




Bangladesh Open University

 SARD SCHOOL OF AGRICULTURE AND RURAL DEVELOPMENT কৃষি ও পল্লী উন্নয়ন স্কুল	School of Agriculture and Rural Development (SARD)
	Master of Science (MS) in Aquaculture

Curriculum layout for the degree of Master of Science (MS) in Aquaculture

1. Requirement for registration: Bachelor of Science in Fisheries (Hon's) or related disciplines from any recognized University
2. Duration: One and a half ($1\frac{1}{2}$) years (Registration valid for three consecutive years)
3. Semester: Three Semesters (Valid up to consecutive six semesters), two semesters in a year each of six (6) months:
4. No. of courses = 12
5. No. of credits = 40
6. Total Marks = 2000

Distribution of courses, credits and marks

MS in Aquaculture shall be offered with 40 credits in 3 semesters each of six months duration. The courses worth 24 credits of which 12 credits shall be offered during the first semester and the other 12 credits during the 2nd semester respectively for the students. Another 16 credits shall be reserved for the research (thesis and thesis defense). The students have to start their research work for thesis (equivalent to 6 courses) under the guidance and supervision of his/her Research Supervisors after the completion of one semester and the same shall be carried through to the last semester when it will be evaluated. After the evaluation of thesis the students have to face thesis defense (equivalent to 2 courses). The distribution of courses, credits and marks are shown below:

Course Type		No. of Courses	Credits	Marks
Course (compulsory)		12	24	1200
Research	a) Thesis	equivalent to 6 courses	12	600
	b) Thesis defense	equivalent to 2 courses	4	200
Total			40	2000

N.B. 1 course = 2 credits = 100 marks; Thesis = 12 credits = 600 marks, Thesis defense (4 credits) = 200 marks: Each course will carry 80 marks for theoretical examination and 10 marks for one course assignment and 10 marks for class attendance.


Course layout for MS in Aquaculture

1st Semester

Sl.	Courses Title	Course code	Credit hrs.	Marks
1	Advanced Freshwater Aquaculture	MSAQ 1201	2	100
2	Aquatic Animal Health Management	MSAQ 1202	2	100
3	Aquafarm Operation	MSAQ 1203	2	100
4	Advanced Aquaculture Feed Technology	MSAQ 1204	2	100
5	Mariculture	MSAQ 1205	2	100
6	Culture of Fish Food Organisms	MSAQ 1206	2	100
Total 6 courses			12	600



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2nd Semester

Sl.	Courses Title	Course code	Credit hrs.	Marks
1	Advanced Coastal Aquaculture	MSAQ 2201	2	100
2	Integrated Aquaculture	MSAQ 2202	2	100
3	Aquaculture Nutrition	MSAQ 2203	2	100
4	Advanced Fish Pathology	MSAQ 2204	2	100
5	Aquarium Fish Culture	MSAQ 2205	2	100
6	Mangrove Aquaculture	MSAQ 2206	2	100
Total 6 courses			12	600

3rd Semester

Title	Credit	Mark
a. Thesis (equivalent to 6 courses)	12	600
b. Thesis defense (equivalent to 2 courses)	4	200
Thesis + Thesis defense	16	800
Grand Total	(12×2)+16 = 40 (Forty)	2000

Syllabus for MS in Aquaculture

Course Title: Advanced Freshwater Aquaculture

Credit hours : 2

Course Code: MSAQ 1201

Unit	Title
1	Importance of fresh water aquaculture, present status and future potentials and recent advances in aquaculture
2	Culture of Indian Major Carps (Rui, Catla, Mrigal, Baus) and Their Hybrids
3	Culture of Endangered Species (Mohashoal, Shor Punt, Nandin)
4	Culture of Exotic Fishes (Silver carp, Bighead carp, Black carp, Common carp, Tilapia, Raj punt)
5	Culture of Catfishes (Magur, Shingi, Air, Pangus, Gulsha, Pabda, Rita and Bagair)
6	Culture of Frogs, Turtles and Molluscs
7	Culture of <i>Macrobrachium</i> sp.
8	Open Water Fish Culture : Cage, pen and raceway aquaculture ponds etc
9	National Fish Culture Policy of Bangladesh

Recommended Textbooks


- Islam, M.A. 1979. Nana Deshe Macher Chash, Bangla Academy.
- Jhingran, V.G. 1977. Fish and Fisheries in India. Hindustan Publishing Crop. Delhi.
- Pillays, T.V.R. 1991 Aquaculture Principles and Practices. Fishing News Books, Blackwell Scientific Publications Ltd. Osney Meal, Oxford OX2 OEL UK 592 pp.
- Huet, M. 1979. Text Book of Fish Culture : Breeding and cultivation of fish, Farming News Book Ltd. Faraham Surry, England.

