FACULTY OF FISHERIES

COURSE LAY OUT AND SYLLABUS

OF

B.SC.Fisheries (Hons.) DEGREE

Level - 3

HAJEE MOHAMMAD DANESH SCIENCE AND TECHNOLOGY UNIVERSITY
DINAJPUR

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Course Layout of B.Sc. Fisheries (Hons.) Degree

	Semesters					
Level /Year	Semester-I			Semester-II		
	Course Title	Course Code	Credit Hour (T+P)	Course Title	Course Code	Credit Hour (T+P)
1	**Compulsory**			**Compulsory**		
	Fisheries Zoology	FBG 101, 102	3+1.5	General Ichthyology	FBG 103, 104	3+1.5
	Aquatic Ecology	FMG 101, 102	3+1.5	Fresh Water Aquaculture	AQC 103, 104	3+1.5
	Chemistry	ACH 107, 108	3+1.5	Physico-Chemical Limnology	FMG 103, 104	3+1.5
	Rural Sociology	SSL 119	3+0	Biochemistry	ACH 109, 110	3+1.5
	Elective (any one)			**Elective (any one)**		
	English Language	SSL 121	2+0	Computer Science	CIT 111	2+0
	Introductory Aquaculture	AQC 101	2+0	Aquatic Soil Science	FMG 105	2+0
	Total Credit		**14+4.5=18.5**	**Total Credit**		**14+6=20**
	Semesters					
2	Semester-I			Semester-II		
	Compulsory			**Compulsory**		
	Biodiversity and Fishery Systematics	FBG 201, 202	3+1.5	Fish Parasitology	AQC 205, 206	3+1.5
	Coastal Aquaculture	AQC 201, 202	3+1.5	Fish Population Dynamics-I	FMG 203	3+0
	Fisheries Microbiology-I	FTL 201	3+0	Principles of Genetics	FBG 204, 205	3+1.5
	Statistics	STT 205, 206	3+1.5	Fisheries Microbiology-II	FTL 203	3+0
	Biological Limnology	FMG 201, 202	3+1.5	Fisheries Microbiology	FTL 204	0+1.5
	Elective (any one)			**Elective (any one)**		
	GIS in Fisheries	AQC 203	2+0	Live Food Culture	AQC 207	2+0
	Shell fish Biology	FBG 203	2+0	Aquatic Environmental Science	FMG 205	2+0
	Total Credit		**17+6=23**	**Total Credit**		**14+4.5=18.5**
	Semesters					
3	Semester-I			Semester-II		
	Compulsory			**Compulsory**		
	Fish Pathology	AQC 301, 302	3+1.5	Fish Nutrition	AQC 303, 304	3+1.5
	Fish Population Dynamics-II	FMG 301	3+0	Fish Farm Design and Construction	AQC 305, 306	3+1.5
	Fish Population Dynamics	FMG 302	0+1.5	Oceanography and Marine Biology	FMG 303, 304	3+1.5
	Fish Physiology	FBG 301, 302	3+1.5	Fish Processing	FTL 305, 306	3+1.5
	Fish Harvesting	FTL 301, 302	3+1.5			
	Elective (any one)			**Elective (any one)**		
	Fishery by-products	FTL 303	2+0	Marine Food Chemistry	FTL 307	2+0
	Biology of Farmed Fishes	FBG 303	2+0	Culture of Ornamental Fish	AQC 307	2+0
	Total Credit		**14+6=20**	**Total Credit**		**14+6=20**

COURSE LAYOUT

Level /Year	Course Title	Course Code	Credit Hour (T+P)	Course Title	Course Code	Credit Hour (T+P)
	Semesters					
4	Semester-I			Semester-II		
	Compulsory			**Compulsory**		
	Fish Genetics and Breeding	FBG 401, 402	3+1.5	Hatchery Management	FBG 403, 404	3+1.5
	Fish Feed Technology	AQC 401, 402	3+1.5	Fish Health Management	AQC 405, 406	3+1.5
	Inland Fisheries Management	FMG 401, 402	3+1.5	Fisheries Extension		3+1.5
	Quality Control of Fishery Products	FTL 401, 402	3+1.5	Marine Fisheries Management	FMG 405, 406	3+1.5
	Fisheries Economies	ECN 407	3+0	**Elective (any one)**		
	Elective (any one)			Principles of Molecular Biology & Biotechnology	FBG 405	2+0
	Integrated Aquaculture	AQC 403	2+0	Sustainable Livelihood Approach (SLA)	FMG 407	2+0
	Fisheries Resources	FMG 403	2+0			
	Total Credit		**17+6=23**	**Total Credit**		**14+6=20**

Credit required for Theoretical : 118
Credit required for Practical : 45
Total Credit required : 163

Level-3 Semester - I

Department of Aquaculture

AQC 301: Fish Pathology

Theoretical: 3 Cr.

Introduction: General significance of fish disease. Degree of infection. Factors producing diseases in fish. General signs of diseased fish.

Pathological changes in diseased fish: Circulatory disturbances, cellular degeneration, necrosis, inflammation, disturbances of growth and development.

Systemic pathology of fish: Integument and musculoskeletal pathology, gill pathology, digestive and related system pathology, renal pathology, pathology of eye.

Viral diseases of fish: Fish pathogenic virus. Epozootiology, distribution etiology, clinical signs and pathology.

Bacterial diseases of fish: Characteristics of major bacterial fish pathogens. Epizootiology, distribution, etiology, clinical signs, pathology and diagnosis. Major typing of bacterial diseases based on pathological signs.

Fungal diseases of fish: Characteristics and life cycle of major fungal fish pathogens. Epizootiology, distribution, etiology, clinical signs, pathology and diagnosis.

Stress and infectious disease: Environmental stress and their effects on fish.

Nutritional Pathology of fish: Pathological syndrome associated with dietary imbalance.

Hereditary fish diseases: Tumors and growth abnormalities.

