks: 100 (Theory 70, Class Test 20 and Attendance 10)

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

Course Objectives:

To provide students with the knowledge of the aquatic microorganism, role of microorganism on contamination and spoilage, effects of processing on microorganisms and foodborne illness.

Course Contents:

1. Contamination and spoilage of fish and sea food: Definition of contamination, microorganisms of cold, temperate and tropical regions, sources of post-harvest contamination; definition and causes of spoilage, factors influencing the kind and rate of spoilage, chemical changes caused by microorganisms; spoilage of frozen fish, canned fish, cured fish, fermented fish and surimi based products.
2. Microbial food borne illness: Food poisoning, bacterial food intoxication and infection-causative agent, mechanisms, precautions; Botulism, Staphylococcal intoxication, Salmonellosis, E. coli infection.
3. Microbial growth in food: Growth curve of yeast, mold and bacteria; factors affecting microbial growth-Temperature, water activity, pH, redox-potential, nutrients, inhibitors and microbial interactions.
4. Antimicrobial agents: Definition, physical (low temperature, heat, desiccation, irradiation, filtration) and chemical (antiseptics and disinfectants, chemical sterilants, antibiotic) antimicrobial agent, definition, types, characteristics, mode of action and uses.
5. Effect of preservation on microorganisms: Effect of low temperature and high temperature, effect of curing and other preservation and processing methods.
6. Food safety and quality control: Microbiological quality of fishery products; quality control and quality assurance; microbiological standard and sanitation in fish processing industry; definition, principles and application of HACCP in fish processing industry.

Recommended books/ literatures:

1. Microbiology - An introduction to protests, J. S. POINDEXTER
2. Food Microbiology. 3rd Edition, Frazier W. C. and D. C. Westhoff. 1990. McGraw Hill Book Co., New York, London. 502 pp.
3. A Text Book of Microbiology, Burrows.
4. Microbiology of Marine Food Products. Ward, D. R. and C. Hackney. 1991. Van Nostrand Reinhold, New York. 438 pp.
5. Introduction to Microbiology, Walter, McBee Temple.
6. Hand Book of Microbiology, P. S. Bisen and Kavita Berma.
7. Microbiology In "Fisheries Studies": Part-I. Mansur, M. A. 2010. Botomul (Publisher), Dhaka. 234-312 pp.
8. Practical food microbiology. edited by Diane Roberts, Melody Greenwood. 3rd ed. 2003.

FHT-1206: Biochemistry - II

Credits: 2

Full Marks: 100 (Theory 70, Class Test 20 and Attendance 10)

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

Course Objectives:

To provide students with the knowledge of metabolism of carbohydrate, protein, lipid in life system and Enzymes, Vitamins, Hormone and overall nutrition in life system.

Course Contents:

1. Background, pioneer, objective, expected outcome, importance and scope of the course.
2. Carbohydrate Metabolism: Major pathways of carbohydrate metabolism, glycolysis, TCA cycle, hexose monophosphate pathway, gluconeogenesis.
3. Lipid Metabolism: β and α -oxidation, propionyl CoA and ketone bodies metabolism.
4. Protein Metabolism: General fate of dietary amino acids, deamination, transamination, decarboxylation, urea cycle, classification of organisms on the basis of nitrogenous end products. Fixation of nitrogen by aquatic plants.
5. Enzymes: Definition, classification, nomenclature, chemical nature and property of enzymes; concepts of enzyme cofactors, factors affecting enzymatic activity; allosteric enzyme, feedback inhibition, role of enzymes in deterioration of fish and fishery products.
6. Vitamins: Definition, classification, sources, chemical properties and biochemical role, dietary vitamin deficiency in fish.
7. Hormone: Definition, classification, function & physiological role of Hormones. Biological functions of pituitary, hypothalamus, adrenal cortex and sex hormones.
8. Nutrition: Basic concept; protein, fat and carbohydrates as nutrients; basic concept on micronutrients like iodine, zinc, magnesium, iron.

Recommended books/ literatures:

1. Outlines of Biochemistry, 5th edn., E. E. Con and P. K. Stumpf (1987), John Wiley and Sons, New York.
2. Text Book of Biochemistry, 2nd edn., A. I. Lehninger (1976), Worth Publi., New York.
3. Practical Biochemistry for Students, P. K. Talwar and A. G. Jhingran (1991), Laypec Brothers, New Delhi.
4. Biochemistry Laboratory Manual, F. M. Strong (1965), William C. Brown Co., Iowa.
5. Biochemistry, D. Voet and J. Voet (1990), John Wiley and Sons, New York.
6. Principles of Biochemistry, 6th edn., A. White, P. Handler and E. L. Smith (1976), McGraw Hill Co., New York.
7. Textbook of Biochemistry by Dr. K. Ram Babu, 2007. Virender Kumar Arya. AIT. B. S. Publishers, India.
8. A Textbook of Biochemistry by A. V. S. S. Rama Rao (1997). UBS Publishers Pvt. Ltd. Co. New Delhi.

Practical and Viva-voce Courses

FHP-1211: Practical and Viva-voce on Developmental Biology

Credit-1

Full marks: 100 (Class record: 10; Practical: 60 +Viva-voce: 20+ Attendance: 10)

1. Identification of fish and shellfish larvae and fry.
2. Identification of post-larvae and juvenile stages of prawn, shrimp and crab.
3. Study of sexual dimorphism of fish and shellfishes.
4. Study of maturation stages of gonads in different size of fishes.

FHP-1212: Practical and Viva-voce on General Ichthyology - II

Credit-1

Full marks: 100 (Class record: 10; Practical: 60 +Viva-voce: 20+ Attendance: 10)

1. Comparative study of skeleton of different fish groups.
2. Dissection and study of Weberian ossicle.
3. Dissection and study of digestive tracts of different fish groups.
4. Dissection and study of the cranial nerves of cartilaginous and bony fishes
5. Dissection and study of the pituitary gland poison gland etc.

FHP-1213: Practical and Viva-voce on Fundamentals of Aquaculture

Credit-1

Full marks: 100 (Class record: 10; Practical: 60 +Viva-voce: 20+ Attendance: 10)

1. Identification of aquaculture species.
2. Identification of aquatic weeds.
3. Identification of organic and inorganic fertilizers and chemicals used in aquaculture.
4. Identification of different feeds and fish feed ingredients.
5. Calculation for input application in pond.
6. Method demonstration on liming, fertilization, stocking, feeding and seed/fish transportation.
7. Water quality monitoring in aquaculture pond.
8. Case study on aquaculture in pond.

FHP-1214: Practical and Viva-voce on Coastal and Marine Ecology

Credit-1

Full marks: 100 (Class record: 10; Practical: 60 +Viva-voce: 20+ Attendance: 10)

1. Acquaintance with the equipments used in the coastal and marine field study.
2. Field visit on coastal ecosystem (physico-chemical and biological parameters) with special reference to estuarine and mangrove community and modification.
3. Field visit and study of the Sundarban river estuary as an Estuarine Ecosystem of Bangladesh.
4. Study of species diversity index in estuarine, coastal and marine habitats
5. Field Visit and Study on the Food Web in Coastal, Estuarine or Brackish water Habitat and Mangrove Ecosystem.

FHP-1215: Practical and Viva-voce on Fisheries Microbiology

Credit-1

Full marks: 100 (Class record: 10; Practical: 60 +Viva-voce: 20+ Attendance: 10)

1. **Microscopic observation of bacteria:** Gram's stain, spore stain, flagella stain, Ziehl-Neelsen's stain, Hiss's methods and Albert's staining.
2. **Isolation and identification of bacteria:** Morphological, biochemical, physiological and serological study.
3. **Quantitative estimation of bacteria:** Consecutive decimal dilution method and most probable number method.
4. **Field visit:** Sample collection from selected fish landing centers, fish markets and processing plants for bacteriological analysis and preparation of report.

FHP-1216: Practical and Viva-voce on Biochemistry - II

Credit-1

Full marks: 100 (Class record: 10; Practical: 60 +Viva-voce: 20+ Attendance: 10)

1. Location, secretion, function and chemical nature of endocrine gland in fish body.
2. Determination of steroids from a given sample by thin layer chromatography (TLC).
3. Determination of the effects of Gonadotropins (FSH, LH) on fish gonads using the non-breeding period.
4. Demonstrate the digestive processes in a given fish by showing the presence of trypsin, amylase and lipase.
5. To study the temperature preference of *Channapunctatus* / common carp / *Heteropneustis*.
6. To study salinity preference of freshwater carp or an air breathing fish.

B. Sc. Fisheries (Honours) Level-2 Semester-3 Examination, June 2021

Theoretical Courses

FHT-2301: Fisheries Systematics

Credits: 2

Full Marks: 100 (Theory 70, Class Test 20 and Attendance 10)

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

Course Objectives:

To provide knowledge to the students on taxonomy, systematics, origin and evolution and zoological nomenclature of fish.

Course Contents:

1. History of biological taxonomy and systematics.
2. Taxonomic characters in fishes.
3. Taxonomic collection, labeling, preservation and curation and cataloguing of fish and other fisheries items.
4. Identification of fishes using taxonomic keys and other methods.
5. Types, theories, categories and basis of classification.
6. Zoological nomenclature, synonyms, synonymy, law of priority, the type method.
7. Species concept and speciation.
8. Origin and evolution of fishes.

Recommended books/ literatures:

1. Methods and Principles of Systematic Zoology. E. Mayer (1953). McGraw Hill Book Co. New York.
2. Animal Species and Evaluation. E. Mayer (1966). McGraw Hill Book Co. New York.
3. Theory and Practice of Animal Taxonomy (4th edn), V. C. Kapoor, 1998, Oxford & IBH Publishing Co. Pvt. Ltd.
4. Principles of Animal Taxonomy, George Gaylore Simpson, 1969, Columbia University Press.

FHT-2302: Molecular Biology and Histology

Credits: 2

Full Marks: 100 (Theory 70, Class Test 20 and Attendance 10)

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

Course Objectives:

To provide students with the knowledge of cytology, molecular biology and histological techniques applied in cell study.

Course Contents:

1. Background, pioneer, objective, expected outcome, importance and scope of the course.
2. Cell-types and structures: Structure, function and chemistry of cell organelles (plasma membrane, endoplasmic reticula, Golgi bodies, lysosome, mitochondria)
3. Histology: types, function, structure and functions of fish tissue.
4. Cell cycle and cell division: Mitosis and meiosis
5. Crossing over: Definition, types, theory, mechanism, factors and significance.
6. Chromosome: structure, chemical composition, changes in structure, variation in number
7. Gene expression: DNA replication, transcription, translation, genetic code
8. Genomes in fishes: Nuclear and mitochondrial gene structure

Recommended books/ literatures:

1. Handbook of histological and cytological techniques, R. R. Benstey.
2. The Cell Structure. C. P. Swanson.
3. Cells and Organells, A. V. Novikoff and E. Holtzman.
4. Cytological Technique, J. R. Baker (1966), John Wiley and Sons. Inc., New York.
5. Basic Histology, L. C. Junqueira and J. Carneuro (1971), Lange Medical Publ., Los Altos, California.
6. Cell Biology, Genetics, Molecular Biology, Evolution and Ecology. P.S. Verma and V.K. Agarwal (2006) S. Chand and Company Ltd. New Delhi.
7. Molecular & Cell Biology for Dummies. René Fester Kratz (2009). Wiley Publishing, Inc., Indianapolis, Indiana.
8. Histological techniques for marine bivalve mollusks and crustaceans. Howard, D. W., E. J. Lewis, B. J. Keller, and C. S. Smith. (2004). NOAA Technical Memorandum NOS NCCOS 5.
9. Zooplankton fixation and preservation. Edited by H. F. Steedman. (1976). The UNESCO Press. Paris 1976.

FHT-2303: Fish Behaviour

Credits: 2

Full Marks: 100 (Theory 70, Class Test 20 and Attendance 10)

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

Course Objectives:

To provide knowledge on movement, feeding, migratory, social, reproductive and special behavior of fish in their different life stages under wild and aquaculture condition.

Course Contents:

1. Terminologies relevant to behaviour.
2. Kinds, Mechanism and Theories of behavior.
3. Feeding behaviour of fishes.
4. Reproductive behaviour of three spine stickle-back, *Petromyzon*, *Hilsa*, *Labeo*, *Puntius*, *Clarias*, *Anabas*, *Channa*, Tilapia etc.
5. Migration: Migratory behavior of fishes.
6. Parental care of fishes.
7. Special behaviour of fish with reference to cave living fishes, fishes in drought condition, aestivation and hibernation etc.

Recommended books/ literatures:

1. Social behaviour of animal
2. The Diversity of Fishes, GS Halfman, BB Collette and DE Facey (2000) Blackwell Science, USA
3. Modern Textbook of Zoology: Vertebrates (2nd ed.), R.L. Kotpal (2000) New Delhi, India.
4. Text Book of Zoology, Vol. II (7th ed.), T. G. Parker and W. S. Haswell (1960), McMillan Co. Ltd., London.
5. General Zoology, T. I. Storer and R. L. Usinger (1965), McGraw Hill Book Co., New York.
6. The Life of Vertebrates, J. Z. Young (1962), Oxford Univ. Press, London.

FHT-2304: Physico-chemical Limnology

Credits: 2

Full Marks: 100 (Theory 70, Class Test 20 and Attendance 10)

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

Course Objectives:

To provide students with the knowledge of different physical and chemical properties of water in view of limnological aspects. The students will learn the soil components, decomposition process of organic matter and its impact on water body during soil-water interaction.

Course Contents:

- 1. Introduction, definition, importance, history and scope of Limnology.**
- 2. Characteristics and formation of inland waters:** pond, lakes, swamps and marshes, streams, estuaries of Bangladesh.
- 3. Rivers:** definition, types, origin, sources of water, rivers of Bangladesh, and rivers of the world.
- 4. The physical characteristics of inland water:** solar radiation and natural waters (light, colour, turbidity, transparency, water current and movement), heat of natural waters (temperature, thermal classification of lakes, heat budget and lake stability, holomixis and meromixis).
- 5. Chemical characteristics of inland water:** Dissolved gases in inland waters (dissolved oxygen, CO₂ and other gases). Dissolved solids in natural waters (nitrogenous compounds, phosphorous, calcium and magnesium, sodium and potassium, iron, silica, trace elements and salinity). Role of nutrients in primary production, pH.
- 6. The nature of water:** The water molecule, physical and chemical characteristics of pure water.
- 7. Soil:** Definition, soil in the aquatic environment, soil components- mineral matter, air and water; characteristics of bottom soils, soil pH, ion exchange, base saturation, organic matter, C/N ratio, essential nutrients, electrochemical exchanges of elements, soil fertility evaluation.
- 8. Soil water interaction** and their role in determining the productivity of aquatic environment.

Recommended books/ literatures:

1. Text Book of Limnology, G. A. Cole (1979), The Mosby Co., London.
2. Limnology, C. R. Goldman and A. J. Horne (1983), McGraw Hill Book Co.
3. A - Treatise on Limnology vol. I and II, G. E. Hutchinson (1975), John Wiley and Sons, NY.
4. Limnology, P. S. Welch (1952), McGraw Hill Book Co.
5. Limnology, R. G. Wetzel (1983), Saunders College Publ., Philadelphia, USA.
6. A Handbook of Limnology, Lind.
7. Limnological Analysis (3rd edn), Robert G. Wetzel and Gene E. Likens (2000), Springer.
8. Fundamentals of Limnology (3rd edn), Franz Ruttner (1970), Walter de Gruyter & Co., Berlin.

FHT-2305: Fish Physiology

Credits: 2

Full Marks: 100 (Theory 70, Class Test 20 and Attendance 10)

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

Course Objectives:

To provide students with the knowledge of fish temperature regulations, digestions, metabolism, respiration, excretion and osmoregulation.

Course Contents:

1. **Temperature regulation:** Classification of fish based on thermal regulation, low and high thermal effect, temperature regulation in homeotherms, fish as poikilotherms, endothermic fishes.
2. **Digestion:** Concept of digestion, digestion mechanism, digestive secretion (function of HCl and role of bile), sources of enzymes and function, absorption and assimilation.
3. **Metabolism:** Concept of metabolism, phases of metabolism: anabolism and catabolism, classification of metabolic rate based on activity levels, water and solute metabolism, cellular metabolism, factors controlling metabolism in fish.
4. **Respiration:** Definition, physiology of respiration, transport and exchange of gases, factors affecting O₂ and hemoglobin affinity, respiratory volume, respiratory quotient.
5. **Excretion:** Definition and concept on excretory products, biochemical composition of excretory products, physiology of excretion.
6. **Osmoregulation:** Osmosis, osmotic pressure, isotonic, hypotonic, hypertonic, uryhaline, stenohaline, electrolytes, osmoregulation in freshwater, marine and migratory fishes.
7. **Growth:** Definition and general concept of age and growth, methods for estimation of age and growth, and factors affecting growth.
8. **Blood circulation:** Composition and function of blood, mechanism and physiology of blood circulation, heart structure, myocardial electrical activity, cardiac flow, heart volume.
9. **Endocrine system:** Hormone secretion and their role in the life process of fishes, hormone versus fish behaviour (specially breeding and migratory).
10. **Reproduction:** Physiology of reproduction, classification of reproductive strategies, Ovarian maturation stages, sexual maturity and reproductive cycle.