Supplementary Textbooks

- Islam, M.A. 1977. Matsya Chash, Ananda Press, Mymensingh.
- Bardach, J.E., J.H. Ryther and H.O. Mclamey. 1972. Aquaculture, John Wiley and Sons. Inc. New York.
- FAO (Food and Agricultural Organization). 1990. Farming Systems. Developments. Guidelines for conduct of Training courses in farming systems development. FAO, United Nation.
- Muir, J.F. and R.J. Roberts, (eds.), 1982. Recent Advances in Aquaculture, Vol. I. II, III and IV Croon Heln. London.
- Joseph, M.M. (ed.) 1990. Aquaculture in Asia. Asian Fisheries Society, Indian Branch, Bangladesh, pp. 398.



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	Master of Science (MS) in Aquaculture

10. Breverage, M.C.M. 1987. Cage Culture. Fishing News Book, Surry UK.

Course Title: Aquatic Animal Health Management

Credit hours: 2

Course Code: MSAQ 1202

Unit	Title	Lesson
1	Introduction	General significance of disease in aquatic organisms, the relationship among host, aquatic environment, pathogens and disease, disease and stress adaptation with their control
2	Disease Diagnosis	Gross, clinical and laboratory diagnosis of fish and shellfish diseases
3	Shrimp Health	Effects of intensification on shrimp health relationship between shrimp health and pond environment and their management
4	Maintenance Chemotherapy	Chemotherapeutants including antibiotics commonly used in aquaculture, selection of drugs, mode of actions and their application for the control of diseases in aquaculture, resistance of fish pathogenic bacteria to different antibacterial agents, residual effects of drugs on the aquatic environment
5	Epidemiology	Concept, cause and disease frequency, natural history of a disease, population definition, timing of disease events, types of epidemiological studies
6	Ulcer Diseases	Types of ulcer diseases in fish, status of EUS, histology, actiology, prevention and control of ulcer diseases in fish
7	Fish Health Control	Management techniques for fish health control, quarantine and prevention of diseases in aquatic organisms, vaccination

Recommended Textbooks

1. Woo, P.T.K. and D.W. Bruno, 1999. Fish Diseases and Disorders (Vol.3). CABI Publishing.
2. Treves-Brown, K. 1998. Applied fish Pharmacology. Aquaculture Series. Chapman & Hall.
3. Egusa, S. 1992. Infectious Diseases of Fish. Oxonian Press Ltd. New Delhi, Argent : B-INFE-DF.
4. Roberts, R.J. 1989. Fish Pathology (2nd ed.). Baillere Tindall, London.

Supplementary Textbooks

5. Brown, L. 1994. Aquaculture for Veterinarians : Fish Husbandry and Medicine. Pergamon Press. Oxford.
6. Plumb, J.A. 1994. Health Maintenance of Cultured Fishes : Principal Microbial Diseases. Argent : B-HEAL-MCF.
7. Thrusfield, M. 1995. Veterinary Epidemiology (2nd ed). The University Press, Cambridge.
8. Chamatchkool, P., J.F. Turnbull and C. Limsuwen 1996. Health Management in Shrimp Ponds (3rd ed.). AAHRI, Kasetsart University Campus, Bangkok.
9. Austin, B. and D.A. Austin. 1999. Bacterial Fish Pathogens : Diseases in Famed and Wild Fish (3rd ed.). Ellis Horwood, England.
10. Gudding, R., A. Lillenaug, P.J. Midtlyng and F. Brown 1997. Fish Vaccinology. Development of Biological Standardization, Karger.
11. Thoesen, J.C. (Editor). 1994. Bluebook : Suggested Procedures for the Detection and Identification of Certain Finfish and Shellfish Pathogens, AFS. Fish Health Section (4th ed). Argent. B-BLUE-SPD.