AQC 302: Fish Pathology

Practical: 1.5

Students shall maintain a record of everything done in the practical and field sessions in a practical note book to be signed and checked by teacher (s) concerned. Viva voce test will form an essential part of the practical examination.

Diagnostic procedure for fish diseases: (a) conventional laboratory techniques for viral, bactrial and fugal identification (b) case study.

Study on clinical and pathological signs of diseased fish under laboratory and field condition.

Study on histopathological techniques: Sampling, tissue processing, microtomy, staining, mounting and microscopic observation

Observation of histopathological changes of different tissues and organs of diseased fish.

Case study for investigation of clinical and pathological signs of fish.

Text and reference books:

Inglis, V., R.J. Roberts and N.R. Bromage. 1993. Bacterial Diseases of Fish. Blackwell Science.

Roberts, R. J. (Editor). 1989. Fish Pathology. 2nd ed. Bailliers and Tindall, London.

Plumb, J.A.1999. Health Maintenance of Cultured Fishes: Principal Microbial Diseases. Iowas State University Press.

Bonded-Reantaso, M.G., McGladdery, S.E., East, I., and Subsinghe, R.E. (eds) (2001). Asia Diagnostic Guide to Aquatic Animal Diseases. FAO Fisheries Technical Paper No 402, Supplement 2. Rome, FAO, 240 pp.

Frerichs, N.G and Millar, S.D. 1993. Manual for the Isolation and Identification of Fish Bacterial Pathogens, Pisces Press, Starling.

Post, G. 1987. Textbook of Fish Health. T.F.H. Publications, Inc. USA.

Austin, B and D. A. Austin. 1999. Bacterial Fish Pathogens: Disease of Farmed and Wild Fish, Ellis Horwood, England.

Bullock, G.L. 1980. Identification of Fish Pathogenic Bacterial TFH Publication.

Chainabut, S and R.J. Roberts. 1999. Pathology and Histopathology of Epizootic Ulcerative Syndrome (EUS), AAHRI, Department of Fisheries, Bangkok, Thailand.

Chanratchakool, P, J. F Turnbull, S, Funge-Smith, I. H MacRae and C. Limsuwan. 1998. Health Management in Shrimp Ponds (3rd Ed.), AAHRI, Bangkok, Thailand.

Brown, L.1994. Aquaculture for Veterinarians: Fish Husbandry and Medicine, Pergmon Press, Oxford.

Noga, E.J. 2000. Fish Disease: Diagnosis and Treatment. Iowa State University Press.

Cross, J.H (Editor). 1983. Bacterial and viral diseases of fish. Washington Sea Grant Publication.

Egusa, S. 1992. Infectious Diseases of Fish. Oxonian Press Ltd. New Delhi.

Ferguson, H.W. Systemic Pathology of Fish. 1989. Iowa State University Press.

McMillan, T. 2000. Fish Histology, Chapman & Hall.

Roberts. R. J. (Editor). 1982. Microbial Diseases of Fish. Academic Press.

Sarig, S. 1981. Diseases of Fishes. (edited by S.F. Snieszko and H.R. Axelrod). Book 3. The Prevention and Treatment of Diseases of Warm water Fishes under Subtropical Conditions, With Special Emphasis on intensive Fish Farming. TFH. Publication.

Sindermann, J. 1990. Principal Diseases of Marine fish and shell fish Vol. 1 & 2 second ed. Academic press inc.

Sindermann. A.J. and O.V. Lighter. 1988. Diseases Diagnosis and Control North Americal Marine Aquaculture. Elsevier.

Sineszko, S.F. and H.R. Axelrod, (Editor). 1976. Diseases of Fishes. V. Environmental Stress and Fish Diseases. TFH. Publication.

Trever-Brown, K.M. 2000. Applied Fish Pharmacology (Aquaculture, Vol. 3). Kluwer Academic Publications.

Austin, B and D. A. Austin (eds). 1989. Methods for the Microbiological examination of Fish and shellfish.Ellis Horwood, England.

Tonguthai, K., Chainabut, S., Somsiri, T., Chanratchkakool and Kanchanakhan, S. 1999. Diagnostic procedure for finfish diseases. Aquatic animal Health Research Institute, Department of Fisheries, Bangkok, Thailand.

Chainabut, S and R.J. Roberts 1999. Pathology and Histopathology of Epizootic Ulcerative Syndrome (EUS), AAHRI, Department of Fisheries, Bangkok, Thailand.

McMillan, T. 2000. Fish Histology, Chapman & Hall.

Department of Fisheries Management

FMG 301**:** Fish Population Dynamics- II

Theoretical: 3 Cr.

Reproduction: Definition, timing of reproduction, gonad maturation stages, gonad-somatic indices, fecundity, length and age at sexual maturity

Recruitment: Definition, timing of recruitment, length at recruitment, factors affecting recruitment and stock-recruitment relationships

Mortality: Definition and types, factors causing mortality; concept of mortality equation, estimation of fishing mortality-age-based catch curves, length-based catch curves, Beverton & Holt equations, virtual population analysis (VPA) and cohort analysis, mark-recapture analysis; natural mortality and its estimation

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

Migration: Definition, types, migration of Hilsa (*Tenualosa ilisha*) from/to marine and fresh waters

Yield: Basic concept of fish yield; definition of equilibrium yield, maximum sustainable yield (MSY) and maximum economic yield (MEY); Fishing to biological reference points; acquaintance with different models to estimate maximum sustainable yield

Estimation of Yield: Estimation of maximum sustainable yield by the models of Schaefer and Fox.

FMG 302 : Fish Population Dynamics

Practical : 1.5 Cr.

Students shall be required to show a good knowledge of the topics included in the theoretical portion of the paper. They shall maintain a record of everything done in practical classes/ field trips in a practical notebook to be signed and checked by the teacher(s) concerned. Viva-voce test will form an essential part of the practical examination.