Recommended books/ literatures:

1. The Physiology of Fishes. Vol.-I & II. Brown, M. E. (1957). Academic Press, London.
2. The Physiology of Fishes. Vol.-III & IV. Brown, M. E. (1957). Academic Press, London.
3. Fish Physiology, Vol.-I. W. S. Hoar & D. J. Randall (1969). Academic Press, New York & London.
4. Modes of Reproduction in Fishes. C. M. Jr. Brender and D. E. Resen. 1966. Natural Histroy Press, New York.

5. An Introduction to Fishes. S. S. Khanna (1981). Indian University Press, Allahabad, India.
6. Introduction to Fish Physiology by Dr. Lynwood, S. Smith (2003). NPH, New Delhi.
7. Fish and Fisheries (2nded) by Pandey, Shukla (2007). Rakesh Kumar Rastogi Publications, Shivaji Road, Meerut, India.
8. Methods and Principles of Systematic Zoology. E. Mayer (1953). McGraw Hill Book Co. New York.

FHT-2306: Fish Nutrition-I

Credits: 2

Full Marks: 100 (Theory 70, Class Test 20 and Attendance 10)

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

Course Objectives:

To provide the knowledge of the fish nutrition concerning the nutrient- carbohydrate, protein, lipid and also vitamin and mineral requirement of fish, crustacean and mollusk.

Course Contents:

1. Introduction and terminology of fish nutrition; nutritional parameters of culturable fish and shellfish;
2. Proteins and amino acids, Optimum dietary protein level, Dietary Protein and amino acid requirement of fish and shell fish, Function of protein in fish and crustaceans.
3. Lipids and fatty acids, dietary lipids requirement of fish, Essential fatty acids requirement of fish. Fatty acid oxidation, Toxic non-essential fatty acids. Problems with higher dietary lipid levels in fish feed.
4. Minerals requirement of fish and shrimp, dietary sources of minerals, biological function of calcium and phosphorus in aquatic animals.
5. Vitamins, Individual vitamins, Vitamins requirement of fish, dietary sources of vitamins
6. Carbohydrates and water. Function of carbohydrates in aquatic animals. Dietary utilization of carbohydrates in fish.
7. **Sources of nutrition:** naturally produced food in ponds; food produced through fertilization and supplementary feeding and complete artificial feeding.
8. **Nutritional disorders:** disorders in protein nutrition, disorders in lipid nutrition, disorders in mineral deficiency, disorders in vitamin nutrition.
9. Nutrition and fish health.

Recommended books/ literatures:

1. Fish Nutrition (2nd edn.). J. E. Halver (1989). Academic Press Inc. New York.
2. Nutrition of Pond Fishes. B. Hopher (1988). Cambridge University Press.
3. Principles of Fish Nutrition. W. Steffers (1989). Ellis Horwood Ltd. John Wiley and Sons. New York.

4. Backyard Fish Farming. P. Bryant, K. Jauncey and T. Atack (1982). Frism Press. Stable Court. Dorchester, England.
5. Finfish Nutrition and Fish Feed Technology. vol. I and II. J. E. Halver and K. Tiews (editors) (1979). NeenemannGmbh and Co. Berlin.
6. Nutrient Requirement of Warm Water Fishes and Shellfishes. National Research Council (1988). National Academy of Sciences; Washington DC.
7. Energetics: New Perspectives. P. Tytler and P. Calow (editors) (1985). 8. Croom Helm. London.
8. Fish Nutrition in Asia. ICLARM.
9. Applied Nutrition by D. V. Reddy (2006). Vijay Primlani for Oxford of IBH Publishing Co. Pvt. New Delhi.
10. Fish is Nutrition. E. Heen and R. Krenzer (1962). Fishing News (Books) Ltd. London.

FHT-2307: Fish Parasitology

Credits: 2

Full Marks: 100 (Theory 70, Class Test 20 and Attendance 10)

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

Course Objectives:

The course aims to provide an understanding of fish parasites, parasitic problems in cultured fish, promote correct diagnoses and appropriate control measures.

Course contents:

1. **Introduction:** Definition of parasite, parasitology and fish parasitology, importance of fish parasitology, major groups of fish parasites.
2. **Symbiosis and parasitism:** Concept, importance and types of symbiosis; concept and types of parasitism.
3. **Life cycle of some representative fish parasites:** *Gyrodactylus* sp., *Dactylogyrus* sp., *Clinostomum* sp., *Clonorchis* sp., *Ligula* sp., *Proteocephalus* sp. *Pallisentis* sp. etc.
4. **Environment and fish parasites:** Host-parasite-environment relationship, factors influencing abundance and composition of fish parasites.
5. **Adaptation of parasites and their mode of life:** Body shape, size, colour and structure-attachment and locomotion organs, different body systems.
6. **Effects of parasite on its host and host's reaction to the parasites:** Mechanical effects, toxic effects, effects as vector and as indirect causes of diseases, others effects; cell and tissue reactions and immunity of host.
7. **Parasitic diseases of fish:** Etiology, affected host, affected sites, symptoms and pathology, transmission process, preventive and control measures.

Recommended books/ literatures:

1. Parasites and Diseases of Fish Cultured in the Tropics. Z. Kabata. (1985). Taylor and Francis.
2. Illustrated Laboratory Manual of Parasitology. R. M. Cable. (1983). Burgess Publ. Co. Miniapolis, New York, San Francisco, London.
3. Parasitology of Fishes. V. A. Dogiel. (1962). G. K. Pet Rushevsky and T. L. Polyansky (editors). Oliver and Boyd. Edinburgh and London.
4. Parasitology of Fishes. Markov. G. S. (1961). Oliver and Boyd, Edinburgh and London.
5. Parasitology of Fishes (Ecology of the parasites of freshwater fishes). V. A. Dogiel (1961). Oliver and Boyd, Edinburgh and London.
6. Advance in Parasitology, Vol. 2 and 3, Edited by: B. Dawes, New York Academic Press.
7. Ecological Aspects of Parasitology. C. R. Kennedy (1973). North Holland, Oxford.

Practical and Viva-voce Courses

FHP-2311: Practical and Viva-voce on Fisheries Systematics

Credit-1

Full marks: 100 (Class record: 10; Practical: 60 +Viva-voce: 20+ Attendance: 10)

1. Study of Descriptive characteristics in fishes.
2. Study of morphometrics and meristics characteristics in fishes.
3. Study of taxonomic collection and preservation, of fisheries specimen.
4. Study of curation and cataloguing of collected specimen.
5. Photographical taxonomic key preparation.

FHP-2312: Practical and Viva-voce on Molecular Biology and Histology

Credit-1

Full marks: 100 (Class record: 10; Practical: 60 +Viva-voce: 20+ Attendance: 10)

1. Identification and operation of hatchery equipments. Preparation of metaphasic chromosome.
2. Histological techniques.
3. Study of the permanent slide preparation of fish tissue.
4. Preparation of temporary slide of placoid scale.
5. Identification of permanent histological slides of fishes.

FHP-2313: Practical and Viva-voce on Fish Behaviour

Credit-1

Full marks: 100 (Class record: 10; Practical: 60 +Viva-voce: 20+ Attendance: 10)

1. Study of different types and stages of reproductive behaviour and parental care found in fishes.
2. Study of Feeding behaviour with special relationship to morphological adaptation of feeding organs found in fishes.
3. Observations on respiratory behaviour of air breathing and non air breathing fishes.
4. Observations on responses of fishes to different physical and chemical stimuli.

FHP-2314: Practical and Viva-voce on Physico-chemical Limnology

Credit-1

Full marks: 100 (Class record: 10; Practical: 60 +Viva-voce: 20+ Attendance: 10)

1. Studies of waterbody morphology: ponds, lakes, river etc.
2. Method for determining area and volume of ponds, lakes and reservoirs.
3. Recording of temperature, turbidity, transparency, colour, light penetration and flow of different waterbodies.
4. Methods of sampling bottom soil, determination of pH, moisture content, organic carbon and total nitrogen.
5. Chemical analysis of dissolved oxygen, free CO₂, pH, alkalinity, total hardness, phosphate, nitrate, nitrite, ammonia, calcium, iron, silica and salinity of different water bodies.
6. Field visits and reports writing on limnological study of beels, haors, baors, river, strimes etc.

FHP-2315: Practical and Viva-voce on Fish Physiology

Credit-1

Full marks: 100 (Class record: 10; Practical: 60 +Viva-voce: 20+ Attendance: 10)

1. Age and growth estimation using hard-part analysis and length-frequency analysis
2. Preparation of blood smears (preparation and microscopic study).
3. Microscopic study of fish ovum and sperm.
4. Study of maturation stages of gonads in different size of fishes, GLI and GSI.
5. Collection and preparation of PG extract for induced breeding of fishes.
6. A comparative study on the digestive tracts of fishes having different food habit.
7. Studies of food habit of fishes by gut content analysis.
8. Measurement of oxygen consumption rate under different metabolic levels.
9. Collection and preparation of Weberian ossicle for necessity in air bladder respiration of fishes.

FHP-2316: Practical and Viva-voce on Fish Nutrition-I

Credit-1

Full marks: 100 (Class record: 10; Practical: 60 +Viva-voce: 20+ Attendance: 10)

1. Methods of sampling and preparation of sample for analysis.
2. Introduction to nutritional laboratory equipments and safety procedure.
3. Proximate analysis of carcass feed ingredients and compounded feed samples: moisture and lipid,

4. Study of Nutritional parameters.
5. Estimation of calorific value of various food stuffs by Bomb Calorimetry.
6. Study of nutritional disorders in fishes.

FHP-2317: Practical and Viva-voce on Fish Parasitology

Credit-1

Full marks: 100 (Class record: 10; Practical: 60 +Viva-voce: 20+ Attendance: 10)

1. Techniques of investigation of fish for collecting parasites
2. Techniques of fixation and preservation of fish parasites
3. Study of some pathogenic fish parasites
4. Collection and identification of parasites from infected fish specimens
5. Quantitative study of fish parasites

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Theoretical Courses

FHT-2401: Biological Limnology

Credits: 2

Full Marks: 100 (Theory 70, Class Test 20 and Attendance 10)

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

Course Objectives:

The basic objective of this course is to understand biological features, productivity and pollution status of inland waterbodies.

Course Contents:

1. **Introduction:** Definition of limnology and biological limnology, types of aquatic organisms, general classification of plankton.
2. **Phytoplankton:** Definition, major groups, growth factors, seasonal succession, association, eutrophication, phytoplankton bloom, toxic and noxious phytoplankton.
3. **Zooplankton:** Definition, major groups, life cycle, cyclomorphosis, food and feeding habit, abundance, distribution and vertical migration.
4. **Benthos:** Definition, major groups, factors affecting the abundance and distribution, role in aquatic environment.
5. **Algal Toxins in Pond Aquaculture:** Harmful algal bloom (HAB), Cyanobacterial ecology and toxins, Prymnesiophytes ecology and toxins, Euglena ecology and toxins in aquaculture pond.
6. **Periphyton:** Definition, major groups, significance in ecosystem.
7. **Aquatic plants:** Definition, types, significance, aesthetic and economic value.
8. **Ecological interaction and interrelationship:** Interrelationship between phytoplankton and zooplankton; interrelationship among phytoplankton, zooplankton and fish; interrelationship between benthos and fish, aquatic vascular plant and fish, plankton and benthos, bacteria and diatoms.

Recommended books/ literatures:

1. Text Book of Limnology, G. A. Cole (1979), The Mosby Co., London.
2. Limnology, C. R. Goldman and A. J. Horne (1983), McGraw Hill Book Co.
3. A Treatise on Limnology vol. I and II, G. E. Hutchinson (1975), John Wiley and Sons, New York.
4. Limnology, P. S. Welch (1952), McGraw Hill Book Co.
5. Limnology, R. G. Wetzel (1983), Saunders College Publ., Philadelphia, USA.
6. Fundamentals of Limnology (3rd edn), Franz Ruttner (1970), Walter de Gruyter & Co., Berlin.

FHT-2402: Freshwater Aquaculture

Credits: 2

Full Marks: 100 (Theory 70, Class Test 20 and Attendance 10)

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

Course Objectives:

To provide students with the knowledge of practices, problems and solutions in freshwater aquaculture.

Course Contents:

1. **Land based aquaculture:** culture of carps, catfishes, tilapias, thaipunti, pangas, prawns, cuchia and crabs.
2. **Water based aquaculture:** cage culture and pen culture.
3. **Integrated fish farming:** definition, principle, types and practices of integrated fish farming, waste fed aquaculture.
4. **Aquarium based aquaculture:** Types, structure and management of aquarium; culture of ornamental fishes in aquarium.
5. Common problems and their solutions to pond based aquaculture.
6. **Good Aquaculture Practices:** concept, principles and practices.

Recommended books/ literatures:

1. Integrated fish Farming System Holds Promise in Bangladesh, A. K. M. Nuruzzaman (1991), Two Sisters.
2. Water Quality Management in Aquaculture, M. S. Rahman (1992), BRAC Prokashana.
3. A Manual of Freshwater Aquaculture, R. Santhanam, N. Sukumaran and P. Natarajan (1987), Oxford and IBH Publishing Co. Pvt. Ltd., New Delhi, Bombay, Calcutta.
4. Fish and Fisheries of India. V. G. Jhingran (1988). Hindustan Publ. Corp. Delhi.
5. Text Book of Fish Culture Breeding and Cultivation of Fish, Marcel Huet (1972), Fishing News Books Ltd., Farnham, Surrey, England.
6. Fisheries Resources and Opportunities in Freshwater Fish Culture in Bangladesh, M. Ameen, (1987), PAT, NRD-II/Danida, Noakhali, Bangladesh.
7. Warm Water Fish Pond, Boyd.
8. Aquaculture Management by James W. Meade (1998). CBS Publishers, India.

FHT-2403: Fish Food Chemistry

Credits: 2

Full Marks: 100 (Theory 70, Class Test 20 and Attendance 10)

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

Course Objectives:

The objective of the course is to equip the students on chemistry of fish food products including the chemical composition, nutritive value, nature and characteristics of different chemical components of fish and shellfish which ultimately determine the food quality, processability and shelf life of fish or shellfish products.

Course contents:

1. Physical structure and properties of fish and shellfish muscles. Chemical composition of fish and shellfish. Role of body constituents in governing fish quality and processability.
2. Post-mortem changes in fish: degradation of organic phosphates and carbohydrates, role of pH, rigor-mortis in fish.
3. Protein in fish: Protein content, protein groups, nutritive value, denaturation and spoilage of protein, stability of muscle proteins under various conditions, gelation properties of fish muscle proteins, changes of protein during processing and preservation of fish and shellfish.
4. Lipid in fish: Lipid types and their variations, polyunsaturated fatty acids, essential fatty acids, denaturation and rancidity of seafood lipid, convenience food and modern diet.
5. Macro and trace elements in fish and shellfish: Inorganic matter in fish and shellfish, effect of processing and preservation on mineral composition.
6. Vitamins in fish: Fat- and water-soluble vitamins, vitamin content in small fish, farmed fish and marine fish, effect of processing and preservation on vitamin content.
7. Flavour compounds of seafood: Nitrogenous and volatile compounds.
8. Marine bio-toxins: Introduction, toxin in marine vertebrates, invertebrates, seaweed and plankton.

Recommended books/ literatures:

1. Fish as food. vol. I-IV. G. Borgstrom (editor) (1965). Academic press, London.
2. Food Chemistry, Edited by H.-D. Belitz · W. Grosch · P. Schieberle. 4th revised and extended ed. 2009. Springer-Verlag Berlin Heidelberg, 617-639.
1. Fish Processing Technology, Hall, G. M. 1997 (ed.). 2nd Edition. Blackie Academic & Professional, London, Weinheim, New York, Melbourne, Madras. 309 pp.
2. Quality assurance in Fish Industry. In Development in Food Science, Huss, H. H., M. Jakobsen and J. Liston. 1992. Elsevier, Amsterdam, London, New York, Tokyo. 587 pp.
3. Fish and Fishery Products: composition, nutritive properties and stability, Ruiter, A. 1995. Cab International, Oxon, UK. 387 pp.
4. Post-harvest Technology of Fish and Fish Products. Balachandran, K. K. 2001. Daya Publishing House, Delhi – 110035. India. 440 pp.
5. Textbook of Fish Processing Technology, Gopakumar, K. 2002 (ed.). Indian Council of Agricultural Research, New Delhi.