Course Title: Aquafarm Operation

Credit hours: 2

Course Code: MSAQ 1203

Unit	Title
1	Criteria for site selection of different types of aquafarms and hatcheries
2	Aquafarm and hatchery layout (finfish, shrimp and prawn) with different components including infrastructure, problems in existing aquafarms and hatcheries in Bangladesh and their possible improvements
3	Aquaculture Systems: Ponds, tanks and raceways, cages, pens, recirculation and flow through systems
4	Aeration-oxygen transfer processes, different kinds of aerators used in different aquaculture systems
5	Water supply and water quality management, sedimentation, filtration and disinfection in different aquafarms and hatcheries
6	Aquafarm and hatchery waste management, feed delivery systems used in aquaculture



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| 7 | Investment appraisal of aquafarm operation, return on investment, internal rate of return, cost-benefit analysis |
| 8 | Preparation of profitable aquaculture project profile |

Recommended Textbooks

- Barnabe, C. 1990. Aquaculture. Vol. I & II. Ellis Horwood Ltd. New York, USA.
- Bose, A.N., S.N. Ghose, C.F. Yabag, A. Mitra, 1991. Coastal Aquaculture Engineering. Cambridge University Press, Cambridge, UK.
- Huet, M. 1979. Text Book of Fish Culture. Fishing News Books, London, UK.
- Pillay, T.V.R. 1993. Aquaculture Principles and Practices. Fishing News Books, London, UK.

Supplementary Textbooks

- Lawson, T.B. 1995. Fundamentals of Aquacultural Engineering. Chapman and Hall, An International Thomson Publishing Company, New York, USA.
- Breverage, M.C.M. 1987. Cage Aquaculture. Fishing News Book Surry, UK.
- Coche, A.G. and J.F. Muri, 1992. FAO Training Service, Simple Methods for Aquaculture, FAO, UNO, Rome, Italy.
- Gray, C.W. 1990. A guide to Shrimp and Prawn hatchery Techniques in Bangladesh. BAFRU, IOA, University of Stirling; Scotland, UK.
- Huguenin, J.E. and J. Colt, 1989. Design and Operating guide for Aquaculture Seawater Systems. Development in aquaculture and fisheries science, 20. Elsevier, Amsterdam.
- Jhingran, V.G. and R.S.V. Pullin, 1985. A Hatchery Manual for the common and Indian carps. ICLARM, Manila.
- Mott, G. 1993. Investment Appraisal. Pitman Publishing Longman Groups UK Ltd.
- Muir, J.F. and R.J. Roberts (eds.) 1982. Recent Advances in Aquaculture. Vol. I. Croon Helam, London, UK.
- Nelson, K.D. 1985. Design and Construction of Earthen Dams. Inkarta Press, Melbourne.
- Shephard, C.J. and N.R. Bromage, (eds.) 1988. Intensive fish farming Oxford, UK. Blackwell Sci. Pub.
- Wheaton, F.W. 1985. Aquaculture Engineering. Robert E. Kriger Publications, Florida, USA.

Course Title: Advanced Aquaculture Feed Technology

Credit hours: 2

Course Code: MSAQ 1204

Unit	Title
1	Feed Stuffs: Conventional and unconventional feed stuffs, dietary ingredients available in Bangladesh, proximate composition of dietary ingredients, naturally occurring and adventitious toxins feed stuffs
2	Non-nutrient dietary components, water, hormone, antibiotics, fibers, binders, antioxidants, pigments and feeding stimulants
3	Feed Formulation, Preparation and Processing-Supplementary and Complete Diets : Feed formulation and preparation for culturable species, feed milling processes, effect of processing on the nutritional value of feed, quality control in feed manufacture, manufacture of compounded feeds in developing countries, microencapsulated diets for larval rearing
4	Digestibility Study of Fish Feed: Digestion co-efficient, determination of nutrient digestibility, apparent and true digestibility, factors affecting vv digestibility
5	Feeding Methods for Supplementary and Complete Diets : Selection of feed ingredients, feed preparation for supplemental and complete feeding
6	Techniques and Methodologies for Fish Feeding Experiments: Control environmental studies and field studies

