

BSc Honours Syllabuses

Department of Fisheries and Marine Science

Year 1 Term I:

Subject Type	Course Code	Course Title	Credit Hours	Page
Major subjects	FIMS 1101	Fisheries Zoology-I (Non Chordates)	3.0	
	FIMS 1102	Fisheries Zoology-I (Non Chordates) Lab/Field Work	1.0	
	FIMS 1103	Introduction to Ecology	3.0	
	FIMS 1104	Introduction to Ecology Lab/Field Work	1.0	
	FIMS 1105	Introduction to Fisheries Resources	3.0	
	FIMS 1107	Planktonology	3.0	
	FIMS 1108	Planktonology Lab/Field Work	1.0	
Minor Subject	BIOL 1101	Biochemistry	3.0	
	BIOL 1102	Biochemistry Lab/Field Work	1.0	
		Total	19.0	

Year 1 Term II:

Subject Type	Course Code	Course Title	Credit Hours	Page
Major Subjects	FIMS 1201	Fisheries Zoology-II (Chordate)	3.0	
	FIMS 1202	Fisheries Zoology-II (Chordate) Lab/Field Work	1.0	
	FIMS 1203	Introduction to Cytology, Histology and Embryology	3.0	
	FIMS 1204	Introduction to Cytology, Histology and Embryology Lab/Field Work	1.0	
	FIMS 1205	Ichthyology	3.0	
	FIMS 1206	Ichthyology Lab/Field Work	1.0	
	FIMS 1207	Wetland Ecology and Mangrove Ecosystem	2.0	
	FIMS 1209	Fisheries Systematics	3.0	
	FIMS 1210	Fisheries Systematics Lab/Field Work	1.0	
Minor Subject	CAFS 1201	Computer Applications for Fisheries Science	2.0	
Course Viva	FIMS 1212	Viva-voce	2.0	
		Total	22	

Year 2 Term I:

Subject Type	Course Code	Course Title	Credit Hours	Page
Major Subjects	FIMS 2101	Biostatistics	3.0	
	FIMS 2102	Biostatistics Lab/Field Work	1.0	
	FIMS 2103	Fish Physiology	3.0	
	FIMS 2104	Fish Physiology Lab/Field Work	1.0	
	FIMS 2105	Limnology	3.0	
	FIMS 2106	Limnology Lab/Field Work	1.0	
	FIMS 2107	Fishery Products and by-products	3.0	
	FIMS 2108	Fisheries Products and by-products Lab/Field Work	1.0	
	FIMS 2109	Fish Nutrition	3.0	
	FIMS 2110	Fish Nutrition Lab/Field Work	1.0	

		Total	20.0	
--	--	--------------	-------------	--

Year 2 Term II:

Subject Type	Course Code	Course Title	Credit Hours	Page
Major Subjects	FIMS 2201	Introduction to Genetics and Molecular Biology	3.0	
	FIMS 2203	Fisheries Microbiology	3.0	
	FIMS 2204	Fisheries Microbiology Lab/Field Work	1.0	
	FIMS 2205	Application of GIS in Fisheries	2.0	
	FIMS 2207	Freshwater Aquaculture	3.0	
	FIMS 2208	Freshwater Aquaculture Lab/Field Work	1.0	
	FIMS 2209	Introduction to Oceanography	3.0	
	FIMS 2210	Introduction to Oceanography Lab/Field Work	1.0	
	FIMS 2211	Principles of Marine Biotechnology	2.0	
Course Viva	FIMS 2214	Viva-voce	2.0	
		Total	21.0	

Year 3 Term I:

Subject Type	Course Code	Course Title	Credit Hour	Page
Major Subjects	FIMS 3101	Inland Fisheries Resources Management	3.0	
	FIMS 3103	Fish Harvesting and Handling	3.0	
	FIMS 3104	Fish Harvesting and Handling Lab/Field Work	1.0	
	FIMS 3105	Fish Genetics	3.0	
	FIMS 3106	Fish Genetics Lab/Field Work	1.0	
	FIMS 3107	Fish Parasitology	3.0	
	FIMS 3108	Fish Parasitology Lab/Field Work	1.0	
	FIMS 3109	Rural Sociology	2.0	
Minor Subject	ENLA 3101	Environmental Law of Bangladesh	2.0	
		Total	19.0	