6. Safety and quality issues in fish processing, Edited by H. Allan Bremner. 2002, Woodhead Publishing Limited and CRC Press LLC

FHT-2404: Fishing Technology

Credits: 2

Full Marks: 100 (Theory 70, Class Test 20 and Attendance 10)

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

Objectives

To provide students with the knowledge of fishing gears and crafts as well as fishing techniques in all types of water bodies.

Course Contents:

1. **Introduction:** Principles and theories of fishing; modern trends in fishing, fishing regulations, types of fishing (industrial fishing, successful and unsuccessful fishing, responsible fishing, sports fishing, pelagic fishing, mesopelagic fishing, benthic fishing), fishing equipment other than nets (lamps, light, pumps etc.).
2. **Fishing gears:** Classification, materials, terminology, numbering systems, characteristics of fishing twines, relative efficiencies of nets of different materials, preservation of net, net weaving and mending, knotless nets.
3. **Fishing gears and their operation:** Trawling gears, seine nets, purse seine net, gill nets, trammel net, hooks and lines.
4. **Manipulation of fish behaviour:** Fish response to stimuli; attraction and concentration (baits and ground baits); frightening by artificial lures, light and sound.
5. **Fishery reconnaissance:** Location and detection of fish and shellfish, plankton monitoring, hydrographic observation, fishing crafts, Eco-sounding, infrared photography, SONAR, fish finder, low light television, laser application, satellite investigation.
6. **Fishing grounds:** Fish migration and fishing. Pattern of a typical fishing ground. Selection of fishing grounds. Fish detection and luring methods. Exploitation of fishing grounds and their maintenance. Fishing grounds in the Bay of Bengal.
7. **Aquaculture harvesting systems:** Fishing techniques, pond draining, drying, trapping, cast netting etc.
8. **Methods of harvesting:** Demersal, Pelagic, shrimp harvesting; narcotising fishing, electrofishing, chemical fishing, without gears fishing, present status of fishing, problems of trash fishes.
9. **Fishing crafts:** Classification, common and technical terms for various parts of fishing craft, materials, Traditional and mechanized crafts of Bangladesh.

Recommended books/ literatures:

1. Fish Catching Methods of the World (3rd edn). A. V. Brandt (1984). Fishing News (Books) Ltd. Surrey, England.
2. Modern Fishing Gears of the World. Vol. I-III. H. Kristyonsson (ed) (1962). Fishing News Books Ltd. London.
3. How to make and set nets. E. Garner (1962). Fishing News Books Ltd. London.
4. On Testing the Freshness of Frozen Fish. G. J. A. Peter (ed.) (1971). Fishing News Books Ltd. London.
5. Harvest and Post-harvest Technology of Fish. Rabindran (ed) (1985). Soc. Fish. Technol. India.
6. Industrial Fishery Technology. M. E. (1963). Reinhold Publ. Corp. New York.
7. Commercial Fishing Methods and Introduction to Vessels and Gears. J. C. Sainsbury (1975). Fishing News (Books) Ltd. London.

FHT-2405: Fish Nutrition-II

Credits: 2

Full Marks: 100 (Theory 70, Class Test 20 and Attendance 10)

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

Course Objectives:

To provide the knowledge of the fish nutrition concerning the energy metabolism, brood stock nutrition, nutritional disorders, digestion, digestibility, larval nutrition and growth of fish, crustacean and mollusk.

Course Contents:

1. Energy metabolism in cultivated fishes and crustaceans: units of measurement and definition of terms, partitioning of biological energy, energy flow in animal system, specific dynamic action (SDA), energy metabolism in fish, energy requirement of fish, factors effecting energy requirement of fish, dietary energy sources.
2. Broodstock nutrition: energy partitioning for reproduction, protein requirement of broodstock, effect of dietary quality on reproductive output, known nutritional requirements of some broodstock fishes.
3. Digestion of feed: General anatomy and organ physiology, definition of digestion, digestive fluids and enzymes, protein digestion, fat digestion, carbohydrate digestion, microbial digestion.
4. Rate of digestion, factors affecting rate of digestion in fish, absorption.
5. Larval nutrition and growth of fish, nutrient requirement of larvae, feeding behaviour and its role in larval nutrition.

6. Digestibility in fish, determination of digestibility, Markers, Factors influencing digestibility.
7. Nutrition and fish quality.

Recommended books/ literatures:

1. Fish Nutrition(2nd edn.). J. E. Halver (1989). Academic Press Inc. New York.
2. Nutrition of Pond Fishes. B. Hephher (1988). Cambridge University Press.
3. Principles of Fish Nutrition. W. Steffers (1989). Ellis Horwood Ltd. John Wiley and Sons. New York.
4. Backyard Fish Farming. P. Bryant, K. Jauncey and T. Atack (1982). Frism Press. Stable Court. Dorchester, England.
5. Finfish Nutrition and Fish Feed Technology. vol. I and II. J. E. Halver and K. Tiews (editors) (1979). NeenemannGmbh and Co. Berlin.
6. Nutrient Requirement of Warm Water Fishes and Shellfishes. National Research Council (1988). National Academy of Sciences; Washington DC.
7. Energetics: New Perspectives. P. Tytler and P. Calow (editors) (1985). 8. Croom Helm. London.
8. Fish Nutrition in Asia. ICLARM.
9. Applied Nutrition by D. V. Reddy (2006). Vijay Primlani for Oxford of IBH Publishing Co. Pvt. New Delhi.
10. Fish is Nutrition. E. Heen and R. Krenzer (1962). Fishing News (Books) Ltd. London.

FHT-2406: Biostatistics

Credits: 2

Full Marks: 100 (Theory 70, Class Test 20 and Attendance 10)

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

Objectives

To provide students with the knowledge of statistics type and its scope, population and sample, variance and data, central tendency and its measures, probability, sampling, correlation and regression, and test of hypothesis.

Course Contents:

1. Definition and scope of statistics, discrete and continuous variables, classification, construction of frequency distribution and graphical representation of data.
2. Central tendency and its measures- mean, median, mode, quartile; dispersion and its measures, moments, skewness and kurtosis.
3. Elementary theory of probability, laws of probability, additive and multiplicative laws of probability and Bay's theorem, random variables, probability distribution, derivation; properties and uses of Binomial, Poisson and Normal distributions, Binomial, Poisson and Normal distribution of observed data.
4. The concept of statistical populations and samples, preliminary idea on sampling methods; definition and use of standardized normal variate, sampling and non-sampling errors.
5. Correlation and Regression: Simple correlation, linear regression, useful theorem in correlation and regression, relationship between co-efficient of correlation and regression co-efficients, residual error, standard error of regression co-efficient.
6. Tests of hypothesis (type I and type II), errors and level of significance, t-test, F-test, chi-square test and their applications; testing of hypothesis regarding population mean, equality of two means, population variation, equality of two population variances, goodness of fit and independence of two attributes in a contingency table, test of significance of correlation coefficient and regression coefficient.

Recommended books/ literatures:

1. Introduction to Biostatistics. H. Bancroft (1957). Hoeber-Herper. New York.
2. Statistical Methods and Scientific Inference. R. A. Fisher (1956). Oliver, Edinberg.
3. Regression Analysis by Example. S. Chatterjee and B. Price (1977). John Wiley, New York.
4. Introduction to Probability and Statistics. (6th edn). H. Alder (1977). San Francism, Freeman.
5. Biostatistics, An Introductory Text. A. Goldstein (1968). MacMillan, New York.
6. Biostatistics. A. Lewis (1971). East West Press, New Delhi.
7. Methods of Statistics. 2nd edn. M. G. Mostafa. Anwari Publ. Dhaka.
8. An Introduction to the Theory of Statistics. 2nd edn. K. N. Shil and S. C. Debnath (1992), 385, Sirajuddowalla Rd. Chittagong.
9. Principles and Procedures of Statistics. G. D. Steel and J. H. Torric (1960). MacGraw Hill Book Co. Inc. New York.

10. An Introduction to the Theory of Statistics. G. U. Yule and M. G. Kendall (1965). Charles Griffin, London.
11. Biostatistical Analysis. J. H. Zar (1999). Prentice and Hall Inc. Englewood Cliffs, New Jersey.
12. Statistical Procedures for Agricultural Research. K. Gomez and A. A. Gomez (1984). 2nd edn. John Wiley and Sons. Inc. New York.
13. Fundamentals of Statistical Theory Vol. I. 2,3. A. M. Goon, M. K. Gupta and D. Gupta (1979). World Press Pvt. Ltd. Calcutta, India.
14. Methods of Statistical Analysis. G. H. Goulden (1952). John Wiley, New York.
15. Elementary Statistics. 2nd edn. R. R. Johnson (1976). Duxberg Press, Massachusetts.

FHT-2407: Aquatic Pollution and Toxicology

Credits: 2

Full Marks: 100 (Theory 70, Class Test 20 and Attendance 10)

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

Course Objectives:

To provide the students with knowledge on aquatic pollution, their sources, impact and mitigation measures.

Course contents:

1. Aquatic environment and pollution: Key concepts, importance of aquatic environmental maintenance, sensitivity of aquatic biota on environmental changes (DO, pH, NH₃ & NO₂, harmful gases, turbidity, salinity), aquatic pollution, sources of pollution, impacts of pollution on aquatic plants, animals and human health.
2. Agricultural development and pollution: Trends in agricultural development and HYV, inputs used in agriculture (fertilizers, insecticides & pesticides), pollution due to agricultural wastes and pesticides, impacts on aquatic resources.
3. Industrial development and pollution: Types of industries, location, raw materials used, sources and types of industrial byproducts and pollution, toxic effects of pollutants from tannery, pharmaceutical, dyeing and textiles, fertilizers, and chemical industries on freshwater and marine ecosystems.
4. Aquaculture development and environment: Culture practices and related problems, land and water use, materials and inputs used (feeds, fertilizers, chemicals and therapeutics), nutrient accumulation and eutrophication, drainage effect on the adjacent areas and water bodies, loss of natural habitats - mangroves, agricultural lands, livestock pastures etc., suggestions for sustainable growth of aquaculture industries.
5. Algal toxins: Toxic algal blooms, ecological implications of algal toxins in aquatic food webs, mode of action of toxins in seafood poisoning, Paralytic Shellfish poisoning (PSP), Diarrhetic Shellfish Poisoning (DSP), *Ciguatera* Fish Poisoning
6. (CFP), *P. fisteria* toxin, domoic acid, links between algal toxin, biological changes and productivity, control strategies.

7. Coastal and marine environment degradation: Causes and nature of degradation of coastal and marine environment (urbanization, tourisms, shrimp farming, sewages, municipal wastes, disposal of solid wastes, industrial wastes, ship breaking activities, oil spillage etc.), impact on coastal and marine fisheries, measures for maintenance of coastal and marine environment for all living organisms.

Recommended books/ literatures:

1. Alabaster, J. S. and R. Lloyd. 1982. Water Quality Criteria for Freshwater Fish. 2nd Ed. Butterfly Scientific Publisher, London. 361 pp.
2. Lloyd, R. 1992. Pollution and Freshwater Fish. Fishing News Books, Oxford, UD. 176 pp.
3. Moriarty, F. 1993. Ecotoxicology: The Study of Pollutants in Ecosystems. Second Edition. T. J. Press (Padstow) Ltd., Padstow, Cornwall, Great Britain. 289 pp.
4. Boyd, C. E. 1988. Water Quality Management for Pond Fish Culture. Elsevier Scientific Publisher B. V., Amsterdam. 318 pp.
5. Calhoun, Y. 2005. Water Pollution. Chelsea House Publishers. 164 pp.
6. Calow, P. 1993 (ed.) Handbook of Ecotoxicology. Volume One. T.J. Press (Padstow) Ltd., Padstow, Cornwall, Great Britain. 289 pp.
7. Carmichael, W. W. 1981 (ed.). The Water Environment: Algal Toxins and Health. Plenum Press. New York. 491 pp.
8. Chorus, I. 2001 (ed.). Cyanotoxins – Occurrence, Causes, Consequences. Springer. 357 pp.
9. Falconer, I. R. 1993. Algal Toxins in Sea Food and Drinking Water. Academic Press. 224 pp.
10. Laws, E. A. 2000. Aquatic Pollution: An Introductory Text. 3rd Ed. Wiley. 639 pp.
11. Saxena, M. M. 1990. Environmental Analysis: Water, Soil and Air. Second Edition. Agro Botanical Publishers (India). 186 pp.
12. Smol, S. 2005. Pollution of Lakes and Rivers. A Hodder Arnold Publication.
13. Ulrich, F. 1981. Metal Pollution in the Aquatic Environment. Springer Verlag.

FHT-2408: Aquatic Biodiversity and Conservation

Credits: 2

Full Marks: 100 (Theory 70, Class Test 20 and Attendance 10)

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

Course Objectives:

To understand the values of different component of biodiversity for conservation of aquatic resources.

Course Contents:

1. Fisheries Biodiversity: Definition, value of fish biodiversity; types of fisheries biodiversity.
2. Species diversity: concept, zoogeographical distribution of fishes, fishes of Bangladesh
3. Genetic diversity: Genetic variation and population structure: Heterozygosity; Genetic variation within populations; Genetic variation between populations; Gene and genotype frequency; Hardy-Weinberg equilibrium; Population differentiations (F_{st}); Effective breeding number (N_e); Quantification of genetic variation: Polymerase chain reaction (PCR); Protein Electrophoresis; Restriction fragment length polymorphism (RFLP); Amplified fragment length polymorphism (AFLP); Random amplified polymorphic DNA (RAPD); mini and microsatellite VNTRs; applications of molecular markers in fisheries management
4. Habitat diversity: Environmental factors of fish habitat and biodiversity, fisheries hot spots of Bangladesh
5. Fisheries biodiversity at global and country level; red data book, red listed fish species and other fisheries items.
6. Causes for the loss of fisheries biodiversity: Effects of environmental degradation on fisheries biodiversity; Effects of species introduction in the aquatic environments; Impact of aquaculture and hatcheries on wild fisheries.
7. Effects of inbreeding, genetic drift, founder effects and bottleneck and hybridization and gene introgression on fish populations: methods of detection; genetic interpretation of inbred and hybridized populations.
8. Management and conservation of species, population and genetic diversity: methods and strategies of fisheries biodiversity conservation; Genetical conservation of exploited fishes; Returning local fish biodiversity; Bangladesh perspectives.

Recommended books/ literatures:

1. Gaston, K. J. and J. I. Spicer. 1998. Biodiversity - An Introduction. Wiley-Blackwell. 133 pp.
2. Helfman, G. E., B. B. Collette, D. E. Facey and B. W. Bowen. 2009. The Diversity of Fishes. Wiley-Blackwell. 736 pp.
3. Patro, L. R. 2010. Aquatic Biodiversity, Discovery Publishing House Pvt. Ltd. 216 pp.

Practical and Viva-voce Courses

FHP-2411: Practical and Viva-voce on Biological Limnology

Credit-1

Full marks: 100 (Class record: 10; Practical: 60 +Viva-voce: 20+ Attendance: 10)

1. Qualitative and quantitative study of phytoplankton, zooplankton, benthos.
2. Estimation of chlorophyll-*a* content.
3. Qualitative study of periphyton and higher aquatic plants.

FHP-2412: Practical and Viva-voce on Freshwater Aquaculture

Credit-1

Full marks: 100 (Class record: 10; Practical: 60 +Viva-voce: 20+ Attendance: 10)

1. Study of growth performances in aquaculture pond.
2. Study of feed performance in aquaculture pond.
3. Method demonstration on aquarium-based aquaculture
4. Case study on land-based aquaculture.
5. Case study on water-based aquaculture.
6. Measurements of different aquaculture inputs applied in fish pond, FCR.
7. Test for natural food production.
8. Method demonstration of liming, fertilization, stocking and supplementary feeding.
9. Economics used in aquaculture such as CBR, BCR etc.
10. Field visit to different types of fish farming and report writing.