Recommended Textbooks


- Balkema, A. A. (Publisher). 1993. Fish Farming Technology. (Reinertsen, H., L., A. Dahle, L. Jørgensen and K. Tvinnerein. Edits). Brookfield, USA. 482pp. (eds.).
- Aquaculture Development and Co-ordination Program. 1983. Fish feeds and feeding in Development Countries, ADCP/REP/83/18. UNDP/FAO, 97, pp.
- Cowey, C.B., M.A. Mackie, and J.G. Bell, (eds), 1985. Nutrition and Feeding in Fish, Academic Press, Inc. (London) Ltd. London, 489 pp.
- Lovell, T. 1989. Nutrition and Feeding of Fish. Van Nostrand Reinhold, New York, 260 pp.

Supplementary Textbooks

- New, M.B., A.G.J. Tacon and I. Csavas (eds.). 1993. Farm-Made Aquafeeds. Proceedings of the Regional Expert Consultation on Farm-Made Aquafeeds, 14-18 Dec. 1992, Bangkok, Thailand. Prayurawong printing, Bangkok, Thailand. 434 pp.



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- Akiyama, D.M. and R.K.H. Tan, (eds.). 1991. Proceedings of the Aquaculture Feed Processing and Nutrition Workshop, American Soybean Association, Singapore 923, 241 pp.
- Association of official Analytical Chemists. 1984, Official Methods of Analytical of the Association of official Analytical Chemists, AOAC, Washington DC, 1015.
- Mozafar, A. 1994. Plant Vitamins-Agronomic, Physiological and Nutritional Aspects. CRC Press, Inc., Florida, USA, 412pp.
- D Melb, J.P.F., C.M. Duffus and J.M. Duffus. 1991. Toxic Substances in Crop plants. The Royal Society of Chemistry, Cambridge, England. 339pp.

Course Title: Mariculture

Credit hours: 2

Course Code: MSAQ 1205

Unit	Title	Lesson
1	Mariculture	Economics, principles of mariculture, history, present status and prospect in Bangladesh
2	Culture of Sea Weeds	Red algae, green algae, brown algae and kelp culture
3	Culture of Molluses	Oyster, pearl, scallop, abalone, clam, mussel, green snail and cattle fish
4	Culture of Crustaceans	Culture of shrimps, lobsters and crabs
5	Culture of Finfish	Flatfish, yellow tail and sea bass
6	Culture of Miscellaneous Organisms	Sea cucumber, sea urchin, sea turtle, green turtle and soft shell turtle

Recommended Textbooks

- Islam, M.A. 1988. Shomudra Upakule Macher Chash, 115 p. Bangla Academy, Dhaka.
- Inverson, E.S. 1967. Farming the Edge of the Sea. Fishing News (Books) Ltd. London.
- Shokita, S.K. Kakazu, A. Tomori and T. Toma, 1991. Aquaculture in Tropical Area. Midori Shobl Co. Ltd., Japan.
- Novey, J. and J. Moore 1983. CRC Hand book of Mariculture. Vol. I. Crustaceans Aquaculture.

Supplementary Textbooks

- Bardach, J.E., J. Ryther and W.O. McLamey, 1972. Aquaculture : The Farming and Husbandry of Freshwater and Marinewater organisms : A Wiley-Interscience Publication; John Wiley and Sons, New York, USA.
- Islam, M.A. 1979. Nana Deshe Macher Chash, Bangla Academy, Dhaka.
- Lee, D.O.C. and J.F. Wickne 1991. Crustacean Farming. Blackwell Scientific Publication Ltd. Oxford, London.
- Laevastu, T. and I. Hela. 1970. Fisheries Oceanography : New Ocean Environmental Services. Fishing News (Books) Ltd. London.
- ODA. 1988. Buffalo/Fish and Duck/Fish Integrated System for small-scale Farmer at the family level. 130 p. AIT. Bangkok, Thailand.
- Stirling. H.P. 1985. Chemical and Biological Methods of Water Analysis for Aquaculture. IAU, US. 119,p.