Year 3 Term II:

Subject Type	Course Code	Course Title	Credit Hour	Page
Major Subjects	FIMS 3201	Fisheries Extension	3.0	
	FIMS 3202	Fisheries Extension Lab/Field Work	1.0	
	FIMS 3203	Coastal and Marine Aquaculture	3.0	
	FIMS 3204	Coastal and Marine Aquaculture Lab/Field Work	1.0	
	FIMS 3205	Fish Processing and Preservation	3.0	
	FIMS 3206	Fish Processing and Preservation Lab/Field Work	1.0	
	FIMS 3207	Fish Pathology	2.0	
	FIMS 3208	Fish Pathology Lab/Field Work	1.0	
	FIMS 3209	Fish Hatchery Operation and Management	3.0	
	FIMS 3210	Fish Hatchery Operation and Management Lab/Field Work	1.0	
	FIMS 3211	Fish Population Dynamics and Stock Assessment	3.0	
	FIMS 3212	Fish Population Dynamics and Stock Assessment Lab/Field Work	1.0	
Course	FIMS 3214	Viva-voce	2.0	

Viva				
		Total	25.0	

Year 4 Term I:

Subject Type	Course Code	Course Title	Credit Hour	Page
Major Subjects	FIMS 4101	Biological and Chemical Oceanography	3.0	
	FIMS 4102	Biological and Chemical Oceanography Lab/Field Work	1.0	
	FIMS 4103	Aquaculture Engineering	3.0	
	FIMS 4104	Aquaculture Engineering Lab/Field Work	1.0	
	FIMS 4105	Fish Feed Technology & Management	3.0	
	FIMS 4106	Fish Feed Technology & Management	1.0	
	FIMS 4107	Research Methodology	3.0	
	FIMS 4109	Quality Control of Fishery Products	2.0	
	FIMS 4110	Quality Control of Fishery Products Lab/Field Work	1.0	
	FIMS 4111	Fisheries Resource Economics	2.0	
Project	FIMS 4114	Research Project	2.0	
		Total	22.0	

Year 4 Term II:

Subject Type	Course Code	Course Title	Credit Hour	Page
Major Subjects	FIMS 4201	Climate Change and Fisheries	3.0	
	FIMS 4203	Coastal Zone Management	3.0	
	FIMS 4205	Biodiversity Conservation and Management of Marine Resources	3.0	
	FIMS 4207	Fisheries Marketing and Agribusiness	3.0	
	FIMS 4209	Aquatic Pollution and Environmental Impact Assessment	3.0	
	FIMS 4211	Marine and Estuarine Ecology	3.0	
Project	FIMS 4214	Research Project	4.0	
Course Viva	FIMS 4216	Viva-voce	2.0	
		Total	24.0	
		Grand Total	172.0	

Lab/Field Work: (General instructions)

Students shall maintain records of their assign lab/field works in a Practical Note Book to be signed and checked by teacher(s) concerned.

Viva-voce will form an essential part of the Lab/Field Work Examinations.

FIMS 1103
3CH

Introduction to Ecology

Introduction: definition, ecology, scope of ecology, sub-division of ecology, Principles and concept of ecology.

Bio-geo-chemical cycles: Carbon cycle, Nitrogen cycle.

Environment: Abiotic, Temperature, pH, Radiation water, Atmospheric gases, Biogenic salts, Current and pressures.

Trophic structure: Food chain, Food web, Ecological pyramids.

Habitat: classification, diapause and dormancy, migration and dispersal. Ecological niche: realized niche, niche overlap, resource partitioning.

Population: Population processes, diagrammatic and conventional life-tables, Age and Growth, Inter-specific interactions, competition and coexistence, nature and characteristics of intraspecific competition, Population structures, natality, mortality, population growth form and concept of carrying capacity, population dispersal.

Community: Concept, composition, structure, ecological succession, concept of climax, ecotone, edge effect, competition, predation, disturbance, instability, habitat size and diversity in community structure.

Ecosystem: concept of ecosystem, types, Concept and components of ecosystem, Kinds of ecosystem, Structure and function of an ecosystem, Major ecosystems.