FHP-2413: Practical and Viva-voce on Fish Food Chemistry

Credit-1

Full marks: 100 (Class record: 10; Practical: 60 +Viva-voce: 20+ Attendance: 10)

1. Determination of major components of fish flesh.
2. Study of post-mortem changes in fish and nature of spoilage.
3. Study of proximate composition of fish: moisture, ash, crude lipid and crude protein.
4. Extraction of actomyosin from fish muscle and determination of protein by Biuret method.
5. Determination of non-protein nitrogen in fish.
6. Study of marine bio-toxins.

FHP-2414: Practical and Viva-voce on Fishing Technology

Credit-1

Full marks: 100 (Class record: 10; Practical: 60 +Viva-voce: 20+ Attendance: 10)

1. Identification of fishing gears and its materials: traps, nets, hooks, spear etc.
2. Identification of crafts: different types of boats, trowels, vassals etc. (Hooks, nets and other) of Bangladesh.
3. Study of net materials, marketing and mending of nets, techniques of net preservation.
4. Field visit to observe operation of fishing gears and craft.

FHP-2415: Practical and Viva-voce on Fish Nutrition-II

Credit-1

Full marks: 100 (Class record: 10; Practical: 60 +Viva-voce: 20+ Attendance: 10)

1. Methods of sampling and preparation of sample for analysis.
2. Proximate analysis of carcass feed ingredients and compounded feed samples: protein, ash and Crude fibre.
3. Digestibility studies of protein, lipid and carbohydrate using various external dietary markers such as, chromic oxide, silica, cellulose, etc.
4. Techniques of collection of faecal materials.
5. Estimation of calorific value of various food stuffs by Bomb Calorimetry.
6. Study of nutritional disorders in fishes.

FHP-2416: Practical and Viva-voce on Biostatistics

Credit-1

Full marks: 100 (Class record: 10; Practical: 60 +Viva-voce: 20+Attendance: 10)

1. Frequency table construction and graphical representation of data; calculation of nations measures of central tendency and dispersion.
2. Fitting binomial and coastal distribution to observed data and use of standardized normal variable.
3. Calculation of correlation coefficient and fitting simple linear regression to observed data.
4. Testing hypothesis regarding population mean; testing significance of simple correlation coefficient and regression coefficient (S); use of chi-square for testing goodness of fit and test of independence of attributes in a contingency table.
5. Field layout analysis of variance and interpretation of data collected in completely randomized design randomized block design and Latin square design.

FHP-2417: Practical and Viva-voce on Aquatic pollution and toxicology

Credit-1

Full marks: 100 (Class record: 10; Practical: 60 +Viva-voce: 20+ Attendance: 10)

1. Identification of water contaminants.
2. Monitoring techniques and modeling systems for impact prediction.
3. Case study of water pollution.
4. Identification of heavy metals in polluted water and fish samples.
5. Techniques for waste treatments.

FHP-2418: Practical and Viva-voce on Aquatic Biodiversity and Conservation

Credit-1

Full marks: 100 (Class record: 10; Practical: 60 +Viva-voce: 20+Attendance: 10)

1. Study of threatened fishes of Bangladesh.
2. Study of conservation techniques for fish biodiversity.
3. Fish biodiversity conservation strategies of Bangladesh.
4. Field visit and report writing on biodiversity conservation activities.

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Theoretical Courses

FHT-3501: Fish Population Dynamics

Credits: 2

Full Marks: 100 (Theory 70, Class Test 20 and Attendance 10)

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

Course Objectives:

To provide knowledge to the students on population parameters, size relationship and condition factors.

Course Contents:

1. Introduction: Importance and definition of different terminologies, salient features of population.
2. Distribution and abundance: Distribution types, factors affecting distributions, relative abundance, absolute abundance of fish populations and their estimations
3. Size relationships and gear selectivity: Linear regression, length-length and length-weight relationships, and condition of fish populations; gear selectivity by covered codend & alternate haul experiments, gill net selectivity
4. Growth: Definition and types, acquaintance with different growth models; Procedures for estimating the parameters of the von Bertalanffy growth curve using data from length-frequency analysis, hard part analysis, mark-recapture experiment, and graphical & computer-based analyses
5. Reproduction: Definition, timing of reproduction, length & age at sexual maturity, frequency of spawning, semelparity & iteroparity, fecundity
6. Recruitment: Definition, timing of recruitment, length & age at recruitment, factors affecting recruitment and stock-recruitment relationships
7. Mortality: Factors causing mortality, concept of mortality equation; estimation of fishing mortality by age-based & length-based catch curves, Beverton & Holt equations, and Weatherall plots; natural mortality and its estimation
8. Migration: Definition, Causes of migration, types of migration, migratory circuit of fishes, migration of some important commercially important fishes (Hilsha, herring, cod etc.)
9. Marking and tagging: Definition, types, materials and duration of tags and marks, principles and techniques of tagging and marking.
10. Life history patterns: Species life history strategy and its environment, effects related to stock density, concept of r- and k- selection of species, Bet-hedging

Recommended books/ literatures:

1. Cushing, D.H., 1968. Fisheries Biology: A study in population dynamics. Univ. Wisconsin, Madison, USA. 200 pp.
2. Cushing, D.H., 1977. Science and the Fisheries. Edward Arnold Publishers Ltd. 25, Hill Street, London W1X 8LL. 60 pp.
3. Dwiponggo, A., 1986. Growth, mortality and recruitment of commercially important fishes and penaeid shrimps in Indonesian waters. Filipiniana Specialist, Manila. 91 pp. FAO. 2001. Yearbook of fishery. Statistics of catches and landings.
4. Gulland, J.A. (ed.), 1983. Fish Stock Assessment: A Manual of Basic Methods. Chichester, U.K., Wiley Interscience, FAO/Wiley series on food and agriculture, Vol. 1. 223 pp.
5. Gulland, J.A. (ed.), 1988. Fish Population Dynamics. Second edition. John Wiley & Sons, Inc., New York.
6. King, M., 1995. Fisheries Biology, Assessment and Management. Fishing News Books, 342 p.
7. Lagler, K.F., 1956. Freshwater Biology, Second edition, William C. Brown Co. Dubuque, Iowa. 421 pp.
8. Nielsen, L.A., 1992. Method of Marking Fish and Shellfish. American Fish. Soc., Special Publication 23, 208 p.
9. Nikolskii, G.V., 1982. Theory of fish population dynamics. Bishen Singh, Mahendra Pal Singh and Otto Koeltz, Sci. Publishers, 323 pp.
10. Parker, N.C., Albert, E.G., Roy, C.H., Douglas, Jr.J.B., Eric, D.P. and Gary, A.W., 1990. Fish Marking Techniques. Amer. Fish. Soc. Symp.-7, 876 pp.
11. Pauly, D., 1984. Fish population dynamics in tropical waters. A manual for use with programmable calculators. ICLARM, Manila, 325 p.
12. Ricker, W.E., 1968. Methods of assessment of fish production in freshwaters. Blackwell Scientific Publications, Oxford, 321 pp.
13. Ricker, W.E., 1975. Computation and interpretation of biological statistics of fish populations. Bull. Fish. Res. Board Can. 191: 382 p.
14. Solomon, M.E. 1976. Population dynamics. Second edition, Arnold (Publishers) Ltd. 67 p.
15. Rounsefell, G.A. and Everhart, W.H., 1953. Fishery Science: Its methods and application. John Wiley & Sons, Inc., New York. 444 pp.
16. Sparre, P., Ursin, E. and Venema, S.C., 1989. Introduction to tropical fish stock assessment. Part 1. Manual. FAO Fisheries Technical Paper. No. 306.1. Rome, FAO. 337 p.
17. Sparre, P., Ursin, E. and Venema, S.C., 1989. Introduction to tropical fish stock assessment. Part 2. Exercises. FAO Fisheries Technical Paper. No. 306.2. Rome, FAO. 429 p.

FHT-3502: Coastal Aquaculture and Mariculture

Credits: 2

Full Marks: 100 (Theory 70, Class Test 20 and Attendance 10)

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

Course Objectives:

To provide students with the knowledge of practices, problems and solutions in coastal and marine aquaculture.

Course Contents:

1. **Introduction:** Definition, present status and problems of coastal aquaculture and mariculture in Bangladesh.
2. **Coastal aquaculture practices:** Open, semi closed, closed, polder culture and new approaches.
3. **Site selection, design and construction** of culture facilities in shore areas; various farming techniques (intertidal, sub-tidal, pens, floating cages, etc.); breeding and larval rearing of marine fin fishes, prawns and other marine organisms.
4. **Culture techniques** of marine fishes (mullet, seabass, milk fish etc.), shrimps and prawns, crabs, mussels, clams, oysters, abalone, scallop, squid, green turtle and sea-weeds.
5. **Mangrove fisheries:** Mangrove ecosystem; energy flow in mangrove swamp; impact of deforestation; prospects of fisheries and fish culture in mangrove areas.
6. **Pearl culture:** Life cycle of pearl oyster, techniques of pearl culture.
7. **Mariculture techniques:** Cage culture, rope culture etc.

Recommended books/ literatures:

1. Aquaculture in Shallow seas: Progress in Shallow Sea Culture, T. Imai (1977), Oxford IBH Publ. Co., New Delhi, Bombay, Calcutta.
2. Aquaculture, J. E. Bardach, J. H. Ryther and W. O. Mclarney (1972), John Wiley and Sons. Inc., New York.
3. Coastal Aquaculture in the Indo-Pacific Region, T. V. R. Pillay (1973), Fishing News (Books) Ltd., London.
4. Coastal Environment and Shrimp Cultivation, A. K. M. Nuruzzaman (1993), BARC Farmgate, Dhaka.
5. CRC Hand Book of Mariculture, Vol. 1: Crustacean Aquaculture, J. McVey, J. Moore (1983).
6. CRC Hand Book of Mariculture, Vol. II: Finfish Aquaculture, J. McVey (1991).
7. Crustacean Farming, D. C. C. Lee and J. F. Wichins (1991), Oxford Fishing News Books/ Blackwell Sci. Publ. Ltd.
8. Prawn and Prawn Fisheries of India, C. V. Kurian and V. O. Sebastian (1976), Hindustan Publ. Co., New Delhi.

9. Problems in Prawn culture, K. Shigeno (1978), Amerind Publ. Co. Pvt. Ltd., New Delhi.
10. Recent Advances in Aquaculture, Vol. 1, J. F. Muir and R. J. Roberts (eds) (1982), Croom Helm, London.
11. Recent Advances in Aquaculture, Vol. 2, J. F. Muir and R. J. Roberts (1985), Beckenham U. J. Croom Helm, London.
12. Recent Advances in Aquaculture, Vol. 3, J. F. Muir and R. J. Roberts (1988), Croom Helm, London.

FHT-3503: Fish Hatchery Management

Credits: 2

Full Marks: 100 (Theory 70, Class Test 20 and Attendance 10)

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

Course Objectives:

To provide students with a complete knowledge on hatchery techniques and management. The course will be exposed to learn the methods of artificial breeding techniques of fish and management of brood and fry during handling and transportation.

Course Contents:

1. **Introduction:** Definition, scope and importance of fish hatcheries; present status and existing problems in Bangladesh.
2. **Hatchery components:** Structural features, incubators, essential components; water (supply, monitoring and treatment).
3. **Fish Breeding:** Natural and artificial breeding, history of Induced breeding, inducing agents and reproductive physiology.
4. **Hatchery techniques:** Baseline techniques for induced breeding (identification of mature fish, hormone treatment, natural and artificial spawning methods, control of spawning time, egg incubation, larval period and nursing, factors effecting egg development).
5. **Breeding techniques:** Fornative, Indian major carps, Chinese and common carps, catfishes and other commercially important fishes and shellfishes of Bangladesh.
6. **Brood stock management:** Pre-spawning, spawning and post-spawning management of broods.

Nursery and brood pond management:

7. **Pre-stocking management:** Eradication and control of aquatic weeds and algae, unwanted fishes, predatory insects; fertilization of pond.
8. **Stocking management:** Stocking of nursery ponds, rearing ponds and grow-out ponds; methods of stocking.
9. **Post-stocking management:** Feeding, periodic fertilization, pond environment monitoring, fish health and hazard monitoring.
10. **Transportation of live fry and fingerlings and adult fishes:** Equipment, water quality, handling, loading and stocking, shipping, use of anesthetics and antiseptics during transportation.

Recommended books/ literatures:

1. Text Book of Fish Culture: Breeding and Cultivation of Fish, M. Huet (1979). Chapter 1. Fishing News Books Ltd. Surrey, England.
2. Aquaculture Engineering. F. W. Wheaton (1987). Robert E. Krieger Pnbl., Florida.
3. Elementary Guide to Fish Culture in Nepal. E. Woynarovitch (1975). FAO, Rome.
4. Fish Culture. C. F. Hickling (1962). Faber and Faber, London.
5. A Hatchery Manual for the Common, Chinese and Indian Major Carps. V. G. Jhingran, R. S. V. Pullin (1985). Asian Development Bank and International Centre for Living Aquatic Resources Management, Manila, Philippines.
6. Shrimp Hatchery Manual, A. B. Al-Hajj and A. S. D. Farmer (1984). SafutKuwit Institute for Scientific Research 85p.
7. A Guide to Shrimp and Prawn Hatchery Techniques in Bangladesh. BAFRU (1990). BafRU/ Inst. of Aquaculture. Stirling, Scotland.
8. Marine Shrimp Culture: Principles and Practices. A. W. Fast and L. J. Lester (1992).
9. Proc. of the SAARC workshop on fish seed production- FRI. 11-12 June 1989.
10. Fish hatchery Management. R. G. Riper. I. B. McElwain. L. E. Orme, J. P. McCraren, L. G. Fowler and J. R. Leonard (1982). US Dept. of Interior Fish Wildlife Service, Washington D.C.
11. The Artificial Propagation of Warm water flit fishes manual for Extension. E. Waynarovich and L. Horvath (1980), FAO.
12. Fishery Science: Its methods and applications. G. A. Rounsefell and W. H. Everhart (1953). John Wiley and Sons. Inc. New York.
13. Prawn hatchery Design and Operation. E. T. Quinition (1989). SEAFDEC Aquaculture Ext. Man. (9): 47p. 2nd edn.

FHT-3504: Fish Pathology and Immunology

Credits: 2

Full Marks: 100 (Theory 70, Class Test 20 and Attendance 10)

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

Course Objectives:

The aims of this course are to develop knowledge of fish pathogen, interactions between fish and pathogen, fish defense mechanism/immunity and disease development.

Course contents:

1. **Introduction:** Definition and importance of fish pathology, definition and types of disease, factors responsible for disease, pathogen and its types, general symptoms and pathological changes of diseased fish, etiology and epizootiology.
2. **Stress:** Definition and symptoms of stress, factors responsible for stress, role of stress to produce disease, effect of stress on protective barriers.

3. **Infection mechanism:** Definition, categories, process of infection, host-pathogen interactions, host defenses.
4. **Pathogenicity and pathogenesis:** Concept and mechanism of microbial pathogenicity and pathogenesis
5. **Common diseases of fish and shrimp:** Common parasitic, fungal, bacterial, viral fish diseases; diseases caused by environmental, dietary and hereditary factors in fishes; common diseases of shrimp.
6. **Fish immunology:** Definition of immunology, definition and types of immunity, immune functions of blood cells (phagocytes, lymphocytes and thromocytes); non-specific immunity (physical barrier, chemical, humoral and cellular defense) and specific immunity (immune system and mechanism); antigen (definition, types, properties, antigenicity) and antibody (definition, types, functions and structure); immunization (definition, types and methods).

Recommended books/ literatures:

1. Fish Pathology (2nd edn.). R. J. Roberts (editor) (1989). Bailliers and Tindall, London.
2. Fish Diseases vol. 1 and 2. W. Schaperclaus (1991). Oxanion Press Pvt. Ltd. New Delhi, Calcutta.
3. Bacterial Pathogens; Diseases in Farmed and Wild Fish. B. Austin and D. A. Austin (1987). Ellis Horwood Ltd.
4. Text Book of Fish Diseases. E. Amlacher (1970). TFH Publication.
5. Bacterial and Viral Diseases of Fish. J. H. Cross (editor) (1983). Washington Sea Grant Publication.
6. Diseases of Fishes (1971). S. Sarig (Edited by- Dr. Stanislaus, F. Snieszko and Dr. Herbert R. Axelrod). T. F. H. Publications Inc. Ltd.
7. Identification of Fish Pathogenic Bacteria. G. L. Bullock (1980). TFH Publication.
8. Fish Defenses Vol. 1: Immunology. Editors: G. Zaccone, J. Meseguer, A. Garcia-Ayala and B.G. Kapoor (2017). CRC press.
9. Fish Immunology (1st Edition). Editors: M. J. Manning and M. F. Tatner (1985). Academic press.