Course Title: Culture of Fish Food Organisms


Credit hours: 2

Course Code: MSAQ 1206

Unit	Title
1	Scope, history, importance, present and future prospect of fish food organisms
2	Culture of Phytoplankton: Enriched fresh and sea water media, isolation sterilization techniques for culture of phytoplankton, particular emphasis of Bacillariophyceae, Haptophyceae, Chlorophyceae and Dinophyceae, growth dynamics, problems and review of different methods used in various countries
3	Culture of Zooplankton: Water quality behaviour, feeding ecology, technique for culture of zooplankton particular emphasis on ciliated, copepods, rotifers and cladocerans
4	Culture of Artemia, tubificids, earthworms and snails
5	Culture of Micro-organisms: Preparation of media, isolation techniques, culture methods of important fish feed micro-organisms (yeast, fungi and bacteria), preparation of media, isolation techniques
6	Preservation and storage of cultured fish food organisms, economics of culture of fish food organisms



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Recommended Textbooks

1. Fogg, G.E. 1965. Algal culture and phytoplankton ecology. University of Wisconsin Press.
2. Spotte, S. 1970. Fish and Invertebrate Culture water management in closed systems. Wiley-Interscience. New York.
3. Collins, C.H. and P.M. Lyne, P.M. 1976 Microbiological Methods, Butterworths, London.
4. Sneath, P.H.A. 1984, Bergeys Manual of Systematic Bacteriology, Vol. I. N.R. Krieg. (eds.) Williams and Wilkins, Baltimore, London.

Supplementary Textbooks

5. Omori, M. and T. Ikeda. 1984. Methods in Marine Zooplankton Ecology, John Wiley & Sons, 332 pp.
6. Jorgensen, C.B. 1988. Biology of Suspension feeding. Pergamon Press, London, 357 p.
7. MoVey, J. and J. Moore, 1983 CRC Hand Books of Mariculture. Vol. I. Crustacean Aquaculture.
8. Sorgoos, P., G., Persoone, M. Baeze-Mesa, E. Bossuyt, and E. Bruggeman, 1978. The use of Artemia Cysts in aquaculture : the concept of "Hatchin Efficiency" & description of a new method for cysts Processing in Proc, The Annual Meeting World Mariculture Society. Avault, J.W., jr. Ed. Louisiana State University, Baton Rouge, 715 p.

Course Title: Advanced Coastal Aquaculture

Credit hours: 2

Course Code: MSAQ 2201

Unit	Title
1	Present status and prospect of coastal aquaculture, problems of coastal aquaculture in Bangladesh, coastal aquaculture and the environment
2	Cultivable species of fishes, crustaceans and molluscs in coastal region of Bangladesh
3	Design, construction and management of brackish water fish and shellfish farms
4	Culture of live food for fish and shellfish larvae
5	Fish and shellfish seed production
6	Collection and transportation of natural fish and shellfish seed and its impact on coastal aquaculture
7	Aquaculture techniques of commercially important fish and shellfish of Bangladesh, sea bass <i>Lates</i> , <i>calalifer</i> , <i>Mugil cephalus</i> , <i>Liza parsia</i> , <i>Macrobrachium</i> and <i>Penaeus</i>
8	Pest and predators in coastal aquaculture in Bangladesh
9	Handling, marketing and processing of coastal fish and shellfishes

Recommended Textbooks


1. Islam, A. 1988. Samudra Upakule Matsye Chash. Bangla Academy.
2. Pillay, T.V.R. 1973. Coastal Aquaculture in the Indo pacific region. Fishing News (Books) Ltd. London.
3. Chen, L.C. 1990. Abalone culture. In: *Aquaculture in Taiwan*, Fishing News Books.
4. Siddiqi, N.A. Islam, M.R. Khan, M.A.S. and Shahidullah, M. 1993. Mangrove Nurseries in Bangladesh. Mangrove Ecosystems Occasional Papers number 1. International Society for Mangrove Ecosystems.