Biomes: Terrestrial, Wetland & Freshwater, Coastal and Marine biomes.

Biogeography: Biogeographic regions, Plate tectonics, Evolution and conservation.

FIMS 1104
1CH

Introduction to Ecology Lab/Field Work

Methods of estimation density, pattern of distribution and dispersal in population of animals.

Study of a pond, stream and estuary ecosystem, community, composition and classification.

Ecological survey of different groups of animals in different habitat with behavior in relation to moisture, vegetation, food and other animals. Collection and survey report should be submitted at the time of examination.

Books/References:

Odum, EP 1971. Fundamentals of Ecology, W.B Saunders Company, USA.

Chapman, JI and Reiss, M.J. 1995. Ecology, Principles & application, Cambridge University Press, Cambridge.

Wootton, RJ Fish ecology. Chapman & Hall Publishings Company, New York.

Weatherly, AH 1972. Growth & Ecology of Fish population. Academic Press, London. New York.

Macan, TT 1974. Fresh water Ecology. Longmans. London.

Moss, B 1980. Ecology of freshwaters. Blackwell scientific Publication.

FIMS 1107**Planktonology****3 CH**

Introduction: Definition, classification and importance of plankton in the aquatic life. Importance of studying planktology.

Phytoplankton: Definition, classification, morphology and physiology.

Factors affecting the growth, distribution and seasonal succession of phytoplankton in different oceans.

Productivity and their measurement (Lake, estuary, Oceans).

Factors affecting primary production, nutrients, light, temperature, micronutrients, grazing etc.

Seasonal and non-seasonal bloom, causes of phytoplankton bloom, the problem of single species bloom, red tide

Culture technique of phytoplankton (*Skeletoma costatum*, *Chlorella* and *Tetraselmis*).

Zooplankton: Definition, classification, morphology and physiology

Factors affecting the growth, distribution and seasonal succession of zooplankton.

Seasonal changes and breeding of Zooplankton.

Geographical distribution of zooplankton

Vertical distribution and migration of zooplankton.

Food and feeding habit of zooplankton.

Culture techniques of commercially important zooplanktons (*Artemia*, rotifer, copepod).

Phytoplankton- zooplankton relationship.

Fish-Plankton relationship.

Plankton collection gears.

Determination of plankton biomass, occurrence, abundance and species richness.

Planktons of the fresh, estuary and coastal water of Bangladesh.

FIMS 1108**Planktonology Lab/Field Work****1CH**

Preparation and handling of plankton collection equipment.

Collection, preservation, identification and estimation of plankton.

Preparation of different culture media for freshwater plankton

Laboratory based culture of plankton.

Measurement of productivity of a water body. Measurement of phytoplankton and zooplankton biomass.

Books/References:

Davis, CC 1955. The marine and freshwater plankton.

Spoel et al. 1979. Zoogeography and diversity in plankton.

Goldman, CR. 1974. Primary productivity in aquatic environment.

Welch, PS 1952. Limnology. Mc Graw-Hill Book Company, NewYork.

Reid, GK and Wood, RB 1979. Ecology of inland waters and estuaries. Reinhold Publ. Co NewYork.

Schwoerbel, J 1987. Hand book of limnology. Ellis Horwood Ltd. NewYork.

Ruttner, F 1953. Fundamental of limnology.

Giller PS and Malmqvist, B 1998. The biology of streams and Rivers, Oxford Univ. Press, Oxford, UK.

Smith, DG 2001. Pennak's freshwater invertebrates of the United States. John Wiley & Sons, New York, NY, USA.

Reymount, JER. 1963. Plankton and productivity in the oceans.

Newell and Newell, 1977. Marine Plankton.

Minor Subject

BIOL 1101

Biochemistry

3CH

Introduction: Scope and importance of Biochemistry.

Acid, base & buffer: Ion Product of water; acid, base, pH; pH indicators; buffer solution and buffer capacity.

Thermodynamics: 1st and 2nd law of thermodynamics. Enthalpy, Entropy, Free energy. Hess law's

Carbohydrates: Nomenclature, classification and structural features.

Lipids: Nomenclature, classification, structure and biological functions of different classes of lipids.