1. Sampling considerations for gathering information about fish populations
2. Recording the length and weight of fish in a sample
3. Estimation of catch per unit effort, fish population abundance estimation by mark-recapture method and Depletion methods
4. Total length-standard length, total length-fork length, and length-weight relationships and condition factor of fish populations
5. Determination of the selectivity of fishing gear by Covered codend experiments
6. Determination of age and growth of fish by length-frequency and hard part analysis
7. Determination of spawning season/s by gonadosomatic index and gonad maturation stages; estimation of fecundity of fish
8. Estimation of total mortality and fishing mortality rate by mark and recapture method

Text books and references:

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 WIX 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., 1958. Hand book of computations for biological statistics of fish populations. Bulletin No. 19. Fisheries Research Board of Canada. Ottawa. 300 pp.
13. Ricker, W.E., 1968. Methos of assessment of fish production in freshwaters. Blackwell Scientific Publications, Oxford, 321 pp.
14. Ricker, W.E., 1975. Computation and interpretation of biological statistics of fish populations. Bull. Fish. Res. Board Can. 191: 382 p.
15. Solomon, M.E. 1976. Population dynamics. Second edition, Arnold (Publishers) Ltd. 67 p.
16. Rounsefell, G.A. and Everhart, W.H., 1953. Fishery Science: Its methods and application. John Wiley & Sons, Inc., New York. 444 pp.
17. 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.
18. Sparre, P., Ursin, E. and Venema, S.C., 1989. Introduction to tropical fish stock assessment. Part 2. Excercises. FAO Fisheries Technical Paper. No. 306.2. Rome, FAO. 429 p.

Level-3, S-I

Department of Fisheries Biology and Genetics

FBG 301: Fish Physiology

Theoretical: 3 Cr.

Introduction: Course goals, objectives and outcomes. Overview of physiological processes in fish.

Temperature regulation: Classification of fish based on thermal regulation; low and high thermal effect, temperature regulation in homeotherms. Fish as poikilotherms. Endothermic fishes.

Physiology of digestion: Digestion mechanism of different classes of food: role of HCl, bile, enzymes and hormones; gastric evacuation; parameters to study efficiency of digestion; absorption of digested food.

Metabolism: Metabolism and its phases. Classification of metabolic rate based on activity level. Factors controlling metabolism of fish.

Physiology of blood circulation: Importance of blood circulation. Components of circulatory system. Cardiovascular parameters and controlling factors.

Physiology of respiration: External and internal respiration. Mechanism of gas transport and exchange; factors affecting O_2 and hemoglobin affinity. Respiratory volume.

Physiology of excretion: Excretory products in different groups of fishes. Mechanism of excretion.

Osmoregulation: Definition of relevant terminology; osmoregulatory approaches in hagfish, lamprey, elasmobranches, marine and freshwater teleosts and euryhaline fishes.

Reproductive physiology: Reproductive cycle. Oogenesis and spermatogenesis. Hormones controlling gonad maturation and reproduction. Environmental and hormonal interplay in controlling reproduction in fishes.

Physiological integration by endocrine system: Hormones and their roles in the life processes of fish. Mechanism of hormonal action at cellular level. Hormonal hierarchy. Feedback control of hormones.

Special organs: light and electric organs

Types of bioluminescence: Structure of light organs. Mechanism of light production. Anatomy of electric organ in fishes. Physiology of electricity production; electro sensation.

FBG 302: Fish Physiology
Practical : 1.5

1. Test of pepsin enzyme in stomach.
Study of oxygen consumption rate under different metabolic levels.
Preparation of blood smear and study on different types of blood cells.
Counting of RBC and WBC by haemacytometer.
Histological study of fish gill.
Histological study of fish kidney.
Studies on ammonia excretion in fishes.
Study of the effects of salinity changes on different species of fish.
Studies on developmental stages of fish gonad.

Text Books and references:

Evans, D.H. (ed.), 1998. The Physiology of Fishes. Second edition. CRC Press.

Jobling, M., 1995. Environmental Biology of Fishes. Chapman and Hall, London Fish and Fisheries Series 16.

Moyle, P.B. and Cech, J.J., 1988. Fishes: An Introduction to Ichthyology. Second edition. New Jersey: Prentice-Hall Inc., Eaglewood Cliffs.

Bond, C.E., 1979. Biology of Fishes. Saunders College Publishing.

Hepher, B., 1988. Nutrition of Pond Fishes. Cambridge Univ. Press.

Hoar, W.S., 1983. General and Comparative Physiology. Third Edition. New Jersey. Prentice-Hall Inc., Eaglewood Cliffs.

Hoar, W.S. and Randall, D.J (eds.), 1969. Fish Physiology. Academic Press Inc.

Hopson, J.L. and Wessells, N.K., 1990. Essentials of Biology. McGraw-Hill Publishing Company.

Iwama, G. and Nakanishi, T. (eds.), 1996. The Fish Immune System. Academic Press.

Steffens, W., 1989. Principles of Fish Nutrition. Ellis Howard Ltd.

Turner, C.D. and Bagnara J.T., 1976. General Endocrinology. Sixth edition. W. B. Saunders Co.

Department of Fisheries Technology

FTL 301 **:** Fish Harvesting

Theoretical : 3 Cr.

1. Modern trends in fishing. Fishing regulation. Fish harvesting and fisheries management for open waters.

2. Different types of fishing and fishing gear: industrial fishing, successful and unsuccessful fishing, responsible fishing, sports fishing. Traditional & modern fishing gears. Fishing twine: construction, terminology, numbering system. Properties of synthetic fibres, fish net efficiency Choice of netting material for important fishing gears Sinkers, floats, buoys in fishing. Fish responses to fishing gears.

3. Navigation in fishing. Location of fishing grounds in sea. Factors in locating fishing grounds–environmental conditions. Electronic equipment for fish finding techniques. Fish detection. Acoustic equipment–echo sounder, echo-ranger, SONAR (sound navigation and ranging), net monitoring system. Mid water fish and bottom fish detection by SONAR.