Supplementary Textbooks

5. Imai, T. 1977. Aquaculture in shallow seas. Progress in shallow sea culture. Amerind publishing Co. Pvt. Ltd. New Delhi.
6. Acosta, B.O. and Pullin, T.S.V. 1989. Environmental impact of the golden snail (*Pamacea sp.*) on rice farming systems : the Philippines ICLARM conference proceedings 28 ICLARM, Manila, Philippines. 34 pp.
7. Barg, U.C. 1992. *Guidelines for the promotion of environmental management of coastal aquaculture development*. FAO Fisheries. Technical Paper 328. Food and Agriculture Organization of the United Nations, Rome.
8. Choo, P.S. 1983. *Mussel Culture* SAFIS Extension Manual Series No. 3. Southeast Asian Fisheries Development Centre in cooperation with the International Development Research Centre.
9. FAO, 1982. *Management and utilization of mangroves in Asian and the Pacific*. FAO Environment paper 3. Food and Agriculture Organization, Rome.
10. Haider, R. Rahman A. A. and Huq, S. (editors) 1991. *Cyclone 1991 An environmental and perceptual study*. Bangladesh Centre for Advanced Studies.
11. Quale, D.B. 1980. Tropical oysters : Culture and methods. Ottawa, out. IDRC-TS 17 e.
12. Shigueno, K. 1975. Shrimp culture in Japan. Association for International Technical Promotion Tokyo, Japan.
13. Sitoy, H.S. Uoung, A.I. and Tabbu, M.Y. 1983. Raft Culture of Mussels. Extension Manual No. 8. Aquaculture Department, Southeast Asian Fisheries Development Center, Philippines.
14. Utting, S.D. and Spencer, B.E. 1991. *The Hatchery culture of bivalve mollusc larvae and juveniles*. Laboratory leaflet number 68. Directorate of fisheries research, Lowerstoft. MAFF.



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Course Title: Integrated Aquaculture

Credit hours: 2

Course Code: MSAQ 2202

Unit	Title
1	Concept of integrated aquaculture and its importance, present status and prospects
2	Integrated Systems: (a) Crops-Animal-Fish; (b) Crop-Livestock-Fish; (c) Waste-Aquaponic Plant; and (d) Human Wastes-Fish-Plant
3	System Environment: Effects of wastes on fish pond, autotrophic and heterotrophic pathways; role of integration on fish production, waste loading and changes in environmental quality
4	Management of Waste Fed Ponds: Addition of wastes, stocking and harvesting procedure and maintaining environmental conditions
5	Economic and Resource Assessment: The effect of value of resource on integration, the economics of using waste in aquaculture, integrated use of land and water in aquaculture, social consideration and energy budgeting and nutrient transfer

Recommended Textbooks

- Little, D and J. Muir, 1987. A guide to Integrated Warmwater Aquaculture, University of Stirling.
- Edmonds, P., K. E. McCoy and C. Chantachaeng., 1986. Pilot small-scale crop/livestock/fish integrated farm 131 p. AIT Bangkok, Thailand.
- Ruddle, K. and G. Zhong. 1988. Integrated Agriculture in South China. Cambridge University press, New York.
- Martyshov, F.G. 1983. Pond Fisheries 454 p. Amerind Publishing Co. Pvt. Ltd. New Delhi, Bombay, Calcutta, India.

Supplementary Textbooks

- Islam. M.A. 1985 Macher Chash Bebhastapana, 277p. Bangla Academy, Dhaka.
- Islam. M.A. 1985 Shomudra Upakule Macher Chash, 115p. Bangla Academy, Dhaka.
- Islam. M.A. 1985 Nana Deshe Macher Chash, 174p. Bangla Academy, Dhaka.
- Islam. M.A. 1985 Macher Pukurer Pani, 229p. Bangla Academy, Dhaka.
- Muir, J.F. and R.J. Robert, 1982. Recent Advances in Aquaculture, Vol. 3, Beckenham U.K. Croon hem. London 420 pp.
- Shigeno, K. 1975. Shrimp culture in Japan. Association of International Technical Promotion Tokyo, Japan. 153 pp.

Course Title: Aquaculture Nutrition

Credit hours: 2

Course Code: MSAQ 2203

Unit	Title
1	Importance of fish nutrition in aquaculture
2	Nutrients: a) Protein and amino acid, general, synthesis and deposition in fish amino acid metabolism, utilization of synthetic amino acid, biological availability of essential amino acid; b) Fat: General, fat and fatty acid metabolism, digestion, absorption, deposition and transportation of fat; c) Carbohydrate: General requirement and digestibility of carbohydrate; d) Energy: General, digestible and metabolizable energy ratio, specific dynamic action (SDA), energy contents of various foodstuffs; e) Fibre: General, digestibility and importance of fibre; f) Vitamin: General, recent advances in vitamin nutrition and metabolism in fish; g) Mineral: Major and minor elements, functions, mineral nutrition and metabolism with special emphasis in calcium and phosphorus
3	Digestive Enzymes and Their Role in Digestion: Proteinase, lipases, carbohydrase and other digestive enzymes
4	Recommended dietary nutrient specifications for cultureable species of fish and shrimp
5	Broodstock nutrition