Amino acids and Peptides: Structural features, classification of amino acids, peptide bonds and biologically important peptides.

Proteins: General introduction ; classification based on shape, structure & biological properties;

Enzymes and Hormone: Definition, classification and function. Nomenclature of enzymes. Endocrine glands and their secretion and action of secretion.

Vitamins and Minerals: Classification, occurrence, deficiency symptoms, biological functions. Vitamin as Coenzymes.

BIOL 1102

Biochemistry Lab/Field Work

1CH

Estimation of vitamin C (Ascorbic acid) from natural/unknown source.

Collection of fish blood and separation of plasma and blood cell.

Total count RBC/WBC

Estimation of protein by burette method.

Estimation of cholesterol from egg yolk.

Books/References:

AOAC 1984 : Association of Official Agricultural Chemists. Washington D.C.

Con, E.E. and Stumpf, P.K. 1987 Outlines of Biochemistry, 5th ed. J. Wiley and Sons, New York.

Lehninger A.I. 1976. Text Book of biochemistry. 2nd ed. Worth Publishers, New York.

Lehninger, A.I. 1980 Practical Biochemistry for students, Laypec Brothrs, New Delhi.

Martin, D.W. Mayes, P.A. and Rodwell, V.W. 1981: Harper's Review of Biochemistry 18th ed. Lange Medical Pub. California.

Mehler, H.R., Cordes, E.H. 1971 : Biological Chemistry. Harper and Row, New York.

Oser, B.L. 1979 : Hawk's Physiological chemistry. 14th ed. Tata McGraw Hill, New York.

Strong, F.M. 1965 : Biochemistry Lab. Manual. William C Brown Co, Iowa.

Voet; D, ard Boet, J. 1009. Biochemistry. John Wiley and Sons, New York.

West, E.S. Todd' W.R; Manson, S.M. Van Bruggen; J.T. 1967 : Text Book of Biochemistry. MacMillan Co., New York.

White, A., Handler, P and Smith, E.L. 1976 : Principles of Biochemistry, 6th ed. McGraw Hill co., New York.

Course Viva

FIMS 1110

Viva-voce

1CH

Structure and function of gills, fish blood as a gas carrier, adaptation for air breathing among fishes, gas bladder of fishes.

Skeletal system of fish. Membranous labyrinth and Weberian apparatus

Digestive system: Food, feeding habits and feeding adaptations; comparative study of the alimentary canal in different groups of fishes.

Reproductive system: Types of reproduction, primary and secondary sexual characters

Integration systems in fishes: Nervous systems- brain and cranial nerves; spinal cord and nerves.

FIMS 1206

Ichthyology Lab/Field Work

1CH

Identification of important marine and freshwater fishes.

Study of different types of scales.

Study of external morphology and internal anatomy of fishes.

Comparative study of digestive systems of fishes with different food and feeding habits.

Identification of important bones and preparation of bone album.

Study of brain, Membranous labyrinth and Weberian apparatus .

Study of fish gonad and GSI.

Identification of Accessory respiratory system and Gas bladder

Lateral line in fishes.

Books/References:

Lagler, K. F., Bardach, J. E., Miller, R. R. and Passino D. R. M., 1977. Ichthyology. John Wiley & Sons, Inc., New York.

Love, M. S. and Cailliet. G. M. (eds.), 1979. Readings in Ichthyology, Prentice-Hall of India Ltd. New Delhi.

Bond, C. F., 1979. Biology of Fishes. Sunders College Publishing, Philadelphia.

Aleev, Y. G. (ed.). 1969. Function and Gross Morphology of Fish. Keter Press, Jerusalem.

Brown, M. E. (Ed.) 1957. The Physiology of Fishes. Vols. I and II. Academic Press, New York and London.

Day, F., 1971. The Fishes of India, Today and Tomorrows Book Agency, New Delhi. Goodrich, E. S., 1958. Studies on the Structures and Development of Vertebrates (Reprint edition) Vols. I an II. Dover Publications. New York.

Gunther, A. C. L. G., 1963. An Introduction to the Studies of Fishes (Reprint edition). Today and Tomorrows Book Agency. New Delhi.