4. 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. Attraction of fish towards to different stimuli.

5. Commercial fishing gears and methods: Purse seining, trawl net. gill net, trammel net; lift net; estuarine set bag net; long line: types and operation. Trolling line and trolling jigs. Traps–characteristics of trap fishing. Other fishing implements– spatula, spears, tongs, seaweed twisters, rakes, scoop net and harpoon gun. Methods of harvesting pelagic, demersal and shell fish in the Bay of Bengal and coastal areas of Bangladesh.

6. Fishing crafts: classification, common and technical terms for various parts. Fishing crafts in Bangladesh freshwater. Mechanized fishing vessel types and characteristics. Marine diesel engine for fishing boat. Major equipment on a fishing trawler.

FTL 302: Fish Harvesting
Practical : 1.5 Cr.

Students shall maintain a record of everything done in the practical and field sessions in a Practical Note Book to be signed and checked by teacher (s) concerned.

Acquaintance with different types of fishing gears: Wounding gears, traps and nets. Identification, description, operation and significance.

Acquaintance with different types of fishing crafts used in Bangladesh: Identification, carrying capacities and significance.

Examination of different net materials: Yarn, strand, twine, cord and its direction. Study of count system of fishing twines.

Identification of different types of natural and synthetic fibers used in fishing.

Practice on net making and mending.

Exercise on different techniques of net preservation.

Field visit to a fish landing center.

Field visit to the river Brahmaputra to see different fishing operation.

Exercise on fish harvesting using seine net and caste net in a University fish pond.

Text books and reference:

Kristjonsson, H. (Ed.) 1975. Modern fishing gears of the World. Fishing News (Books) Ltd. Surrey, England.

Training Department, SEAFDEC (Ed.) 1988. Fishing Technology outline. TD/TRB/45, October 1988. Text Reference book. Southeast Asian Fisheries Development Center, Phroprudoeng, Samutpraken, Thailand.

Brandt, A. V. 1984. Fish catching methods of the world (Third Edition). Fishing News (Books) Ltd. Surrey, England.

Nomura, M. 1978. Outline of fishing gear and method. Kanagawa International Fisheries Training Center. Nagai, Yokoshika-shi, Kanagawa-ken, Japan.

Garner, J. 1982. How to make and set nets or the Technology of netting. Fishing News (Books) Ltd. Surrey. England.

Sainsbury, J. C. 1975. Commercial fishing methods: an introduction to vessels and gears. Fishing News (Books) Ltd. Surrey. England.

Chokesanguan, B. (Ed.) 1985. Basic knowledge of trawl and trawling. Training Department. Td/LN/58, September 1985. Southeast Asian Fisheries Development Center. Samutpraken, Thailand.

Thomson, D. 1978. Pair trawling and pair seining. The technology of two-boat fishing. Fishing News (Books) Ltd. Surrey. England.

Thomson, D. 1981. Seine fishing. Bottom fishing with rope warps and wing trawls incorporating the *Seine Net – its origin, evolution and use.* Fishing News (Books) Ltd. Surrey. England.

Perry Mrin, W. H. (Captain) (Ed.). 1982. Fishermen's handbook. Fishing News (Books) Ltd. Surrey, England.

Rabindran, K., Nair, N.U., Perigreen, P.A., Madhavan, P., Pillai, A.G.G., Panicker, A. and M. Thomas (Eds.) 1985. Harvest and post-harvest technology of fish. Society of Fisheries Technologies, Cochin, India.

Department of Fisheries Technology

FTL 303 : Fishery Products and By-products (Elective)
Theoretical : 3 Cr.

1. **Introduction to fishery products and by-products in Bangladesh:** Scientific and technological development in fishery products.

2. **Chilled and frozen products:** Chilled and frozen fishery products, frozen storage, scientific and technological problems associated with chilled and frozen fishery products.
3. **Dried and dehydrated fishery products:** Types of various traditional sun dried and dehydrated products. Technological problems and quality control of dehydrated and dried products.
4. **Salted products:** Kinds of salted fish and fish roe. Technical problem in curing of fish and fish roe. Storage of salted products.
5. **Smoked products:** Categories of smoked fish and shellfish. Technical problems associated with smoked fish
6. **Canned products:** Kinds of canned products, shape and size of can, storage of canned fish, technical problem in canned fish.p
7. **Fermented fishery products:** Types of fermented products and technical problems in fermented products.
8. **Surimi and diversified value-added fishery products:** Various minced and surimi based fish and shrimp products, fish ball, fish finger, kamaboko , chikwa, fish cakes, fish pickles, fish soup powder etc.
9. **Fishery By-products:** Fish meal, fish protein concentrate, fish oil and refining, shark fin rays, fish maws/Isinglass, pearl essence, fish glue, ambergris, fish marinades, fish silage, fish hydrolyzate etc.

Text books and reference:

1. Tanikawa, E. Motohiro, T, and Akiba, M. 1985. Marine products in Japan, Published by Koseisha Koseikaku Co., Ltd., Tokyo. Gopakumar 1997. Tropical fishery products, Science Publishers, Inc.

2. Windsor, M. and Barlow, S. 1981. Introduction o Fishery by-products. Fishing News Books Ltd.;

3. Hall, G. M. 1997. Fish processing technology. Blakie Academic & Professional, London, Weinheim, New York, Melbourne, Madras.

4. Govindan, T.K. 1985. Fish Processing Technology, Oxford & IBH publishing Co., New Delhi Bangladesh Agricultural University, Mymensingh Department of Fisheries Technology

Department of Fisheries Biology and Genetics

FBG 303 : Biology of Farmed Fishes (Elective)
Theoretical : 2 Cr.