FHT-3505: Oceanography

Credits: 2

Full Marks: 100 (Theory 70, Class Test 20 and Attendance 10)

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

Course Objectives:

The basic objective of this course is to understand different physical, chemical and biological characteristics and features of marine environment.

Course Contents:

1. **Introduction:** Definition of oceanography, ocean and sea; importance of the ocean and oceanography; history and study topics of oceanography; description of the world ocean; topography of the ocean bottom; marine environment (classification and description of major marine habitats).
2. International convention on sea, Exclusive economic zone (EEZ) of Bay of Bengal.
3. **Physico-chemical properties of sea water:** Temperature, light, salinity, dissolved gases and major nutrients.
4. **Marine pollution:** Definition and sources of marine pollution, pollution in coastal region and vulnerability to increasing pollution level, abatement or management of pollution.
5. **Oceanic sediment:** Definition, importance, sources, classification; transportation, distribution and arrangement of oceanic sediments; factors influencing marine sedimentation.
6. **Oceanic tides, waves and currents:** Definition, type and role of tide on marine organisms; definition, structure of wave, coastal upwelling and eddy diffusion; definition, role of current on marine organisms, factors influencing currents in the ocean.
7. **Marine food chain and webs:** Food chain and webs in marine ecosystem, marine fisheries food webs.
8. **Fisheries oceanography:** Definition of fisheries oceanography; utilization of oceanographic knowledge in locating new fishing grounds, identification and location of unused fishery resources, information for improving fishing tactics and fishery forecasting.

Recommended books/ literatures:

1. Climate and Fisheries. D. H. Cushing
2. Marine Climate, Weather and Fisheries. T. Laevastu.
3. Climatology. D.S. Lal.
4. Foundation of Climatology. E.T. Stringer.
5. An Introduction to physical oceanography. W. Von Arx.
6. Principles of oceanography. A. R. Davis.
7. Geochemistry of sediments. E. T. Degens.
8. Chemical Oceanography. R. Lange.

FHT-3506: Fish Processing - I

Credits: 2

Full Marks: 100 (Theory 70, Class Test 20 and Attendance 10)

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

Course Objectives:

To provide students with the knowledge of general principles of food preservation, commercial handling of fish and shellfish, value addition of wet fish and preservation by chilling and freezing.

Course Contents:

1. **Introduction:** General principles and methods of food preservation with special emphasis on fin fish and shellfishes. Post-harvest loss of fish at different stages from harvest, transportation, processing to marketing. Loss reduction.
2. **Commercial handling fish and shellfishes:** Good practices of handling of raw material, handling of fish on board and shore plant, temporary and bulk preservation and transportation.
3. **Chilling of fish:** Preservative effect and changes in fishes and shellfishes during chilling; chilling with ice; preservative ice, other methods of chilling; factors affecting the quality of fish and fin fish during chilling.
4. **Freezing:** Characteristics of refrigerated media and basic process of cold preservation, methods of freezing; factors affecting quality during processing and subsequent freezing. Freezing of shrimp/prawn in Bangladesh: exportable shrimps/prawns products, commercial freezing of prawn, semi IQF of whitefish, quality requirements of frozen shrimp. Storage of frozen shrimps.
5. **Value-addition of wet fish:** Skinning, beheading, gutting, dressed fish, fish chunk, fish fillet, mince, boned fish, boneless fish, fish steak, fish loins, shashimi, etc.
6. **Fish working premises:** Layout and design, equipment, staff hygiene, sanitation and cleaning: cold storage and processing plant.
7. **Packaging of fresh fish:** Modern packaging materials, wholesale packaging, traditional packaging, retail packaging, airfreight packaging.

Recommended books/ literatures:

1. Fish Processing Technology. T. K. Govinda (1985). Oxford and IBH Publi. Co., New Delhi.
2. Post-harvest Technology of Fish and Fish Products. Balachandran, K. K. 2001. Daya Publishing House, Delhi – 110035. India. 440 pp.
3. Fish Handling, Preservation and Processing in the Tropics. Part I and II. I. J. Clusas (editor). (1985). Tropical Development and Research Institute, London.
4. Processing of Aquatic Food Products. F. W. Wheaton and T. B. Lawson (1985). Wiley Inter Science, New York.
5. The Technology of Fish Utilization. K. Krenzer (1965). Fishing News (Books) Ltd. London.
6. The Freezing Preservation of Foods, Donald (editor). (1963). TheAviPubli. Co., Inc.
7. Preservation of Fish Products by Refrigeration. V. P. Zaitsev (1962). U. S. Department of Commerce.

8. Fish processing Technology. T. K. Govindan (1985). Oxford and IBH Publishing Co. Pvt. Ltd. (New Delhi, Bombay, Calcutta).
9. Advances in Fish Processing Technology by D. P. Sen. Sunil Sachdev. Allied Publishing Pvt. Ltd., New Delhi.
10. Participatory Training of Trainers: A New Approach Applied in Fish Processing by Dr. A. K. M. Newsad Alam, 2007. Bangladesh Fisheries Research Forum (BFRF).

FHT-3507: Geographic Information System (GIS) and Remote Sensing

Credits: 2

Full Marks: 100 (Theory 70, Class Test 20 and Attendance 10)

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

Geographic Information System (GIS)

Course Objectives:

To provide students with the knowledge of GIS technique and its application in the field of fisheries and aquaculture.

Course Contents:

1. **Introduction:** Overview, definition, approaches, GIS and other Information Systems. history and development of GIS.
2. Use of information technology (IT) and information system in related field, contribution of GIS in IT revolution, general fields of GIS application.
3. **Elements of GIS:** types of GIS- vector GIS and raster GIS, methods of data collection of vector GIS.
4. **Data Management:** Input, storage, manipulation and output of GIS, data structure and types- its management in raster and vector GIS, integration of vector and raster GIS.
5. **Map production and analysis:** Type of maps and their application, systematic patterns of search, distribution points, uniform and cluster patterns, nearest-neighbour analysis, distribution lines, test for randomness, testing for a specific trend, test of goodness of fit, computer contouring, moving averages, kriging, trend surface.
6. **GIS Softwares:** ARC/VIEW, ARC/INFO, IDRISI, a review of Cartalink.
7. Application of GIS in Fisheries and Aquaculture.

Remote Sensing

Course Objectives:

The objective of the course is to furnish the students with the fundamentals of remote sensing and its application in the field of fisheries and aquaculture.

Learning Outcomes:

At the end of the course, the students will be able to know the generalized process of remote sensing, energy source and interactions, sensor platforms, sensor systems, different environmental satellites, Image processing techniques, application of remote sensing to fisheries and aquaculture and the activities of SPARRSO.

Course Contents:

1. **Introduction to remote sensing:** Historical overview, application of remote sensing in fisheries and aquaculture, generalized process of remote sensing.
2. **Electromagnetic energy and remote sensing:** Electromagnetic energy, energy interaction in the atmosphere, energy interactions with the earth's surface.
3. **Sensors and platforms:** Sensors, platforms, image data characteristics, data selection criteria.
4. **Aerial camera:** Aerial camera, spectral and radiometric characteristics, scales of aerial photo spatial resolution.
5. **Multispectral scanners:** Some operational space borne multispectral scanners.
6. Digital image classification: Preparation for image classification, unsupervised image classification.
7. SPARRSO.

Recommended books/ literatures:

1. Principles of Geographical Information Systems for land Resource Assessment, P. A. Burrough.
2. Spatial processes, models and applications. A. D. Clifford J. K. Ord.
3. Introductory Readings in Geographic Information Systems. D. J. Penquet and D. F. Marble
4. Understanding GIS: The ARC/INFO Method. Esri.
5. Geographic Information Systems: a management perspective. S. Aronoff
6. Principles of Remote Sensing: An introductory text book. Edited by Lucus L. F. Janseen and Gerret C. Huurneman, 2001 ITC, Netherlands.
7. Imaging Radar for resource survey. Tervett.
8. Introduction to environmental remote sensing. Curtis.
9. Remote sensing application in marine science and technology. A. P. Cracknel.
10. Imaging Radar for resource survey. Tervett.
11. Introduction to environmental remote sensing. Curtis.
12. Principles of Remote Sensing ITC (Educational Textbook series; 2). Second Edition. Lucas L.F. Janssen and Gerrit C. Huurneman (eds.). (2001). ITC, Enschede, The Netherlands.
13. Introduction Geo-Information Science (GRS-10306). Kempen B. and W.TH. tenHaaf (Ed.). (2010). Wageningen University.
14. Fundamentals of Remote Sensing by Canada *Center for Remote Sensing Remote Sensing Tutorial*

FHT-3508 Rural Sociology

Credits: 2

Full Marks: 100 (Theory 70, Class Test 20 and Attendance 10)

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

Objectives

To provide students with the knowledge of social structure, livelihood, economic condition and problems of fishermen or fish farmer.

Course Contents:

1. **Introduction:** Definition of sociology and rural sociology; historical background of rural sociology; importance of rural sociology; primary concept of society, community, culture and group; factors influencing social life
2. **Social structure:** Comparative study of rural and urban sociology
3. **Social stratification:** Elements, types, slavery, estates castes class and status
4. **Social mobility:** Reasons, types, horizontal, vertical and geographical mobility
5. **Social changes:** Factors involved
6. Socio-economic conditions of the fishermen
7. Rural development.

Recommended books/ literatures:

1. Sociology. S. Koeig (1957). Barnes and Noble Inc. New York.
2. Foundation of Modern Sociology. M. Spencer. (1981). Prentice Hall. Canada.
3. Sociology. P. B. Horton and C. L. Hunt. (1964). McGraw Hill Inc. Book Co. New York, San Francisco, Toronto, London.
4. Small Scale Fisheries in Asia: Socio-economic Analysis and Policy. T. Panayotou (1987). Idrc-229c. Canada.

Practical and Viva-voce Courses

FHP-3511: Practical and Viva-voce on Fish Population Dynamics

Credit-1

Full marks: 100 (Class record: 10; Practical: 60 +Viva-voce: 20+Attendance: 10)

1. Sampling considerations for gathering information of fish populations
2. Estimation of catch per unit effort; recording the length and weight of fish in a sample; estimation of population size.
3. Establishment of length-length and length-weight relationships, and condition factors of fish populations
4. Estimation of population abundance by mark-recapture and depletion methods; cohort and virtual population analysis
5. Study of age and growth of fish populations by length-frequency and hard part analysis; familiar with FISAT software and its application on computer for stock assessment
6. Determination of spawning season of aquatic animals by gonad-somatic index, external feature of gonads and their maturation stages; estimation of fecundity of fish species
7. Estimation of total mortality and fishing mortality
8. Estimation of fecundity by different methods.

FHP-3512: Practical and Viva-voce on Coastal Aquaculture and Mariculture

Credit-1

Full marks: 100 (Class record: 10; Practical: 60 +Viva-voce: 20+Attendance: 10)

1. Collection and identification of commercially important fishes and shellfish, sea weeds of coastal area with special reference to new approach to aquaculture.
2. Laboratory culture of artemia, rotifers, seal algae and others important zooplankton etc.
3. Culture techniques of oyster, mussels, clams and seaweeds.
4. Field visit to study on different aquaculture techniques practiced in coastal and marine areas.

FHP-3513: Practical and Viva-voce on Fish Hatchery Management

Credit-1

Full marks: 100 (Class record: 10; Practical: 60 +Viva-voce: 20+ Attendance: 10)

1. Identification and operation of hatchery equipments.
2. Selection and identification of brood fishes.
3. Dose preparation of different inducing agents.

4. Demonstration of artificial breeding (induced and striping methods).
5. Visit to a fin and shellfish fish hatchery and report writing.

FHP-3514: Practical and Viva-voce on Fish Pathology and Immunology

Credit-1

Full marks: 100 (Class record: 10; Practical: 60 +Viva-voce: 20+Attendance: 10)

1. Study of general symptoms of diseased fish.
2. Study of pathological changes in different organs in diseased fish.
3. Study of common fish pathogen.
4. Isolation and identification of fish pathogen from diseased fish.
5. Field visit-collection of diseased fish from fish farm, hatchery, fish ponds.

FHP-3515: Practical and Viva-voce on Oceanography

Credit-1

Full marks: 100 (Class record: 10; Practical: 60 +Viva-voce: 20+Attendance: 10)

1. Study of the world ocean, sea and bays special reference to Bangladesh.
2. Preparation of zonation model of marine environment.
3. Measurements of different physico-chemical properties of sea waters including tides, waves and currents.
4. Study on marine sediment arrangement

FHP-3516: Practical and Viva-voce on Fish Processing - I

Credit-1

Full marks: 100 (Class record: 10; Practical: 60 +Viva-voce: 20+Attendance: 10)

1. Acquaintance with fish processing laboratory and safety use of lab equipment, glasswares and chemicals.
2. Preparation of icing of fish and shrimp.
3. Types of ice and ice markets.
5. Preparation of frozen fish and shrimp

FHP-3517: Practical & Viva-voce on Geographic Information System (GIS) & Remote Sensing

Credit-1

Full marks: 100 (Class record: 10; Practical: 60 +Viva-voce: 20+ Attendance: 10)

1. Introduction with GIS software
2. GIS Data management
3. Query, overlay and map production.
4. Creating map from XY data of nursery pond location.
5. Downing Google earth image for digitizing.
6. Georeferencing and digitizing of google earth image.
7. Creating feature classes in Geodatabase.
8. Working with Landsat Satellite image.
9. Scale determination of aerial photograph.

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Theoretical Courses

FHT-3601: Principle of Fish Genetics

Credits: 2

Full Marks: 100 (Theory 70, Class Test 20 and Attendance 10)

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

Course Objectives:

To understand the basic principles of genetics for quantitative and qualitative phenotypes in fish and their application.

Course Contents:

1. Introduction: Historical background of genetics and genetical terminology; role of genetics in aquaculture
2. Mendelian genetics: Mendelian law and deviation of mendelism.
3. Genetics of qualitative phenotypes: Phenotypes produced by single autosomal gene (complete dominant gene action, incomplete dominant gene action, additive gene action); Phenotypes produced by two or more autosomal genes (epistatic gene action, non-epistatic gene action)
4. Genetics of quantitative phenotypes: Phenotypic variance; genetic and environmental variance; genetic-environment interaction variance.
5. Inheritance associated with sex: Sexuality; Sex determination; sex-linked and sex-limited inheritances in fishes.
6. Linkage: Definition, types, theory, mechanism factors and significance.
7. Mutation: Definition, types, gene mutation and chromosomal mutation, metagene, importance of mutation; Uses of mutation in fish
8. Polymorphisms and multiple allelism: Definition, properties, examples.

Recommended books/ literatures:

1. Genetics for fish hatchery manager. D. Tave, 1993. 2nd ed. Van Nostrand Reinhold, New York.
2. An introduction to quantitative genetics. D. S. Falconer, 1996.
3. Genetics. Strickberger, M. W. 1985. Prentice-Hall of India Pvt. Ltd. New Delhi-110001.
4. Principles of Genetics. Tamarin, R. H. 1999. McGraw Hill Inc. Book Co. New York, San Francisco, Toronto, London.
5. Biology of the Gene. Levine, L. 1980. The C. V. Mosby Company, St. Louis / Toronto / London.
6. Introduction to Genetic Analysis. Griffiths, J. F., Miller, J. H., Suzuki, D. T., Lewontin, R. C., Gelbart, W. M. 1998. W. H. Freeman and Company. New York.
7. The Principles of Heredity. Synder, L. H. and David, P. R. 1957. D. C. Health and Company, Boston.

8. Genetics. Verma, P. S. and Agarwal, V. K. 1975. S. Chand and Company Ltd., Ram Nagar, New Delhi-110055.
9. Fundamentals of Genetics. Sing, B. D. 2000. Kalyani Publishers, New Delhi.

FHT-3602: Fish Stock Assessment

Credits: 2

Full Marks: 100 (Theory 70, Class Test 20 and Attendance 10)

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

Course Objectives:

To provide students with the knowledge of unit stocks, bioinformatics, DNA in fish stock, structure and size of fish stock, mortality, exploitation, maximum sustainable yield, maximum economic yield and the relationships between population parameter estimations, stock assessment and fisheries management.