Lagler, K. F., 1950. Studies in Freshwater Fishery Biology. (3rd rev. ed.), Michigan, USA.

Lagler, K. F., 1952. Freshwater Fishery Biology IOWA Press Inc. U.S.A.

Rahman, A. K. A., 1989. Freshwater Fishes of Bangladesh., The Zoological Society of Bangladesh, Dhaka 1000.

Romer, A. S., 1949. The vertebrate body. W. B. Saunders Company. Philadelphia.

FIMS 1207

Wetland Ecology and Mangrove Ecosystem

2CH

Introduction: Definition, history and heritage of wetlands, hydrological context, importance of wetland for Bangladesh.

Kinds of wetlands: Saltwater, freshwater, riverine, lacustrine and palustrine wetlands, manmade wetlands.

Ecology of wetlands: Geomorphological characteristics and forest status; habitat for migratory birds; fisheries organisms (freshwater and marine).

Socio-economic aspects of wetlands: Human settlements, role in bio-diversity conservation, wetland crops, navigation and communication media, source of food and medicinal plants, biomass production and role in cottage industries, coral reef formation, eco-tourism and flood control.

Developmental activities and threats: Impact of development activities, disappearing and pollution of wetlands, land use conflicts and reclamation, role in endangering bio-diversity.

Wetlands legislation: Proposed legislative framework, sectional laws, historical aspect and abolition of Jamindari; institutional and policy conflicts.

Future strategies for resource management, sustainable development and public awareness, and international collaboration.

Wetland management: Restoration, rehabilitation and management of wetlands.

Role of organizations in the conservation of wetlands: National management policy, role of the Ministry of Environment and Forest, Ministry of Livestock and Fisheries, Department of Fisheries (DoF), Bangladesh Fisheries Research Institute (BFRI), Bangladesh Fisheries Development Corporation (BFDC), Bangladesh Water Development Board (BWDB), Space Research and Remote Sensing Organization (SPARRSO); Non-government Organizations (national and international)

Books/References:

Ahmed, A.T.A. 1994. Paper presented at the training programme on fisheries and environment under FAO/UNDP Project of the Fisheries Research Institute, Mymensingh.

Barber, C.V. 1995. The convention of biological diversity: why it matters to Asian Fisheries. Paper presented at Symposium on Biological Diversity, Asian Fisheries Forum, Beijing, China, October 16-20, 1995.

Finlason, M. 1992. Integrated management and conservation of wetlands in agricultural forested wetlands. International Waterfowl and Wetlands Research Bureau (IWWRB), Special Publication No. 22.

Khan, M.S., E. Haque, A.A. Rahman, S.M.A. Rashid and H. Ahmed. 1994. Wetlands of Bangladesh. Bangladesh Centre for Advanced Studies (BCAS), 91 p.

Norse, E.A. 1993. Global marine biological diversity. Island Press, Washington D.C., 383 p.

Philipp, D.P., J.M. Epifanio, J.E. Marsedn, J.E. Claussen and R.J.Wolotira. 1995. Protection of aquatic biodiversity. Oxford and IBH publishing Co. Pvt. Ltd., Calcutta, 282 p.

Sasckumar, A., N. Marshall and D.J. Macintosh. 1994. Ecology and conservation of Southeast Asian marine and freshwater environments including wetlands. Kluwer academic Publishers Group, London, 336 p.

Tsai, C. and M.V. Ali. 1997. Openwater fisheries of Bangladesh. The University Press Limited, Dhaka, 204 p.

Vymazal, J. 1995. Algal and element cycling in wetlands. CRC Press, Inc., Florida, 689 p.

FIMS 1209

Fisheries Systematics

3CH

Fisheries systematics: Suitability of fishes to systematic studies, Historical background, Tasks of the systematist, its scope and relations with other branches of biology.

Fish taxonomy: General taxonomy of fishes, importance of taxonomy, problems of taxonomists, aims and tasks of a taxonomists, taxonomic keys.

Zoological nomenclature: History, ICZN and Rules of nomenclature.

Taxonomic methods and procedure of classification, and external morphology of fishes. taxonomic collection, description, publication and how to write them; Linnean Hierarchy.