1. **Introduction:** Course goals, objectives and outcomes Present status of farmed fishes: an overview
2. **Life history of important group of farmed fishes with references to food and feeding habit, digestion, growth and reproduction:** Freshwater fishes- Cyprinids, Cichlids, Catfishes, Snakeheads, Perches, Exotic fishes, and Trout Marine fishes Sea bass, Sea bream, Eel, Flounder, Yellow tail, Mullet, Milkfish, and Salmon
3. **Early life history stages of farmed fishes:** Gonadal embryonic and larval development. Environmental effects: Temperature, salinity, light, current and metabolic effects on feeding.
4. **Behavior manipulation in farmed fishes:** Environmental control through Pond/Cage/Tank/Pen design, Water quality and feeding patterns. Dominance regulation and suppression of aggressive behavior. Domestication and environmental manipulation. Recent developments in the field of biology of farmed fishes

Text Books and references:

1. Black, K.D. and Pickering, A.D. (eds.), 1998. Biology of Farmed Fishes. Sheffield Academic Press, England.
2. Chakrabarty, N.M., 1998. Biology, Culture and Production of Indian Major Carps - A Review. Narendra Publishing House, Delhi, India.
3. Nash, C.E. and Novotny, A.J. (eds.). 1995. Production of Aquatic Animals. Fishes. Elsevier, Amsterdam, The Netherlands.
4. Beveridge M.C.M. and McAndrew, B.J. (eds.), 1998. Tilapias: their Biology and Exploitation. Chapman and Hall, London.
5. Pillay, T.V.R., 1990. Aquaculture: Principle and Practice. Fishing News Books, Oxford, England.
6. Billard, R., 1999. Carp: Biology and Culture. Springer (in association with Praxix Publishing, (UK).
7. Billard, R. and Gall, G.A.E. 1995. The Carp. *Aquaculture*, Vol. 129. Elsevier.
8. Winfield, I.J. and Nelson, J.S. (eds.), 1991. Cyprinid Fishes: Systematics, Biology and Exploitation. Chapman and Hall.

Semester- II

Department of Aquaculture

AQC 303 : Fish Nutrition

Theoretical: 3 Cr.

1. Introduction: Role of nutrition in aquaculture practices. Terminology used in fish nutrition.

2. Protein and amino acids: Classification and functions, quantitative dietary protein requirements for fish and crustaceans, protein as an energy source and amino acid requirement. Factors affecting protein and amino acid requirement. Amino acid availability, evaluation of protein quality.

3. Lipid and fatty acids: Dietary lipid requirement of fish and shellfish, lipid as energy and essential fatty acid source, essential fatty acid requirement of fish and shellfish and sources of fatty acids.

4. Carbohydrates: Carbohydrates as energy source. Utilization of dietary carbohydrates and fibre.

5. Minerals: Classification and general functions, macro and microelements, functions and sources, and mineral requirement for fish.

6. Vitamins: Water-soluble and fat-soluble vitamins, biological functions and dietary sources.

7. Energy metabolism in cultivated fish and crustaceans: Partitioning of biological energy, specific dynamic action, energy metabolism and energy requirement of fish and crustacean. Factors affecting energy requirements, Dietary energy sources. Nutrient budget in pond ecosystem.

8. Digestion and absorption of nutrients: Digestive fluids and enzymes, protein, fat, carbohydrate and microbial digestion. Rate of digestion, factors affecting rate of digestion, absorption and assimilation and excretion.

9. Digestibility and digestibility coefficients: Apparent and true digestibility, direct and indirect methods of digestibility determination - advantages and disadvantages. Factors affecting digestibility.

10. Nutritional disorders in fish due to nutrients.

11. Larval and broodstock nutrition: Energy partitioning for reproduction, effect of dietary quality on reproductive output, nutritional requirements of broodstock and larvae.

AQC 304: Fish Nutrition

Practical: 1.5

Students shall maintain a record of everything done in the practical and field sessions in a practical notebook to be signed and checked by teacher (s) concerned. Viva voce test will form an essential part of the practical examination.

1. Introduction to laboratory equipment and safety procedures

2. Proximate composition analysis, feed ingredients, compounded feed and naturally produced food and carcass samples: a) moisture/ dry matter, b) protein, c) lipid, d) ash, and e) crude fibre.

3. Estimation of gross energy value by Bomb Calorimeter

4. Techniques for faecal collection.

5. Determination of chromic oxide content in feed and fecal sample.

6. Digestibility studies of dry matter, protein and lipid content in feed.

7. Analysis of growth responses, food conversion and protein utilization.

8. Aquarium setting for nutritional studies.

9. Study of growth performances under different feeding practices in field conditions.

Text and reference books:

De Silva, S.S. and Anderson, T.A., 1995. Fish Nutrition in Aquaculture. Chapman & Hall, London, 319 pp.

Halver, J.E. 1988. Fish Nutrition. Academic Press, New York,798pp.

3. Hepher, B., 1990. Nutrition of Pond Fishes. Cambridge University Press, Cambridge, 388 pp.

AOAC, 1990. Official Methods of Analysis-15th Edition, Association of Official Analytical Chemists, Washington DC.

Goddard, S., 1996. Feed Management in Intensive Aquaculture, Chapman & Hall, Dept. BC, 115 Fifth Avenue, New York, NY 10003, 194 pp.

Guillaume, J., Kaushik, S., Bergot, P. and Metailler, R., 2001. Nutrition and Feeding of Fish and Crustaceans. Praxis Publishing, Chichester, UK, 408 pp.

Lovell, T., 1998. Nutrition and Feeding of Fish. Kluwer Academic Publishers, 3300 AH Dordrecht, The Nethelands, 267 pp.

New, M.B., 1987. Feed and Feeding of Fish and Shrimp. ADCP/REP/87/26, UNDP/FAO, Rome, 275 pp.

Steffens, W., 1989. Principles of Fish Nutrition. Ellis Horwood Ltd., West Sussex, 384 pp.

Tacon, A.G.J., 1990. Standard Methods for the Nutrition and Feeding of Farmed Fish and Shrimp. Argent Laboratories Press, Washington, 454 pp.