Course Contents:

1. Introduction: Definitions, scope and importance, concept of unit stock, identification and separation of unit stocks, spacing within a unit stocks.
2. Bioinformatics: Definition, types of data, database, internet, application in fisheries management
3. Use of DNA in fish Stock Assessment: Species Identification, Age determination, Fisheries Surveillance, ecosystem monitoring (Food-web, Environmental stress, effects of climate change), Detection of pathogens and invasive species
4. Fisheries Stock Structure: Patterns and extent of biological stock; Mixed-stock analysis, harvest rate and abundance, Evolutionary response to fishing
5. Monitoring Genetic diversity for fisheries Management; Genetic consequence of stock enhancement program
6. Stock structure and size: Stock abundance and its estimation by Mark-recapture and Depletion methods. Fishery-dependent and fishery-independent data, Logbooks and Sampling surveys.
7. Stock assessment: Different conventional methods for estimation of fishing, natural and total mortality, Estimation of exploitation rate, Estimation of maximum sustainable yield (MSY) and maximum economic yield (MEY). Equilibrium models (surplus production models); non-equilibrium models (process-error and observation-error methods); potential yield estimators; biomass models; virtual population and cohort analysis; yield per recruit model; Thomson and Bell model; simulation and ecosystem models.
8. Conclusion: Relationships between population parameter estimations, stock assessment and fisheries management; effects of fishing on target species, non-target species, environment and ecosystems.

Recommended books/ literatures:

1. King, M. 1995. Fisheries Biology, Assessment and Management. Fishing News Books, 342 pp.
2. King, M. 2007. Fisheries Biology, Assessment and Management. 2nd edition, Blackwell, 382 pp.
3. Sparre, P., E. Ursin and S.C. Venema. 1989. Introduction to tropical fish stock assessment. Part 1. Manual. FAO Fisheries Technical Paper. No. 306.1. Rome, FAO. 337 pp.
4. Cushing, D.H. 1968. Fisheries Biology: A study in population dynamics. Univ. Wisconsin, Madison, USA. 200 pp.
5. Gulland, J.A. (ed.) 1983. Fish Stock Assessment: A Manual of Basic Methods. Chichester, U.K., Wiley Interscience, FAO/Wiley series on food and agriculture, Vol. 1. 223 pp.
6. Gulland, J.A. (ed.) 1988. Fish Population Dynamics. Second edition. John Wiley & Sons, Inc., New York.
7. Lagler, K.F. 1956. Freshwater Biology, Second edition, William C. Brown Co. Dubuque, Iowa. 421 pp.
8. Pauly, D. 1984. Fish population dynamics in tropical waters. A manual for use with programmable calculators. ICLARM, Manila, 325 pp.
9. Ricker, W.E. 1968. Methods of assessment offish production in freshwaters. Blackwell Scientific Publications, Oxford, 321 pp.
10. Ricker, W.E. 1975. Computation and interpretation of biological statistics of fish populations. Bull. Fish. Res. Board Can. 191: 382 p.
11. Rounsefell, G.A. and W.H. Everhart. 1953. Fishery Science: Its methods and application. John Wiley & Sons, Inc., New York. 444 pp.
12. Sparre, P., E. Ursin and S.C. Venema, S.C., 1989. Introduction to tropical fish stock assessment. Part 2. Exercises. FAO Fisheries Technical Paper. No. 306.2. Rome, FAO. 429 pp.

FHT-3603: Aquaculture Engineering and Farm Management

Credits: 2

Full Marks: 100 (Theory 70, Class Test 20 and Attendance 10)

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

Course Objectives:

To provide students with the knowledge of modern techniques of aquaculture engineering from site selection to run a fish farm. The course will be especially focused to achieve different engineering tools and techniques for designing and construction of a fish farm.

Course Contents:

1. Aquaculture engineering, importance and present status in Bangladesh. .
2. **Site selection:** General consideration, social criteria, soil topography and its survey for freshwater and brackish water fish farm.
3. **Soil:** Components of soil, physical properties and classification.
4. **Construction:** Pond types, criteria of pond construction, calculation dike/wall height and slope, wall volumes; designing of pits, placements of inlets and outlets; sluices and monks.
5. **Design:** Structural feature of fish and shrimp farm, placement of ponds and layout of fish and shrimp hatcheries.
6. **Water recycling and wastewater treatment:** Techniques of wastewater treatment, use of filter/screen, water flow/level measurements.
7. **Monitoring water quality in fin fish and shrimp farms:** Water quality improvement, metabolic rate, DO, pH consumption and excretion, turbidity, sludge/pit, handling/removal.
8. **Pumps and aeration devices for fin fish farm:** Use of pumps in fish culture, types of pump (common air pump, submersible aerator and floating aerator, blowers), general principle of aeration in aquaculture; aeration of ponds and tanks (screens and grading devices).
9. **Fencing for fin fish farm:** Types, structure and construction.

Recommended books/ literatures:

1. Aquaculture Engineering. Odd-IvarLekang (2007). Blackwell Publishing Ltd., Oxford, UK.
2. Aquaculture Engineering. F. W. Wheaton (1987). Robert E. Krieger Pnbl., Florida.
3. Aquaculture Engineering. F. W. Roberts (1987). Robert E. Krieger Publ., Florida.
4. Textbook of Fish Culture; Breeding and Cultivation of Fish. M. Huet (1979). Fishing News Books. Ltd. Farnham Survey, England.
5. Designs and Construction of Earth Dams. K. D. Nelson (1985). Inkata Press, Melbourne.
6. Elementary Guide to Fish Culture in Nepal. E. Woynarovitch (1975). FAO, Rome.
7. Waste Water Treatment. M. N. Rao and A. K. Datta (2002). Oxford and IBH Publishing Co. Pvt. Ltd. New Delhi, India.
8. Aquatic Plants for the Waste Water Treatment. A. R. Upadhyay (2004). Daya Publishing House, Delhi, India.
9. Simple Methods for Aquaculture Management for Freshwater Practices. FAO Training Series 21/1. 1997. Baba BarkaNath Printers, New Delhi, India.
10. Textbook of Fish Culture; Breeding and Cultivation of Fish. M. Huet (1979). Fishing News Books. Ltd. Farnham Survey, England.
11. Designs and Construction of Earth Dams. K. D. Nelson (1985). Inkata Press, Melbourne.

FHT-3604 Fish Processing - II

Credits: 2

Full Marks: 100 (Theory 70, Class Test 20 and Attendance 10)

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

Course Objectives:

To provide students with the knowledge of different processing methods of fish and shellfish, their packaging and planning and design of fish processing plant.

Course Contents:

1. Drying and dehydration: Basic mechanism of fish drying, physical properties of fish in relation to drying, methods and processing, technology, drying of salt treated fish; quality aspects of dried fish.
2. Smoking: Preservative effect and changes in fish during smoking, factors affecting smoking, quality aspects of smoked fish.
3. Salting: Types of salting, technological aspects of salting, salting process and characteristic features of salting, effect of salt quality on shelf life of salted fish.
4. Canning: Principles of canning, preparation of raw material, canning operation, types and availability of can materials, tests of canned products.
5. Irradiation: Introduction, Sources of Radiation, Radiation process, Measurement of irradiation energy, Radiation dose, Effect of irradiation on fish and fishery products, Detection of irradiation in foods.
6. Packaging: Function of packaging, package selection, packaging materials, packaging regulations, future of packaging.
7. Modern approaches to fish processing: Vacuum and Modified atmosphere packaging, Sausvide technology in fish processing
8. Design and planning of a fish processing plant.

Recommended books/ literatures:

1. Fish as food. vol. I-IV. G. Borgstrom (editor) (1965). Academic press, London.
2. Fish Processing Technology. T. K. Govinda (1985). Oxford and IBH Publi. Co., New Delhi.
3. Post-harvest Technology of Fish and Fish Products. Balachandran, K. K. 2001. Daya Publishing House, Delhi – 110035. India. 440 pp.
4. Fish Handling, Preservation and Processing in the Tropics. Part I and II. I. J. Clusas (editor). (1985). Tropical Development and Research Institute, London.
5. Processing of Aquatic Food Products. F. W. Wheaton and T. B. Lawson (1985). Wiley Inter Science, New York.
6. Industrial Fishery Technology. M. E. Stausby (1963). Reihnold (editor). Publ. Corp. New York.

7. Advances in Fish Processing Technology by D. P. Sen. Sunil Sachdev. Allied Publishing Pvt. Ltd., New Delhi.
8. Modified atmospheric processing and packaging of fish, edited by W. Steven Otwell, Hordur G. Kristinsson, Murat O. Balaban. Blackwell Publishing Asia.
9. Fish Processing – Sustainability and New Opportunities, Edited by George M. Hall. 2011. Blackwell Publishing Ltd.
10. Food preservation techniques, Edited by Peter Zeuthen and Leif Bùgh-Sùrensen. 2003, Woodhead Publishing Limited and CRC Press LLC
11. Participatory Training of Trainers : A New Approach Applied in Fish Processing by Dr. A. K. M. NowsadAlam, 2007. Bangladesh Fisheries Research Forum (BFRF).

FHT-3605: Fishery Byproducts Technology

Credits: 2

Full Marks: 100 (Theory 70, Class Test 20 and Attendance 10)

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

Course Objectives:

To provide students with the knowledge of different fishery byproducts with their uses and processing methods.

Course Contents:

1. Introduction to fishery **product** and by-products in Bangladesh: Scope of fishery product and by-product production, raw materials, abundance. Scientific and technological development.
2. Fishmeal, fish scrap and other seafood waste meal: Processing, quality deterioration, preservation, utilization and nutritional value.
3. Fish oils: Fish oil processing – dry rendering & wet rendering methods; nutritive value; quality deterioration and preservation of fish oil.
4. Fish silage: Processing, preservation and utilization; quality and nutritional value.
5. Fish hydrolysate and fish protein concentrate (FPC): Processing, nutritive value, deterioration and preservation.
6. Specialty products: Gelatin, fish glue, caviar, roe and milt, leather, chitin, chitosan, dried shark's fin, fish maws/Isinglass, ambergris, pearl essence, pearl, ornamental shell, tortoise shell and coral products.
7. Nutraceutical and pharmaceutical products: Agar, alginic acid and alginate, iodine, mannitol, insulin.
8. Taste and flavor active compounds in seafood: extraction, storage and utilization

Recommended books/ literatures:

1. Fish as food. vol. I-IV. G. Borgstrom (editor) (1965). Academic press, London.
2. Fish Processing Technology. T. K. Govinda (1985). Oxford and IBH Publi. Co., New Delhi.
3. Post-harvest Technology of Fish and Fish Products. Balachandran, K. K. 2001. Daya Publishing House, Delhi – 110035. India. 440 pp.
4. Fish Handling, Preservation and Processing in the Tropics. Part I and II. I. J. Clusas (editor). (1985). Tropical Development and Research Institute, London.
5. Marine and Freshwater Products Handbook, edited by Roy E. Martin, Emily Paine Carter, Lynn M. Davis, George J. Flick Jr. 2000. Technomic publishing Company inc
6. Processing of Aquatic Food Products. F. W. Wheaton and T. B. Lawson (1985). Wiley Inter Science, New York.
7. Industrial Fishery Technology. M. E. Stausby (1963). Reihnold (editor). Publ. Corp. New York.
8. Introduction to Fishery By-Products. M. Windsor and S. Barlow (1981). Fishing News Books Ltd. Farnham, Surrey, England.
9. Fish Processing Technology. T. K. Govinda (1985). Oxford and IBH Publi. Co., New Delhi.
10. Processing of Aquatic Food Products. F. W. Wheaton and T. B. Lawson (1985). Wiley Inter Science, New York.
11. The Technology of Fish Utilization. K. Krenzer (1965). Fishing News (Books) Ltd. London.
12. Industrial Fishery Technology. M. E. Stausby (1963). Reihnold (editor). Publ. Corp. New York.
13. Fish processing Technology. T. K. Govindan (1985). Oxford and IBH Publishing Co. Pvt. Ltd. (New Delhi, Bombay, Calcutta).
14. Marine Products in Japan. E. Tanikawa (1985). Koseisha Co. Ltd

FHT-3606: Fish Feed Technology-I

Credits: 2

Full Marks: 100 (Theory 70, Class Test 20 and Attendance 10)

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

Course Objectives:

To provide the knowledge of the fish feed concerning feed ingredients sources, Live feed, feed formulation, feeding methods, feeding rate and frequency.

Course Contents:

Section: A

1. An introduction to Fish Feed and their importance and advantage in intensive and semi-intensive aquaculture.
2. **Fish Feed stuffs:** Sources of plant and animal origin ingredients for fish feed and their proximate composition.

3. **Live feeds:** *Tubifex*, *Artemia*, *Daphnia*, *Moina*, rotifers etc.
4. **Non-conventional fish protein sources:** Fish silage, fish meal, micro-encapsulated diets etc.

Section: B

1. **Fish Feed Formulation:** Formulation of feeds based on nutritional requirements of various culturable fish species by the use of Pearson's square method, analysis of 'best buy' based on protein and energy.
2. **Supplementary feed:** Selection of supplementary feeds, Supplementary diet feeding techniques.
3. **Feeding methods:** Broadcasting, feeder, demand and non-demand feeders, feed particles shape and size.
4. **Type of fish feed:** Classification based on the stage of life cycle, Product quality fish feed.
5. **Feeding rate and feeding frequency,** Practice of feeding in aquaculture, Basic rules of feeding frequency, Effect of environmental factors on feeding.
6. **Fish feed preparation and presentation**

Recommended books/ literatures:

1. Tropical Feeds, tropical Feeds. B. Gohl (1981). Food and Agricultural Organization of the United Nations, Rome.
2. Finfish Nutrition and Fish Feed Technology. vol. I-II. J. E. Halver and K. Tiews (editors) (1979). H. Heenmann GmbH and Co. Berlin.
3. Fish Feed Technology. Aquaculture Development and Coordination Programme 1980. ADCP/FEP/80/11 UNDP/FAO, Rome.
4. Fish Feeds and Feeding in Developing Countries. Aquaculture Development and Coordination Programme (1983). ACDP/REP/83/18 UNDP/FAO, Rome.
5. A Guide to Tilapia Feeds and Feeding. K. Jauncey and D. Ross. (1982). Institute of Aquaculture, University of Stirling, Scotland.
6. Toxic Constituents of Plant Foodstuffs. D. E. Linear (editor). Academic Press, New York.
7. Feed and Feeding of Fish and Shrimp. M. B. New (1987). ACDP/REP/87/26 UNDP/FAO, Rome.

FHT-3607: Fisheries Marketing

Credits: 2

Full Marks: 100 (Theory 70, Class Test 20 and Attendance 10)

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

Course Objectives:

The course aims to provide an understanding of fish market, market segmentation, consumer behavior, marketing research and ethical considerations in marketing, strategic planning and marketing process, and global fish marketing.

Course contents:

1. **Introduction:** Definition and types of market; definition, importance, basic function, strategy and environments of marketing; marketing mix.
2. **Designing product:** Definition, levels and types of products; product decisions, product line, product mix and product life cycle.
3. **Pricing product:** Definition, objective, factors and steps of pricing, pricing strategy, general pricing methods, price adjustment, fish pricing method.
4. **Placing product:** Definition, qualities and types of marketing channel; types of middlemen, fish marketing channel; physical types and structure of fish market.
5. **Promoting products:** Advertising, sales promotion, public relations and personal selling.
6. **Market analysis:** Market segmenting-bases, ways and evaluation; selecting market segment and choosing a market; market positioning; consumer buying behaviour-factors affecting consumer behaviour and types of buying behaviour; the buyer decision process.
7. **Marketing cost, margin, efficiency and management:** Importance, component and factors of marketing cost; types, component and estimation of marketing margin; form and increasing measures for marketing efficiency; different state of demand and management tasks.
8. **International marketing:** Definition, reasons for development, importance features and environment of international marketing; export and import; document used in international marketing, channel structure, problem of international marketing.
9. **Problems of fish marketing:** Problems from growers, traders, processors and consumers point of view; mitigation measures of fish marketing problems.

Recommended books/ literatures:

1. Inland Fish Marketing in India. Srivastava and Uma Kant (1985), IIM Ahmedabad & Concept Publishing Company, New Delhi.
2. Marine Fish Marketing in India. Gupta, V.K. (1984), IIM Ahmedabad & Concept Publishing Company, New Delhi.
3. The Global fish market and the need for multilateral fishing disciplines. J. Le Blanch In: Leonard B (ed), 2003, Diane Publishing.
4. The fish market at the center of the world, Bestor T.C. In: P.E. Lilienthal (2004), California studies, University of California Press.

5. Principle of Marketing (17thedition). Philip T. Kotler and Gary Armstrong (2017), Prentice Hall.
6. Management of Marketing (11thedition). Philip Kotler (2002), Prentice Hall;
7. Agricultural Marketing in India (4th edition). S.S. Acharya and N.L. Agarwal (1987), Oxford and IBH Publishing Company.