Recommended Textbooks


- Halvor, J.E. (ed.) 1989. Fish Nutrition, Second Edition. Academic press, Inc., California, 788 pp.
- Steffens, W. 1989. Principles of Fish Nutrition. John Wiley & Sone; New York.
- Cho, C.Y., C.B., Cowey, T. Watanabe, (eds.). 1985. Finfish Nutrition in Asia : Methodological Approach to Research and Development. International Development Research Centre, Ottawa, Ont. 154 pp.
- Kaushik, S.J. and P. Luguët, (eds). 1993. Fish Nutrition in Practice. INRA, Paris, 972 pp.

Supplementary Textbooks

- Hepher, B. 1988. Nutrition of Pond Fishes. Cambridge University Press, Cambridge, U.K. 38 pp.
- Cowey, C.B. Mackie, M.A. and Bell, C.G. (Editors). 1905. Nutrition and Feeding in Fish. Academic Press, Inc. (London) Ltd. London, 499 pp.



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- De Silva, S.S. (ed). 1991. Fish Nutrition Research in Asia. Asian. Fish Soc. Spec. Pub, 5, Asian Fisheries Society, Manila, Philippines 200 pp.
- Muir, J.F. and R.J. Roberts (eds.). 1982. Recent Advances in Aquaculture. Vol. I. Croom Helm. London, 453 pp.
- National Research Council. 1983. Nutrient Requirements of Warmwater Fishes and Shellfishes. National Academy of Sciences, Washington D.C. 102 pp.
- Tytler, P, and P. Calow, (eds). 1985. Fish Energetic New Perspective. Croom Helm. London, 343 pp.

Course Title: Advanced Fish Pathology

Credit hours: 2

Course Code: MSAQ 2204

Unit	Title
1	Advanced knowledge of cell death, epizootiology, degree of infection, inflammation, neoplasm and immunopathology in fish
2	Systemic Pathology of Teleosts: Pathological changes in different organs of fish by infections and non-infectious diseases
3	Viral Diseases of Fish: Pathology epizootiology, pathogenesis, isolation and identification, transmission and maintenance of fish pathogenic viruses
4	Bacterial Fish Diseases: Pathology, epizootiology, pathogenesis. Experimental infections. Challenge test with pathogenic bacteria
5	Mycotic Disease of Fish: Fungi responsible for significant diseases in aquaculture, pathology epizootiology, pathogenesis and experimental infection of fishes, with pathogenic fungi
6	Shrimp Diseases: Infections agents including virus, bacteria and fungi, non-infectious diseases including toxic syndromes

Recommended Textbooks

- Roberts, R.J. 1988. Fish Pathology (2nd Ed.). Bailliere Tindall, London, UK.
- Woo. P.T.K. and D.W. Bruno. 1999. Fish Diseases and Disorders (Vol.3), CABI Publishing.
- Ferguson, H.W. 1989. Systemic Pathology of Fish. Iowa State University Press. Ames, Iowa, USA.
- Egusa, S., 1991. Infectious diseases of fish. Oxonian press Ltd., New Delhi.

Supplementary Textbooks

- Ken Wolf. 1988. Fish Viruses and fish viral diseases (1st Ed.)
- Inglis, V., R.J. Roberts and N.R. Bromage (Eds). 1993. Bacterial diseases of fish. Blackwell Scientific Publ., Edinburgh, U.K.
- Bruno D.W. and T.T. Poppe. 1996. A colour atlas of Salmonid Diseases. Academic Press. London.
- Plumb, A. 1994. Health maintenance of culture fishes : Principal microbial diseases. CRC Press, Inc.
- Austin, B. and D.A. Austin. 1999. Bacterial Fish Pathogens : Diseases in farmed and wild fish (3rd Edition). Ellis Horwood, England.
- Chanratchakool, P., J.F. Turnbull and C. Limsuwan. 1996. Health Management in Shrimp ponds. AAHRI, Kasetsart University Campus, Jatujak, Bangkok, Thailand.