Tacon, A.G.J. and Basurco, B., 1997. Feeding Tomorrow's Fish. CIHEAM/FAO/IEO, Zaragoza (Espana), 307 pp.

Webster, C.D. and Lim, C.E., 2002. Nutrient Requirements and Feeding of Finfish for Aquaculture. CABI Publishing, CAB International, Wallingford, Oxon OX10 8DE, UK, 448 pp.

Department of Aquaculture

AQC 305: Fish Farm Design and Construction

Theoretical: 3 Cr.

1. **Introduction:** Importance and scope. Basic engineering principles for aqua farming; its present status and prospects.
2. **Site selection:** General considerations, soil and water quality. Survey techniques.
3. **Aquaculture systems:** Land based, water based and specialized systems.
4. **Design process:** Project planning; farm layout including hatcheries, nurseries and grow out units for carp, catfish and shellfish. Cages, raceways, tanks, recirculatory system, on-bottom and off-bottom culture systems.
5. **Construction process:** Contract, tender and bid; contract development, tender documents, evaluation of bids, bills of quantity, project costing, project site management, project monitoring and project ancillaries.
6. **Basic hydraulic systems:** Basic relationships in hydraulic systems; pumps and its installation procedures. Water flow through channel, pipe, weirs, sluice gate, monk, tidal gate and pen stock gate.
7. **Feeding system:** Feed storage, different types of feeders and feed delivery systems.
8. **Aeration systems:** Oxygen budget; oxygen requirement, principles of gas exchange, acration and oxygenation; types of blowers, aerators, compressors and oxygenation systems.
9. **Farm hygiene:** Sterilization and disinfections of farm units by heat, chlorinating, oozonation, UV-irradiation and other methods.
10. **Wastewater treatment and disposal:** Types of wastes in aqua farms, waste management, wastewater treatment by physical, chemical and biological methods.

AQC 306: Fish Farm Design and Construction

Practical : 1.5

Students shall maintain a record of everything done in the practical and field sessions in a practical note book to be signed and checked by teacher (s) concerned. Viva voce test will form an essential part of the practical examination.

1. Acquaintance with laboratory equipment.
2. Acquaintance with a theodolite.
3. Determination of soil texture.
4. Plane table and contour survey.
5. Site selection for commercial farms by individual student in his/her respective locality.
6. Design and cost estimation of a rural pond construction.
7. Design and cost estimation for the construction of a pond complex.
8. Design and cost estimation for the construction of cage, recirculatory system, raceway, finfish and shellfish farms.
9. Design and construction of inlet, outlet and overflow structures.
10 Case study: Field visit to different government and private fish farms to study their design and construction.

Text and reference books:

Bose, A. N., S. N. Ghosh, C. T. Yang and A. Mitra. 1991. Coastal Aquaculture Engineering. Cambridge University Press, Cambridge, UK. 365 pp.

Lawson, T. B. 1995. Fundamentals of Aquacultural Engineering. Chapman and Hall, New York., U.S.A 355 pp.

Pilay, T. V. R. 1993. Aquaculture: Principles and Practices. Cambridge University Press, Cambridge, UK. 575 pp.

Coche, A. G. and J. F. Muir. 1992. Training Series, Pond Construction. FAO, Rome, Italy.

Coche, A. G., J. F. Muir and T. Laughlin. 1995. Training Series. FAO, UNO, Rome, Italy.

Coche, A. G. and T. Laughiin. 1998. Training series, Topographic Tools. FAO, Rome, Italy.

Little, D. and J. Muir. A. Guide to Integrated warm water Aquaculture, University of Stirling. UK 238 pp.

Gray, C. W. 1990. A guide to shrimp and prawn hatchery techniques in Bangladesh. BAFRU, IOA, University of Stirling, Scotland, UK.

Huet, M. 1979. Textbook of Fish Culture: Breeding and Cultivation of Fish. Fishing News Books Ltd. UK.

Islam, M. A. 2001. Aquaculture. Bangla Academy. Dhaka. 352 pp.

Islam, M. A. Carp Jatiyo Macher Hatchery Mannual, Roushon Ara Choudhury, Mymensingh. 56 pp.

Muir, J. F. and R. J. Robert. 1982. Recent Advances in Aquaculture, Vol.3, Croon Helm, London, U. K.

Murray, K. R. 1988. Aquaculture Engineering Technologies for the Future. The Institution of chemical Engineers Symposium series No. 111, 20-23 June, 1988, IOA, University of Stirling, UK. 418 pp.

Nelson, K. D. 1985. Design and Construction of Earth Dams. Inkata Press, Melbourne, Australia.
Williuam Seamen. Jr., L. M. Sprague. 1991. Artificial Habitats for Marine and Freshwater Fisheries. Academic Press, Inc., London., UK.
16 Woynarovitch, E. 1975. Fish Ponds and their Construction: Elementary Guide to Fish Culture in Nepal, FAO, Rome, Italy.

Department of Fisheries Management

FMG 303: Oceanogrphy and Marine Biology
Theoretical: 3 Cr.

Introduction: Ocean, seas, straits, gulfs, bays – terminology and geographical locations. Origin and history of the oceans. Development of the oceanography. Topography of the ocean bottom- continental shelf, continental slope, continental rise, abyssal plain, seamounts etc. Classification of marine environment. Difference between coastal and oceanic environment.

Oceanic sediments: Importance, sources and classification. Transportation and distribution of sediments. Factors influencing marine sedimentation. Arrangement of sediments in the sea.

Oceanic tides, waves and currents: Tide, wave and current producing forces. Influence of tides, waves and currents on marine environment and fisheries. Major surface currents of the oceans and upwelling.

Properties of seawater: Temperature, light, salinity, dissolved gases and major nutrients. Factors influencing distribution of nutrient elements. Role of different physicochemical factors on marine organisms.