Speciation: Concept of species and implications; Speciation types: Mechanism of genetic differentiation; Allopatric speciation sympatric speciation, Phyletic speciation; Species selection: Process of species selection, Example of species selection; Speciation through Geological time scale.

List of common and representative Families of living fishes with special reference to those of Bangladesh.

Classification and external morphology of commercially important crustaceans and mollusks.

FIMS 1210

Fisheries Systematics Lab/Field Work

1CH

Techniques of identification of freshwater and marine fishes.

Morphometric and meristic analysis of fishes.

A brief report of the local fauna, their abundance, occurrence and ecological conditions.

Books/References:

Kapoor, VC 1994. Theory & practice of animal taxonomy. Oxford & IBH Publishing Co. PVT. Ltd. New Delhi.

Mayer, E 1969. Principles of Systematic Zoology. McGraw Hill Book Co., New York.

Lagler, KF Bardach, JE Miller, RR & Passino, DRM 1977. Ichthyology. John Wiley & Sons. Inc., New York.

Jhingran, VG 1988. Fish and Fisheries of India. Hindustan Publ. Corp. Delhi.

Shafi and Quddus. 1982. Bangladesher Matsho shompod. Bangla Academy.

Ataur Rahman. 1985. Freshwater Fishes of Bangladesh. Zoological Society of Bangladesh.

Day: Fishes of India.

YEAR 2 TERM I

Major Subjects

FIMS 2101

Biostatistics

3CH

Introduction: Definition, of biostatistics, data, variable, factor, treatment, accuracy, precision, significant numbers

Data: qualitative and quantitative, continuous and discrete data

Scaling: ordinal, nominal, ratio and interval scaling

Population and sampling

Descriptive statistics: Data description: frequency distribution, graphical presentation (group and ungroup)

Measures of central tendency: Mean, median and mode

Measures of dispersion: range, variance, standard deviation, standard error of the means, coefficient of variations (CV) and confidence interval (CI).

Probabilities: Definition,

Distribution: Normal distribution: Poisson distribution, binomial distribution, t-, and f-distribution. Skewness and Kurtosis.

Inferential statistics:

Experimental design: CRD and CBRD.

Data transformations: Logarithmic, square root, Arcsine transformations,

Hypothesis testing: basis of hypothesis testing, Significance of hypothesis testing, One sample, two sample and Paired hypothesis testing; ANOVA: 1-, 2-, and multi-way anova, multiple comparisons: Tukey test and DMRT. Type I and type II error. Non parametric test.

Correlations and Regressions: Definitions, determination of coefficients of correlation; Rank correlation, multiple correlation. Regression: linear and curvilinear, coefficient of determination,

FIMS 2102

Biostatistics Lab/Field Work

1CH

Construction of frequency tables and graphical representation of data generated from supplied fin and shellfish samples.

Determination of various measures of central tendency, quantity, various measures of dispersion of data generated from supplied fin and shellfish samples.

Fitting Binomial, Poisson and Normal distribution of data generated from supplied fin and shellfish samples. Use of normal variable.

Calculation of correlation coefficient and fitting simple linear regression to observed data generated from supplied fin and shellfish samples.

Testing hypothesis regarding population mean, testing significance of simple correlation coefficient and regression coefficients.

Use of Chi-square for testing goodness of fit and test of independence of attributes in a contingency table.

Field layout, ANOVA and interpretation of data collected in completely randomized design, randomized block design and Latin square design. Examples of covariance analysis in a completely randomized design.

Books/References:

Bailey, NTJ 1995, Statistical Methods in Biology, 3rd edition, Cambridge University press, UK, 255.

Sokal, RR and Rohlf, FJ 1987. Introduction to Biostatistics, 2nd edition, W H Freeman and Co New york, USA, 363 pp.

Mian, MA and Miyan, MA 1974. An Introduction to Statistics, 3rd edition, Ideal Library, Dacca, 708 pp.

Zar, J H, 1996. Biostatistical Analysis, 3rd edition, Prentice-Hall Intr. Inc., New jersey, USA, 662 pp., + 205 app. + 121 p ref.

FIMS 2103

Fish Physiology

3CH

Introduction: Comparison between aquatic and terrestrial life, Swimming mechanics and composition of a fish.