FHT-3608: Fisheries Economics

Credits: 2

Full Marks: 100 (Theory 70, Class Test 20 and Attendance 10)

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

Course Objectives:

To provide students with the knowledge on principles, theories and practices of aquaculture and fisheries economics for sustainable management of aquatic resources towards economic benefits.

Course Contents:

1. **Introduction:** Basic definitions, scope and methods, partial and general equilibrium analysis, macro and micro economics.
2. **Supply and demand:** Definitions, utility analysis of demand, law of diminishing marginal utility, indifference curve, elasticity of supply and demand, law of supply and demand, consumer's surplus. Applications in fisheries.
3. **Theory of production:** Factors of production, scale of production, production possibility curve and production function, laws of returns, isoquants or equal product curves, cost and cost curves, market and market structure.
4. **National income:** Meaning, concepts and basic definitions; measurement of national income; difficulties in measurement; significance of national income statistics.
5. Financing in fisheries: Money, banking, credit, micro-credit and fisheries.
6. **Economic analysis in fish culture:** Basic concepts and important definitions, steps in fish farm planning, cost benefit ratio, economic problems, farm profitability analysis, economic analysis of different fish farming techniques.

Recommended books/ literatures:

1. An Introduction to Economics for Students of Agriculture. B. Hill (1980). Pergamen Press, London.
2. The Economics of Natural Resources. R. Lecomber (1979). MacMillan, London.
3. Small Scale Fisheries in Asia: Socio-economic Analysis and Policy. T. Panayotou (1987). Idrc-229c. Canada.
4. Resources Economics: An Economic Approach 10 Natural Resources Environmental Policy. A. Randal. (1987). Wiley, New York.

5. Aquaculture Economics: Basic Concepts and Methods of Analysis. Y. C. Shang. (1981). Westview Press, London.
6. Economics (13th edn.). P. A. Samuelson and W. D. Nordhaus (1989). McGraw Hill, New York.
7. Food from the Sea: The Economics and Policies of Ocean Fisheries. F. W. Bell. (1978). Westview Press, London.

Practical and Viva-voce Courses

FHP-3611: Practical and Viva-voce on Principle of Fish Genetics

Credit-1

Full marks: 100 (Class record: 10; Practical: 60 +Viva-voce: 20+Attendance: 10)

1. Statistical Methods for analysis of results of genetic crosses
2. Electrophoresis techniques
3. Extraction of Genomic DNA from fish tissue
4. Karyology of fishes: Methods of chromosome preparation in fishes.
5. DNA bar coding system

FHP-3612: Practical and Viva-voce on Fish Stock Assessment

Credit-1

Full marks: 100 (Class record: 10; Practical: 60 +Viva-voce: 20+Attendance: 10)

1. Identification and separation of unit stocks through morphological- and meristic characters and reproductive-growth parameters,
2. Stock abundance and its estimation by Mark-recapture and Depletion methods. Fishery-dependent and fishery-independent data, Logbooks and Sampling surveys.
3. Relationships between population parameter estimations, stock assessment and fisheries management; effects of fishing on target species, non-target species, environment and ecosystems.
4. Estimation of Genetic diversity from DNA and protein data
5. Use of DNA data for unit and mixed-stock assessment
6. Use of DNA data for estimation of abundance and harvest rate
7. Determination of effect of stock assessment program in a riverine population.
8. Uploading protein and DNA data in Gene bank.

FHP-3613: Practical and Viva-voce on Aquaculture Engineering and Farm Management

Credit-1

Full marks: 100 (Class record: 10; Practical: 60 +Viva-voce: 20+Attendance: 10)

1. Determination of soil texture.
2. Planes table tad Contour survey.
3. Drawing and designing of earthen and concrete ponds, mini hatchery; cage designing.
4. Layout and structural designing of shrimp and prawn hatchery.
5. Cost estimation of pond excavation and establishment of mini shrimp and prawn hatchery.
6. Preparation of a shrimp and prawn aquaculture farm design
7. Cage farm design, layout and construction.
8. Construction of water treatment plant for shrimp hatchery.

FHP-3614: Practical and Viva-voce on Fish Processing - II

Credit-1

Full marks: 100 (Class record: 10; Practical: 60 +Viva-voce: 20+Attendance: 10)

1. Acquaintance with fish processing laboratory.
2. Technique of fish salting and determination of salt concentration with time interval.
3. Processing and preservation of fish by sun drying, salting and smoking method and observation on their physical and chemical changes.
4. Vacuum and modified atmosphere packaging of fish and fishery products

FHP-3615: Practical and Viva-voce on Fishery Byproducts Technology

Credit-1

Full marks: 100 (Class record: 10; Practical: 60 +Viva-voce: 20+Attendance: 10)

1. Identification of fishery by-products available in Bangladesh.
2. Preparation of fish paste and their quality assessment.

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3. Preparation of FPC and their quality assessment.
4. Preparation of fish meal and their quality assessment.
5. Preparation fish oil and their quality assessment.
6. Preparation of FPI and their quality assessment.
7. Visiting fisheries byproducts manufacturing industries/plants.

FHP-3616: Practical and Viva-voce on Fish Feed Technology - I

Credit-1

Full marks: 100 (Class record: 10; Practical: 60 +Viva-voce: 20+Attendance: 10)

1. Fish feed stuffs: Identification of plant and animal origin ingredients and feeds.
2. Survey of commercially available plant and animal origin fish feed ingredients used with fish feed in different areas of Bangladesh.
3. Live feed culture and application
4. Feed formulation exercise: Square method, use of spreadsheet.
5. Formulation of balanced diet for fish species.
6. Observation of different feeding methods for fish.

FHP-3617: Practical and Viva-voce on Fisheries Marketing

Credit-1

Full marks: 100 (Class record: 10; Practical: 60 +Viva-voce: 20+Attendance: 10)

1. Study of fish/fish product, fish/fish product pricing, fish/fish product placing (Middlemen and channel) and fish/fish product promotion in local fish markets.
2. Value chain analysis of fish and fisheries products.
3. Development of advertising messages for fish products.
4. Calculation of marketing margin and producer's share in the consumer's payment.
5. Visit to local fish markets report writing

B. Sc. Fisheries (Honours) Level-4 Semester-7 Examination, June 2023**Theoretical Courses****FHT-4701: Genetics in Fish Breeding**

Credits: 2

Full Marks: 100 (Theory 70, Class Test 20 and Attendance 10)**Time: 3 hours (Six questions to be set and five to be answered)****Course Objectives:**

To understand the use of different genetics principles in breeding program.

Course Contents:

1. Inbreeding: Definition; Genetic effects and problems; Inbreeding depression; Practical application of inbreeding; Calculation of inbreeding; Effective breeding number (N_e); Genetic drift; Management measures to prevent inbreeding and genetic drift in hatchery
2. Hybridization: Definition; Types of cross breeding; Application of hybridization; genetic effects; Natural and artificial hybridization; Hybridization planning; Outbreeding and hybrid vigour; Selective breeding; Heterosis; Rotational cross; Heritability
3. Selection: Genetic variation and selection; Selection vs neutralism; types of selection; Methods of selection; Individual selection; Family selection; Selection index; Combined selection;
4. Biotechnology: Sex manipulations- sex reversal, gynogenesis, androgenesis; chromosomal manipulations (Triploids, tetraploids, haploids, gynogens; androgens);
5. Genetic engineering: Gene structure; definition; recombinant DNA technique, GMOs, gene manipulation, use of genetic engineering and biotechnology in medicine, agriculture and fisheries.
6. Hatcheries and brood management of Indian major carps: broodfish selection, record keeping, inbreeding and genetic drift; Effective breeding number (N_e); Hatchery facilities; Selective breeding and linecrossing technique of indigenous species for stock improvement.

Recommended books/ literatures:

1. Genetics for fish hatchery manager. D. Tave, 1993. 2nd ed. Van Nostrand Reinhold, New York.
2. Genetics. Strickberger, M. W. 1985. Prentice-Hall of India Pvt. Ltd. New Delhi-110001.
3. Principles of Genetics. Tamarin, R. H. 1999. McGraw Hill Inc. Book Co. New York, San Francisco, Toronto, London.
4. Biology of the Gene. Levine, L. 1980. The C. V. Mosby Company, St. Louis / Toronto / London.
5. Introduction to Genetic Analysis. Griffiths, J. F., Miller, J. H., Suzuki, D. T., Lewontin, R. C., Gelbart, W. M. 1998. W. H. Freeman and Company. New York.

6. The Principles of Heredity. Synder, L. H. and David, P. R. 1957. D. C. Health and Company, Boston.
7. Genetics. Verma, P. S. and Agarwal, V. K. 1975. S. Chand and Company Ltd., Ram Nagar, New Delhi-110055.
8. Fundamentals of Genetics. Sing, B. D. 2000. Kalyani Publishers, New Delhi.
9. The Principles of Heredity. Synder, L. H. and David, P. R. 1957. D. C. Health and Company, Boston.
10. Genetics. Verma, P. S. and Agarwal, V. K. 1975. S. Chand and Company Ltd., Ram Nagar, New Delhi-110055.
11. Fundamentals of Genetics. Sing, B. D. 2000. Kalyani Publishers, New Delhi.

FHT-4702: Fisheries Resources Management

Credits: 2

Full Marks: 100 (Theory 70, Class Test 20 and Attendance 10)

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

Course Objectives:

To provide the students with knowledge on fisheries resources, with its conservation and management measures.

Course Contents:

1. **Introduction:** Definition and types of fisheries resources; definition of fisheries management, management functions, organization and authority; definition and types of conservation.
2. **Life-history data of fishes in relation to management:** Importance of life history to management, salient features-degree of movement, zone inhabited and manner of reproduction.
3. **Habitat improvement in inland water:** Definition and types of habitat, definition, objectives and necessity of habitat improvement; habitat improvement methods in standing and running water body.
4. **Control of undesirable fish population:** Concept of undesirable population, controlling methods- poisoning, netting, weirs/electric shocker, biological control, liberalized fishing and water level control.
5. **Fisheries regulations:** Definition, purpose, theory, types and effective application of fisheries regulation; fish acts in Bangladesh, wildlife ordinance (aquatic) of Bangladesh; regulatory authority.
6. **Creation of new fishing areas:** Definition, necessity and basic principles to created new fishing areas.
7. **Protection against hazards:** Types of hazards; definition, sources, effects, detection and abatement of pollution; removal of obstruction, fish pass.

8. **Open water fisheries management:** River, haor, baor, kaptai lake, cholonbeel and other major beels, brackish water and sea management.
9. **Openwater fisheries policy:**Jalmahal policy; new fisheries management policy (NFMP).
10. **Freshwater recreational fisheries:** Definition, objectives, present status and future prospects, management
11. **Management problems:** Predictions of abundance, natural balance and environmental monitoring; role of nutrients; special problems of selected fisheries; inter-and in intra-specific relations.
12. **Fisheries co-operatives:** Definition, objective, principles and activities of fisheries co-operatives; problems and their mitigation; role of GOs and NGOs in development of fisheries co-operatives.

Recommended books/ literatures:

1. Fishery Science. G. A. Rounsefell and W. H. Everhart (1983). John Wiley and Sons. New York
2. Freshwater Fishery Biology (2nd ed.). K.F. Lagler (1956). W. C. Brown Co. Dubuque, Iowa, USA.
3. Inland Fisheries Management in Bangladesh. M. Agüero, S. Huq, A. K A. Rahman and M. Ahmed (editors) (1989). DoF, Dhaka, BCAS, Dhaka and ICLARM, Manila, Philippines.
4. Fishery Management. R. S. For and J. D. Bravshew (1961). Faber and Faber, London.
5. Status and potential of Bangladesh Fisheries. M. A. Karim (1978). MOFL. Govt. of the Peoples Republic of Bangladesh.
6. Freshwater Fisheries Management. R. G. Templeton (1984). Fishing News Books Ltd. London.
7. Management of Artificial Lakes and Ponds. G. W. Bennett (1965). Reinhold Publ. Corp., New York.

FHT-4703: Fish Health Management and Pharmacology

Credits: 2

Full Marks: 100 (Theory 70, Class Test 20 and Attendance 10)

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

Course Objectives:

This course is designed to provide a broad knowledge on fish health and to develop effective fish and shrimp health management strategies to maintain the disease-free status for cultured stocks.

Course Contents:

1. **Introduction:** Definition, principles, basic concept and importance of fish health management.
2. **Sanitation practices in aquaculture:** Sanitation practices for fish ponds and tanks, recirculation systems, water, feed, animals, hands, feet and equipment, transplantation of new species, eggs and fish, design facility.
3. **Diagnosis of fish disease:** Principles of disease diagnosis, epidemiological and clinical diagnosis, postmortem examination, microbiological, histopathological and haematological methods.
4. **Prevention and control of fish disease:** Definition, significance of prevention and control of disease, general preventive and control measures of disease.
5. **Therapy of fish diseases:** Definition and types of therapy, chemotherapy, selection of drugs and their mode of actions, methods of application of drugs, use of common drugs in aquaculture.
6. **Vaccination in aquaculture:** Definition, types and mode of action of vaccine, definition, general principles and methods of fish vaccination, commercial fish vaccines, use of adjuvant and immunostimulants, effectiveness of a vaccine, advantages of vaccination over chemotherapy, prospect of vaccine development.
7. **Preventive and control measures for fish diseases:** Pathogenic (parasitic, fungal, bacterial and viral) and non-pathogenic (environmental, dietary and hereditary) origin.
8. **Pharmacology:** Pharmacological terms, principles of drug activities; absorption, mechanism of action, distribution, metabolism, excretion of drugs; concept of drug receptor, dose response relationship, factors affecting drug effect and dosage, mechanisms of drug resistance; antibacterial, antiviral, antiprotozoal, antiparasitic and antihelminthics agents; probiotics, immunostimulants, anesthesia and anesthetics; safety of aquaculture medicines and the law, proper use of the drugs, chemicals and antibiotics, considering food safety and GAP system in the steps of aquaculture.

Recommended books/ literatures:

1. Introduction to Fish Health Management. Vinyl Bound (1995) by Becky A. Lasee (Editor)
2. Introduction to Fish Health Management (1995). Becky A. Lasee, LaCrosse Fish Health Center (U.S.), La Crosse Fish Health Center.

3. Fish Diseases vol. 1 and 2. W. Schaperclaus (1991). Oxanion Press Pvt. Ltd. New Delhi, Calcutta.
4. Bacterial Pathogens; Diseases in Farmed and Wild Fish. B. Austin and D. A. Austin (1987). Ellis Horwood Ltd.
5. Bacterial and Viral Diseases of Fish. J. H. Cross (editor) (1983). Washington Sea Grant Publication.
6. Diseases of Fishes (1971). S. Sarig (Edited by- Dr. Stanislaus, F. Snieszko and Dr. Herbert R. Axelrod). T. F. H. Publications Inc. Ltd.
7. Identification of Fish Pathogenic Bacteria. G. L. Bullock (1980). TFH Publication.211
8. Fish Pharmacology and Toxicology (2017), G. Pandey. DAYA Publishing House.
9. Fish Medicine: 2nd edition (2011), Michael Stoskopf. Vet Book.

FHT-4704: Fish Feed Technology - II

Credits: 2

Full Marks: 100 (Theory 70, Class Test 20 and Attendance 10)

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

Course Objectives:

To provide the knowledge of the fish feed concerning non-nutrient and anti-nutrient component, feed processing feed industry and feed storage.

Course Contents:

Section: A

1. Background, pioneer, importance and scope of the course.
2. Non-nutrient component in fish feed.
3. **Toxic constituents in feedstuffs:** Antinutritional factors present in plant feedstuffs; adventitious toxic factors in feedstuffs.
4. Natural and chemical contaminants of feed stuff
5. Antibiotics and probiotics in aquafeed, Feeding stimulants.

Section: B

1. **Feed processing and manufacturing plant:** Basic steps in aquafeed manufactures. Feed mills and their design, component part of a feed mill and pellet mill; fish feed manufacturing process.
2. **Feed industry:** Status and problems of aquafeed industry, Floating and sinking feed manufacturing process.
3. **Feed storage:** Storage and damage of fish feed during storage and quality control.
4. **Feed evaluating methods and feed utilization parameters:** MWG, PWG, SGR, FCR, FCE, PER, NPU, ANPU and Digestibility.
5. **Labeling specification for fish and shrimp feed:** Quality aspects of protein source, Characteristics of potential feed ingredients. Fish and shrimp Feeds and legal aspects.

6. **Alternative Protein sources for fish feed:** Plant and animal by-products.