Fisheries oceanography: Utilization of oceanographic knowledge in locating new fishing areas/grounds, identification and location of unused fishery resources, information for improving fishing tactics, and fishery forecasting.

Marine communities: Classification and distribution of phytoplankton and zooplankton. Seasonal succession of phyto- and zooplankton. Phytoplankton-zooplankton interrelationships and their relations to fish production. Harmful algal blooms and causes of such bloom. Definition and importance of ichthyoplankton, benthic communities and seaweed.

Marine environment and pollution: Petroleum hydrocarbon, chlorinated hydrocarbon, sewage and heavy metal pollution, and their impact on marine ecosystem. Present environmental status and extent of pollution in the Bay of Bengal.

FMG 304 : Oceanography and Marine Biology
Practical : 1.5 Cr.

Students shall be required to show a good knowledge of the topics included in the theoretical portion of the paper. They shall maintain a record of everything done in practical classes/ field trips in a practical notebook to be signed and checked by the teacher(s) concerned. Viva-voce test will form an essential part of the practical examination.

Acquaintance with different oceanographic equipment.
Study of some physico-chemical parameters of seawater.
Collection, preservation, identification, counting and estimation of phytoplankton, zooplankton, ichthyoplankton from coastal and marine waters.
Collection of coastal flora and fauna.

Analysis of phytoplankton pigments.
Identification of some seaweeds.
Analysis of marine sediments.
Field trips to the coastal areas of Bangladesh.

Text books and references:

1. Barnes, R.S.K. and Hughes, 1988. An Introduction to Marine Ecology. Fishing News Books, Oxford.
2. Boney, A.D., 1974. Phytoplankton. 118 pp.
3. Castro, P. and Huber, M.E., 1992. Marine Biology. Wm. C. Brown Publishers, Oxford. 592 pp.
4. Casro, P. and Huber, M.E., 1997. Marine Biology. WCB/McGraw-Hill. 450 pp.
5. Cousteau, J., 1996. Atlas of the Oceans. Reed International Books Ltd., London. 200 pp.
6. Davis, C.C., 1955. The Marine and Freshwater Plankton. Michigan State University Press, East Lansing, Michigan.
7. Garrison, T., 1995. Essentials of Oceanography. Wadsworth Publishing Company, London. 351pp.
8. Harrison, P. and Parsons, T., 2000. Fisheries Oceanography. Fishing News Books, Oxford. 304pp.
9. Hock, C., Mann, D.G. and Jahns, H.M., 1998. Algae: an introduction to phycology. Cambridge University Press, UK. 627 pp.
10. Jamurs, P.A., 1993. Concepts in Biological Oceanography: an interdisciplinary primer. Oxford University Press, Oxford. 348 pp.
11. Laevastu, T. and Hayes, M.L., 1981. Fisheries Oceanography and Ecology. Fishing News Books, Oxford. 199 pp.
12. Laevastu, T., 1993. Marine Climate, Weather and Fisheries: The effects of weather and climate changes on fisheries and ocean resources. Fishing News Books, Oxford. 204 pp.
13. Mann, K.H. and Lazier, J.R.N., 1996. Dynamics of Marine Ecosystems: Biological – Physical Interactions in the Oceans. Fishing News Books, Oxford. 400 pp.
14. Mridha, S., 1995. Bangopasagar: Samudra Bijnan (Bay of Bengal: Oceanography). Bangla Academy, Dhaka. 261 pp.
15. Newell, G.E. and R.C. Newell, 1977. Marine Plankton: a practical guide. The Anchor Press Ltd., Essex. 244 pp.
16. Parsons, T.R., Takahashi, M. and Hargrave, B., 1984. Biological Oceanographic Processes. Pergamon Press. Oxford. 330 pp.
17. Pickard, G.L. and Emery, W.J., 1990. Descriptive Physical Oceanography: An Introduction. Pergamon Press. Oxford. 320 pp.
18. Pillai, N.R., 1990. Marine Biology and Ecology. Himalaya Publishing House, Delhi, India. 107pp.
19. Sarker, M.N., Status of the red seaweeds in Bangladesh. Marine Fisheries Survey, Management and Development Project, Cox's Bazar, Bangladesh.
20. Summerhayes, C.P., Ballard, R.D. and Thorpe, S.A., 1999. Oceanography. Fishing News Books. Oxford. 352 pp.

21. Tomas, C.R. (ed.) 1997. Identifying Marine Phytoplankton. Academic Press, California. 858 pp.

Department of Fisheries Technology

FTL 305: Fish Processing

Theoretical : 3 Cr.

1. Introduction to fish processing: Production and marketing steps of fish and prawn in Bangladesh. Loss of food value due to improper handling and transportation. Bio-factor of fish and quantity of bio-factors in different groups of fish. Role of bio-factor on human health.
2. General principles of fin fish and shellfish preservation and storage. Structure of fish muscle, biochemical properties of white and dark muscle of fish.
3. Postmortem changes in fish: Rigor mortis. Biochemical changes in fish during rigor mortis. Rigor mortis and keeping quality of fish. Effects of rigor mortis on fish processing and control measures.
4. Fish processing at low temperature: Types and methods of freezing. Shrimp/fish freezing method in Bangladesh. Factor affecting the quality of fish and shrimp during freezing transportation and storage. Time-temperature relationship in freezing.
5. Fish curing (Drying and dehydration, salting, smoking): Basic principles and methods of fish curing. Details of each curing method. Variations in curing methods for different species of fish. Quality aspects and storage.
6. Fish canning: Principles, preparation of raw materials and steps of canning. Types of can materials. Examination of processed fish can.
7. Modern approaches to fish processing: Modified atmosphere packaging. *Saus vide* technology in fish processing. Vacuum packaging. Hurdle's approach in fish processing. Irradiation in fish processing.
8. Packaging: Functions of packaging. Appropriate package selection. Packaging materials. Packaging regulation.
9. Planning and design of cold storage and fish processing plant

FTL 306: Fish Processing

Practical: 1.5

Students shall maintain a record of everything done in the practical and field sessions in a Practical Note Book to be signed and checked by teacher (s) concerned.