Digestion: Physiology of Digestion, Absorption, and Assimilation.

Metabolism of protein, carbohydrate and lipids.

Blood: Functions of blood, blood clotting. Mechanism and physiology of circulation, Regulation of heart beat & Blood pressure.

Respiration: Blood & water flow patterns in gills, Responses of the respiratory system to external changes, Air breathing in fishes.

Excretion and Osmoregulation: Osmoregulatory functions in gills, Kidney function in freshwater and seawater fish, Intestinal function in osmoregulation. Integration of osmoregulation.

Endocrine system: Origin and functions of endocrine glands, Role of hormones in the life process of fishes.

FIMS 2104

Fish Physiology Lab/Field Work

1CH

Collection of blood, centrifuge, plasma separate and storage, determination of plasma chloride, sodium, potassium, calcium, glucose; Serological tests of fishes.

Determination of oxygen requirement, blood hematocrit, total and differential counts of blood corpuscles, Observation of respiration of fishes in oxygenated and deoxygenated water.

Books/References:

Smith, L S 1999. Introduction of physiology. Narendra Publ. House, Delhi.

Kumar, S & Tembhe, M. 1996. Anatomy & physiology of fishes. Vikas Publ. House Pvt. Ltd, Delhi.

Brown, ME 1957. Physiology of fishes. Academic Press London.

Hoar, WS Randall, D.J. and Drett, J.R. 1979. Fish physiology. vol. 111. Academic Press London.

FIMS 2105

Limnology

3CH

Introduction: Scope of limnology, physical, chemical and biological limnology, relations in inland waters.

Physico-chemical factors of water and their influences: Surface film, light, color, turbidity, temperature, thermal bar and stratification, heat energy and water movement, dissolved oxygen, free carbon di-oxide and pH, solids in lakes, streams and estuarine water.

Aquatic environment: lentic environment, origin, dynamics, sediments and nature of bottom. Lotic environment, origin and morphology of streams and estuarine basin.

Carbon fixation, secondary productivity, decomposition and decomposers, aquatic fungi, recycling nutrients in fresh water, Soil water interactions and productivity.

Aquatic plants: Aquatic plants and their limnological significance, characters of large aquatic plants, biological classification of large aquatic plants, distribution and role of aquatic plants in Inland water.

Role of aquatic insects in pond productivity. Ecological factors affecting the aquatic life, abundance, development and life cycle. Impact of water quality, climate and weather on the life of aquatic insects. Associations in aquatic life, co-existence, competition, predation and parasitism.

FIMS 2106

Limnology Lab/Field Work

1CH

Studies of water-body morphometry, shore line surveys of ponds, lakes, stream Survey methods, water level recording procedures, methods for determining area and volume of pond, lakes, and reservoirs.

Analysis of water sampling methods, pH, temperature, turbidity, dissolved oxygen, free carbon dioxide, alkalinity, total hardness, phosphate, nitrate, nitrite, ammonia, calcium, iron, silicate and salinity.

Partial analysis of soil and important physical and chemical characteristics.

Study of aquatic habitats and their insect animalcules. Sampling methods of aquatic insects, identification and report writing

Books/References:

Welch, PS 1952. Limnology. Mc Graw-Hill Book Company, NewYork.

Reid, GK and Wood, RB 1979. Ecology of inland waters and estuaries. Reinhold Publ. Co NewYork.

Boyd, CE 1979. Water quality in warmwater fish ponds. Auburn. Univ. Albama.

Schwoerbel, J 1987. Hand book of limnology. Ellis Horwood Ltd. NewYork.

Ruttner, F 1953. Fundamental of limnology.

Borror, DJ DeLong, DM and Triplehorn, CA 1984. An Introduction to the Study of Insects.

Richards, OW and Davies, RG 1988. Imm's General Text Book of Entomology, The English language Book Society and Mathew and Co. Ltd., London, UK.

Rahman, R and Hossain, M 1988. Aquatic Insects, In Bengali., Bangla Academy, Dhaka.

Giller PS and Malmqvist, B 1998. The biology of streams and Rivers, Oxford Univ. Press, Oxfird, UK.