Recommended books/ literatures:

1. Finfish Nutrition and Fish Feed Technology. vol. I-II. J. E. Halver and K. Tiews (editors) (1979). H. Heenmann GmbH and Co. Berlin.
2. Fish Feed Technology. Aquaculture Development and Coordination Programme 1980. ADCP/FEP/80/11 UNDP/FAO, Rome.
3. Fish Feeds and Feeding in Developing Countries. Aquaculture Development and Coordination Programme (1983). ACDP/REP/83/18 UNDP/FAO, Rome.
4. A Guide to Tilapia Feeds and Feeding. K. Jauncey and D. Ross. (1982). Institute of Aquaculture, University of Stirling, Scotland.
5. Feed and Feeding of Fish and Shrimp. M. B. New (1987). ACDP/REP/87/26 UNDP/FAO, Rome.

FHT-4705: Fisheries Extension

Credits: 2

Full Marks: 100 (Theory 70, Class Test 20 and Attendance 10)

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

Course Objectives:

To provide students with the knowledge of principles, philosophy, teaching-learning, communication, group, team, organization, leadership, innovation-decision, program planning and evaluation.

Course Contents:

1. **Introduction:** definition, principles, philosophy and objectives of extension; scope, potentials and problems of fisheries extension in Bangladesh.
2. **Terminology:** Knowledge, attitude, skill, education, research, development, need, motivation, stakeholder, participation, facilitation.
3. **Communication:** Definition, types and elements of communication.
4. **Extension teaching methods and teaching aids:** Concept, types, importance and use.
5. **Learning:** Definition, process, general principles, adult learning principles, traditional versus participatory learning.
6. **PRA tools/techniques:** concept, importance, types, application and methods.
7. **Group:** concept, mode and type of group; identification and management of critical members; group formation and mobilization, team building.
8. **Organization:** Definition, main features of an extension organization, categories, qualifications, duties and responsibilities of extension personnel.

9. **Participatory extension activities:** case study, role play, brain storming, meeting, seminar, workshop, panel discussion etc.
10. **Innovation decision process:** Meaning of diffusion, elements in the diffusion process, models of innovation-decision process, innovativeness and adopter categories, rejection and discontinuance of innovations, factors affecting transfer of technologies.
11. **Leadership:** Concept and types of leadership, recognition for good leadership, role of professional and local leaders.
12. **Program planning and evaluation:** Concept, importance, principles and procedures of program planning for fisheries development; participation of people, favorable and unfavorable conditions for program planning; principles, types and procedures for evaluation of program.
13. **Rural youth:** Role of rural youths in extension work, present condition of rural youth in Bangladesh, needs and interests of rural youths, past and present program for development of youth in Bangladesh, youth program in other countries, involvement of youth for development of fisheries and related agricultural activities.

Recommended books/ literatures:

1. Leadership and Dynamic Group Action. G. M. Belal, J. M. Bholen and J. N Raudabaugh (1972). Ames: The law Stale University Press.
2. Extension and Rural Welfare. O. P. Dahama (1976). Agra, Ramprasad and Sons.
3. Agricultural Extension Manual (The Training and Visit System). Development of Agricultural Extension. Ministry of Agriculture. Government of the People's Republic of Bangladesh.
4. Notes on Extension in Agriculture. Ivan Fay. Asia Publ. House, Bombay. Calcutta, New Delhi.
5. Extension Education in Community Development. M. C. Kamatch (editor). New Delhi, Directorate of Extension, Ministry of Food and Agriculture, Government of India.
6. An Introduction to Extension. A. T. Mosher (1978). Agricultural Development Council, New York
7. Agricultural extension - A Reference Manual. A. H. Mander (editor) (1972). FAO, United Nations, Rome.
8. Leadership for Action in Rural Communities. D. W. Kreitlow, E. W. Aiton and A. P. Orrence (1965). The Interstate Printers and Publishers.

FHT-4706: Fish Inspection and Quality Control

Credits: 2

Full Marks: 100 (Theory 70, Class Test 20 and Attendance 10)

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

Course Objectives:

To provide students with the knowledge of quality, quality program, quality organization, quality assessment and official inspection practices.

Course Contents:

1. Introduction: Concept and purpose of quality assurance, importance of fish inspection and quality control programs, problems in quality assurance of fishery products.
2. Food laws and regulations: Food laws and competent authority, Enforcement of food laws, Inspection and quality control regulations for fish and fishery products, fish feed and animal feed act, fish hatchery act, updated version as well as previous acts with amendments, EU and USFDA regulations and guidelines.
3. Industrial quality management: Good manufacturing practices (GMP), standard operating procedures (SOP) and sanitary sanitation standard operating procedures (SSOP) of fish processing industries.
4. Modern approach to quality-HACCP: Principles, aims, HACCP program, steps of HACCP implementation, hazard, sources and categories of hazards, HACCP plant and worksheet, problems of HACCP implementation.
5. Traceability system in exportable foods: Legal background, Pre-requisites of traceability, benefits and steps of implementing traceability in fish and shrimp value chain, certification and accreditation procedure, constraints /weakness and improvement of the system.
6. Standard specification of fishery products: CODEX standards, International Organization of Standardization (ISO-9000-4), International Commission of Microbiological Specification (ICMS), Bangladesh Standard Specification of BSTI.
7. Sanitation in processing industries: Hygiene practices, cleanup procedures, water supplies, various aspects of sanitation in fish processing.
8. Quality deterioration and defects in products: Chilled processed fish, frozen fish, smoked fish, dried and salted fish, canned fish, marinades and heat processed fish.
9. Methods of assessing quality of fish for consumption: Sensory methods, mechanical or instrumental methods and laboratory methods-chemical/biochemical analysis and microbiological analysis.
10. Inspection: Organization of fish inspection and quality control, the Importance of inspection in the utilization of fishery resources, programmes of fish inspection and quality control (FIQC), organizational structure, duties and responsibilities and inspection services of FIQC.
11. Inspection of fishery products: Fresh, precooked and frozen fish, hygiene and safety aspect of fishery products.
12. Checklist of inspections of farms, depots and processing industries.

Recommended books/ literatures:

1. Control of Fish Quality. J. J. Connell (1980). Fishing News Books Ltd.
2. Safety and quality issues in fish processing, Edited by H. Allan Bremner. 2002, Woodhead Publishing Limited and CRC Press LLC
3. Fundamentals of Quality Control for the Food Industry. A. Kramer and B. A. Twigg (1966). The AVI Publ. Co. Inc. West port.
4. Processing of Aquatic Food Products. F. W. Wheaton and T. B. Lawson (1985). Wiley Inter Science. New York.
5. On Testing the Freshness of Frozen Fish. G. J. A. Peter (editor) (1971). Fishing News Books Ltd. London.
6. Harvests and Post-harvest Technology of Fish. K. Rabindran (editor) (1985). Society of Fisheries Technologists, India.
7. Industrial Fishery Technology. M. E. Stausby (1963). Reinhold Publ. Corp. New York.
8. Food authenticity and traceability Edited by MicheÁle Lees. 2003, Woodhead Publishing Limited and CRC Press LLC
9. Fish and Fishery Products Hazards and Controls Guidance Fourth Edition, 2011. U.S. Department of Health and Human Services Food and Drug Administration Center for Food Safety and Applied Nutrition (240) 402-2300
10. Technological Control in the Fish Processing Industry. G. V. Gerasimov and M. T. Antonova (1979). Amerind Publishing Co. Pvt. Ltd. New Delhi, Bombay, Calcutta, New York.

FHT-4707: Research Methodology

Credits: 2

Full Marks: 100 (Theory 70, Class Test 20 and Attendance 10)

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

Objectives

To provide students with the knowledge of importance and scope of the research methodology, experimental design, Concept and types of research, and Thesis and scientific paper writing and publications.

Course Contents:

1. Background, pioneer, objective, expected outcome, importance and scope of the course.
2. Research Problem and Design: Concept of research problem, problems encountered by researches in Bangladesh and its solution. Needs for research design, different research design, developing a research plan.
3. Data Collection and Analysis: Data collection methods, selection for appropriate method for data collection, problems of data processing, normality check of data, appropriate test for data analysis.
4. Principles of experimental design, field lay-out and analysis of variance in completely randomized design, randomized block design and Latin square design, analysis of co-variance in a completely randomized design.
5. Concept and types of research, different steps of conducting research.

6. Thesis and scientific paper writing and publication: Introduction, materials and methods, results and observations, review of literature and references.
7. Computer and its application in research: introduction of computers, data input and analysis, uses of various software.

Recommended books/ literatures:

1. How to write and publish a scientific paper, Robert A. Day (1996). Cambridge University Press, Canada.
2. Writing your thesis, Paul Oliver (2006), Vistaar Publications, New Delhi.
3. Introduction to information systems, James A. O'Brien.

Practical and Viva-voce Courses

FHP-4711: Practical and Viva-voce on Genetics in Fish Breeding

Credit-1

Full marks: 100 (Class record: 10; Practical: 60 +Viva-voce: 20+Attendance: 10)

1. Sexing of fish by gonad squashing and aceto-carmin staining method
2. Induction of androgenesis in tilapia
3. Production of monosex population in tilapia by using sex-reversed males/females.
4. Practical on selective breeding, hybridization, genetic drift, effective breeding number.
5. Induced breeding of fish: selection of breeders
6. Field visit on public and private hatchery with special reference to breeding problems.

FHP-4712: Practical and Viva-voce on Fisheries Resources Management

Credit-1

Full marks: 100 (Class record: 10; Practical: 60 +Viva-voce: 20+Attendance: 10)

1. Fisheries resources in Bangladesh
2. Riverine, haor, baor, lake, beel and flood plain fisheries management
3. Fish sanctuary: Management and conservation aspects
4. Fish pass: Management and conservation aspects
5. Fisheries management and food security
6. Fish acts in Bangladesh
7. Field visit and report writing on fisheries management techniques.

FHP-4713: Practical and Viva-voce on Fish Health Management and Pharmacology

Credit-1

Full marks: 100 (Class record: 10; Practical: 60 +Viva-voce: 20+Attendance: 10)

1. Diagnostic techniques of fish disease
2. Drug administration techniques
3. Vaccination in aquaculture
4. Prevention and control of pathogenic fish diseases
5. Calculation of diseases treatment

FHP-4714: Practical and Viva-voce on Fish Feed Technology - II

Credit-1

Full marks: 100 (Class record: 10; Practical: 60 +Viva-voce: 20+Attendance: 10)

1. Survey of commercially available packed fish feed, chemicals etc. used with fish feed in different areas of Bangladesh.
2. Review on non-nutrients and toxic component found in fish feed ingredients.
3. Preparation of moist, semi-moist, live feeds, pellets and crumbles.
4. Observation feeding intensity on pellets by different culturable species (aquarium experiment).
5. Small scale pellets manufacturing process.
6. Evaluation of Experimental diets.
7. Visit to feed manufacturing plant and report writing.

FHP-4715: Practical and Viva-voce on Fisheries Extension

Credit-1

Full marks: 100 (Class record: 10; Practical: 60 +Viva-voce: 20+Attendance: 10)

1. Collection of basic fisheries extension data.
2. Preparation of questionnaire or interview schedule for collection of data from the villages.
3. Survey of fisheries condition, preparation and presentation of survey report.
4. Preparation of session plan based training program and practice training.
5. Preparation and use of extension communication materials: leaflet/folder, poster, flash cards.
6. Preparation of extension program for fisheries development in an area
7. Visit to the office of the District Fisheries Office in order to be acquainted with different fisheries development program and roles played by the District level office.
8. Preparation of annual calendar of work.

9. Prepare/organize participatory extension activities: case study, role play etc.

FHP-4716: Practical and Viva-voce on Fish Inspection and Quality Control

Credit-1

Full marks: 100 (Class record: 10; Practical: 60 +Viva-voce: 20+Attendance: 10)

1. Organoleptic, physical, biochemical and bacteriological evaluation of fresh, chilled and frozen fish and shellfish Products
2. Determination of total volatile base nitrogen (TVB-N) from fish sample.
3. Determination of peroxide value (PV) of fish sample.
4. Enumeration of total viable count of bacteria and fungus.
5. Enumeration of coliform and fecal coliform in fish and fishery products
6. Enumeration of Salmonella in fish and fishery products.
7. Equipments required in a modern shrimp processing plant.
8. Traceability in shrimp industry of Bangladesh
9. Group work and presentation about GMP, HACCP and ISO 9000.
10. Field trip.

FHP-4717: Practical and Viva-voce on Research Methodology

Credit-1

Full marks: 100 (Class record: 10; Practical: 60 +Viva-voce: 20+Attendance: 10)

1. Searching of literature and information from books, dissertations, abstracts, journals and periodicals for building up bibliographies.
2. Sample collection and data analysis.
3. Different statistical tests selection and its application with collected data.
4. Preparation of poster and power point presentation.
5. Different fisheries software run through computers using collected data.

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Internship Courses

FHI-4801: In Plant Attachment

Credits: 1

Full Marks: 100 (Presentation 80, Viva-voce 20)

Students will be attached to different aspects of fisheries sector *viz.* hatcheries, processing industries/plants, fish feed industries, fish farms, upazila fisheries offices, district fisheries offices, BFRI, BFDC or relevant organizations individually or in a group for 15 days to acquire practical experience according to the prescribed datasheet approved by the academic committee. They will maintain the data sheet to record their daily observations along with the comment of the concern authority. After completion the task, students will give a presentation (80 marks) along with the submission of raw data sheets and face viva-voce (20 marks) at the date decided by the examination committee. Based on the performances in the place of attachment, student will also collect a certificate from the concern authority and submit it during viva-voce.

FHI-4802: JOC

Credits: 2

Full Marks: 100 (Presentation 80, Viva-voce 20)

Students will carry out a 30 days field work for the fulfillment of this course. Students will be divided into several groups to assign in the practical work *viz.* hatchery management, fry rearing, nursery management, pond preparation, feed production, cage preparation and management, aquarium fish culture and other relevant fields recommended by the academic committee. Students will apply their knowledge in the assigned field and will demonstrate their work experience as presentation (80 marks) and face viva-voce (20 marks) at the date decided by the examination committee.

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FHI-4803: Excursion

Credits: 1

Full Marks: 100 (Report 80, Viva-voce 20)

An excursion (10 days) will be conducted based on the prescribed sites and activities (including tour plan) as decided by the course teachers with the prior approval of the academic committee of the Department. Attended students will submit a report (80 marks) and attend viva-voce (20 marks) at the date decided by the examination committee. However, if a student unable to complete the excursion tour, he/she will complete an alternative work according to the decision of the academic committee and will submit a similar report on the same day.

The prescribed sites and/or activities to be carried out under this course are as follows:

1. Coastal and marine habitat: Study of physical, chemical and biological properties, collection of sediments.
2. Kaptai lake fishery: Different species caught, harvesting method, aquaculture practice (if any), physical, chemical and biological properties.
3. Haor, baor, spring and mangrove fishery: Physical, chemical and biological properties, CBFM/Co-management activities.
4. Fish landing center: Different species found, valuable species, storage system, market and value chain.
5. Prawn and shrimp farms: Culture system, major problems.
6. Shrimp and prawn hatcheries: Brood, feed and seed quality, capacity, major problems.
7. Fish processing industries: Methods, application of standard.
8. Other fisheries sites(including hotspots) and activities.

FHI-4804: Aquaculture Practical Experience

Credits: 2

Full Marks:100

To carry out the course each student will spend one crop season (90 days) with a particular fish farmer and will study on- culture system and practices (Pre-stocking, stocking and post-stocking management including growth, survivability/mortality, production, economics and marketing).All the students will be attached to the academic staff (teachers available in the department) as their research supervisor. Students should submit a dissertation with in 25 pages on the date decided by the relevant examination committee.

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FHI-4805: Research Work

Credits: 3

Full Marks: 100

Students will carry out a research work at the Semester-8 of Level-4. At the beginning of Semester-8 all the students will be attached to the academic staff (teachers available in the department) as their research supervisor. Finally, they will submit a thesis (100 Marks) based on research findings at the date decided by the examination committee. Thesis may be consisted of abstract (10 marks) introduction (including problem statement, review of literature, importance and objective) (25 marks), materials and methods (20 marks), results and discussion (20 marks), conclusion and recommendation (5 marks) and reference/literature cited (20 marks).

FHI-4806: Fisheries Extension Field Trip

Credits: 1

Full Marks: 100 (Report 80, Viva-voce 20)

Students will carry out a 10 days Extension Field Trip for the fulfillment of this course. Students will be attached in a Upazila with the supervision of the course teachers to carry out

the extension field trip. During the trip students will participate all the activities as designed by the course teachers and submit a report on their daily activities (80 marks) and face viva-voce (20 marks) at the date decided by the examination committee.