Course Title: Aquarium Fish Culture

Credit hours: 2

Course Code: MSAQ 2205

Unit	Title
1	History and importance of aquarium fish culture, important species (indigenous and exotic)
2	The Aquarium: Types and size, preparation, photosynthesis, decomposition and aeration
3	Maintenance of the Aquarium: Biological filter and water exchange, handling of aquarium species, biological filters pruning and manuring plants, removing dust and sediments, disinfection
4	Food and Feeding: Life food, balanced artificial feed, feeding regime, waste removal
5	Breeding of Aquarium Species: Brood selection, conditioning, breeding, fry rearing
6	Showing: Choosing and preparing fish for show, show standards
7	Health management of aquarium fishes

Recommended Textbooks

- G.E. Hevey, and J. Hems. 1965. Freshwater tropical fishes. Spring Books. London.
- Dick, M. 1992. Tropical Aquarium Fishes, How to keep freshwater fish, Chancellor Press, London.
- Roberts. R.J. 1989. Fish Pathology, Bailliere Tindall, London.



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Master of Science (MS) in Aquaculture

Supplementary Textbooks

4. Islam, M.A. 1985. Macher Roog, Bangla Academy, Dhaka.
5. Islam. M.A. 1985 Macher Pokurer Pani, 229 p. Bangla Academy, Dhaka.

Course Title: Mangrove Aquaculture

Credit hours: 2

Course Code: MSAQ 2206

Unit	Title
1	Mangrove Resources: Flora and fauna, fauna, importance, present status and prospect of mangrove aquaculture in Bangladesh
2	Aquafam practices and management in mangrove areas
3	Utilization of mangrove areas for aquafams
4	Mangrove dependent fisheries in Sundarban areas with special reference to cultivable species
5	Sustainable exploitation of the mangroves for aquaculture in Bangladesh
6	Role of mangrove plant as nursery ground of important cultivable species of fisheries importance
7	Factors affecting the recruitment of fish and shellfish in mangrove areas
8	Management of acid sulphate soil for aquaculture operation
9	Integration of mangrove aquaculture with agriculture, livestock and wildlife

Recommended Textbooks

1. Imai, T. 1977. Aquaculture in Shallow seas. Progress in shallow sea culture. Amerind publishing Co. Pvt. Ltd. New Delhi.
2. Lee, D.O.C. and J.F. Wickens, 1992. Crustacean farming Oxford; Blackwells Scientific.
3. Milne, P.H. 1979. Fish and shellfish farming in coastal water. White friars press Ltd. London and Tonbridge.
4. Bailey, C., S. Jentoft and P. Sinclair eds. 1996. Aquaculture development : Social dimensions of and emerging industry. Boulder, Co. U.S.A. Westview Press.

Supplementary Textbooks

5. Bandayopadhyay, A.K. and T.S. Sinha. 1985. Rice Cultivation in coastal saline soils. Inf. Brochure cent. Soil Salin. Res. Inst. Kamal, 10; 1-11.
6. Brinkuman, R. and V.P. Singh. 1982. Rapid reclamation of fish ponds on acid sulphate soils. In : Proceedings of the Bangkok Symposium of acid sulphate soils edited by H. Dost and N. Vam breeman. Publ. Inst. Land Reclam. Improve., Wageningen, 31 : 318-330.
7. Primavera, J.H. 1995. Mangroves and brackishwater Pond culture in the Philippines Hydrobiologia 295 (1-3); 303-309.
8. Shang, Y.C. 1981. Aquaculture economics: basic concepts and methods of analysis. Boulder, C.A. U.S.A. Westview Press.
9. Shigueno, K. 1975. Shrimp Culture in Japan. Association for International Technical Promotion Tokyo, Japan.
10. Smith, P. 1993. Prawn farming in Australia. Sediment is a major issue, Australian fisheries, 52 (12): 29-32.

Any kind of information, please contact with:

Professor Dr. Md. Shah Alam Sarker

Program Coordinator

&

Professor (Fisheries)

School of Agriculture and Rural Development

Bangladesh Open University, Gazipur-1705

Telephone: +88 09666730730 Extn. 675

Cell: +88 01718630776

E-mail: sarkeralam@yahoo.com