1. Acquaintance with fish processing laboratory.
2. Study of proximate composition of fish- (Moisture, lipid, ash and crude protein)
3. Determination of non-protein nitrogen (NPN) of fish.
4. Determination of salt (NaCl) content in salted fish.
5. Freshness test of fish by subjective method.
6. Processing and preservation of fish by sun drying, salting and smoking method and observation on their physical and chemical changes.

Text books and reference:

1. G. M. Hall, 1997. Fish processing technology. Blakie Academic & Professional, London, Weinheim, New York, Melbourne, Madras
2. Tanikawa, E. Motohiro, T, and Akiba, M. 1985. Marine products in Japan, Published by Koseisha Koseikaku Co., Ltd., Tokyo.
3. Govindan, T.K. 1985. Fish Processing Technology, Oxford & IBH publishing Co., New Delhi.
4. Motohiro, T.; Hashimoto, K.; Kadota, H. and Tokunaga, T. (1992). Science of Processing Marine products, Vol. I & II. Kanagawa International Fisheries Training Center. Japan International Cooperation Agency.
5. Stansby, M. E. (1963). Industrail Fishery Technology. Reinhold Publ Corp. New York.Zaitsev, V. P. (1965). Preservation of Fish Products by Refrigeration. U.S. Department of Commerce.
6. Clucas, I, J. and Ward, A. R. 1996. Post-harvest Fisheries Development: A guide to handling, preservation, processing and quality. Natural Resource Institute, Central Avenue, Chatham Maritime, Kent ME44TB, UK.
7. A O A C. (1980).Official methods of analysis. Association of Official Analytical Chemists.Washington, D. C.
8. Howgate, P., A. Johnston and Whittle, K. L. (1992) Multilingual Guide to EC freshness grades for fishery products (Torry Research Station, Food Safety Directorate, Ministry of Agriculture, Fisheries and Food; Aberden. Scotland, UK.
9. Hasegawa, H. (1987). Laboratory Manual on Analytical Methods and procedures for Fish and Fishery Products. Marine Fisheries Research Department, Southeast Asian Fisheries Development Center, Singapore.

Department of Fisheries Technology

FTL 307: Marine Food Chemistry

Theoretical: 2 Cr.

1. Main groups of marine organisms used as food: Marine plants, mollusks, crustaceans and fish .

2. Nutritive values of proteins of major groups of marine food organisms: Protein content, protein groups, stability of muscle proteins under various conditions.

3. Flavour compounds of seafood's: Nitrogenous and volatile compounds.

4. Nutritive value of marine fish and shellfish lipids : Lipid types and their variations, polyunsaturated fatty acids, essential fatty acids. Convenience food and modern diet .

5. Vitamins in marine fish and shellfish : Fat and water-soluble vitamins. Vitamin content in farmed and wild fish . Effect of processing on vitamin composition ..

6. Micro and trace elements in fish and shellfish : Inorganic matter in fish and shellfish .Effect of processing on mineral composition of fish .

7. Marine bio-toxins: Toxin in marine vertebrates, invertebrates, seaweed and plankton .

Text books and reference:

1. Ruiter,A. 1995. Fish and Fishery products: composition, nutritive properties and stability, Cab International.

2. Noguchi, T. and Hashimoto, K,1997. A Pictorial Handbook of the Toxic Fishes Related to Food Hygiene .

3. Huss, H.H. Jakobsen, M and Liston , J. 1992. Quality assurance in fish industry. In Development in Food Science, Elsevier, Amsterdam, London, New York, Tokyo .

4. Hall, G.M. 1997. Fish processing technology. Blakie Academic & professional , London, Weinheim, New York, Melboume, Madras.

Department of Aquaculture

AQC 307 : Culture of Ornamental Fish

Theoretical : 2

1. **Introduction:** History and importance of ornamental fish culture. Important ornamental fish species (indigenous and exotic), natural habitats, present status and prospect of ornamental fish culture in Bangladesh.
2. **Aquarium preparation:** Types and size of the aquaria, preparation, aeration, filtration (chemical and biological), photosynthesis, and decomposition.
3. **Selection of aquarium fish:** Species selection, transportation of fish, stocking, introduction of suitable communities, acclimatization and release of fish into the aquarium.
4. **Maintenance of the aquarium:** Aeration, water exchange, maintenance of biological filters, handling of ornamental fish, pruning and manuring aquarium plants, removing dust and sediments and disinfecting the aquarium.
5. **Food and feeding:** Live food, balanced artificial feed, feeding regime, waste removal.
6. **Seed production of ornamental fish:** Brood selection, conditioning, spawning and fry rearing of some local and exotic ornamental fish species.
7. **Health management of ornamental fishes:** Common diseases of ornamental fish and their prevention and control.
8. **Popularization of ornamental fish keeping:** Display, demonstration, training and exhibition.

Text and reference books:

1. G.E. Hervey, and J. Hems. 1965. Freshwater tropical fishes. Spring Books. London, UK.
2. Mills, D. 1992. Tropical Aquarium Fishes, How to keep freshwater fish. Chancellor Press, London, UK.
3. Petrovicky, I. 1993. The illustrated guide to Tropical Aquarium fishes. Chancellor Press, London, UK.
4. Islam, M. A. 1985. Macher Pokurer Pani, Bangla Academy, Dhaka.
5. Islam, M. A. 1985. Macher Roog, Bangla Academy, Dhaka.
6. Grzimek, B and Ladiges, W (Editors). 1973. Grzimek's animal life encyclopedia. Van Reinhold Company, UK.
7. Roberts, R.J. 1989. Fish Pathology (2nd Ed.). Baillere Tindall, London, UK.
8. Smartt, J. and Bundell, J. H. 1996. Gold fish breeding and Geneties. T. F. H. Pubkiestions me. U.S.A