Merritt, RW and Cummins, KW 1996. An introduction to the aquatic insects of North America. Kendall-Hunt, Dubuque, IA, USA.

Clucas, I. J. and A. R. Ward. 1996. Post-harvest Fisheries Development: A guide to handling, preservation, processing and quality. Natural Resource Institute, UK.

Gopakumar, K. (Ed.). 2002. Textbook of Fish Processing Technology. Indian Council of Agricultural Research, New Delhi.

Govindan, T.K. 1985. Fish Processing Technology, Oxford & IBH publishing Co., New Delhi.

Hall, G. M. 1992. Fish processing Technology. Blackie Academic & professional, An Imprint of Chapman & Hall, London.

K. Gopakumar 1997. Tropical fishery products, Science Publishers, Inc.

Lanier, T. C. and C. M. Lee (ed.) 1992. Surimi processes Technology, Marcel Dekker, Inc., NY, USA.

Nowsad, A. K. M. A. 2007. Participatory Training of Trainers: A New Approach Applied in Fish Processing. Bangladesh Fisheries Research Forum. Bangladesh.

Rogenstein, J. M. 1991. Introduction to fish Technology. An Osprey Book. VanNostrand Reinhold, NY, USA.

Stansby, M. E. 1990. Industrial Fishery Technology. Reinhold Publ. Corp., New York.

Tanikawa, E. Motohiro, T, and Akiba, M. 1985. Marine products in Japan, Koseisha Koseikaku Co., Ltd., Tokyo

Wheaton, F. W. and T. B. Lawson. 1985. Processing of aquatic food products. Wiley and Sons NY, USA.

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

FIMS 2109

Fish Nutrition

3CH

Introduction: Basic concepts of nutrition, terminologies relationship between aquaculture and nutrition, modes of nutrients acquisition by fish, factors affecting the dietary habits of fish, fate of digested nutrients, food utilization.

Nutritional requirements of fish and shellfish: Qualitative and Quantitative requirements for protein, amino acid, fat, fatty acids, phospholipids and sterols requirements, carbohydrates requirement, source, function and requirement of vitamins and minerals, energy content and partitioning of energy.

Ingestion, digestion absorption and metabolism of food: Feeding and digestion in fish and shrimps, digestive enzymes, gastrointestinal flora, digestion rate, digestibility coefficient, determining food digestibility, factors affecting digestibility, absorption and metabolic pathways.

Sources of nutrients: Naturally produced food, food production through fertilization, supplementary and complete artificial diet.

Nutritional disorders, deficiency sign, effects of deficiency on growth, health and survival, effects on flesh composition and carcass quality.

Methods used in nutritional studies: Study of nutritional quality of feeds, digestibility study, performance measures, deficiency studies, chemical evaluation and organoleptic properties.

FIMS 2110

Fish Nutrition Lab/Field Work

1CH

Proximate analysis of carcass feed ingredients and compounded feed samples, protein, lipid, ash, fiber and moisture.

Digestibility studies of protein, lipid and carbohydrate using various external dietary markers such as, chromic oxide, silica, cellulose etc.

Analysis of responses and conversion efficiencies.

Techniques for fecal collection and estimation of calorific value of various foods stuff by Bomb calorimeter.

Books/References:

Halver JE editor, 1989. Fish Nutrition Second Edition Academic Press Inc. New York, 798 pp.

Hepher, B 1988. Nutrition of Pond Fishes. Cambridge University Press 388 pp.

Steffens, W 1989. Principles of Fish Nutrition. Ellis Horwood Limited. Chichester, 384 pp.

De Silva, SS and Anderson, TA 1995. Fish Nutrition in Aquaculture. Chapman & Hall, London, 317 pp.

Goddard, S 1996. Feed Management in Intensive Aquaculture. Chapman & Hall, New York, 194 pp.

Tacon, AGJ 1990. Standard Methods for the Nutrition and Feeding of Farmed fish and Shrimp. Argent Laboratories Press, Washington, 208 pp.

New, MB A G J Tacon and I. Csavas, 1997. Farm-made Aquafeeds. Daya Publishing House, Delhi, 434 pp.

Lavens, P and P. Sorgeloos, 1996. Manual on the Production and Use of Live Food for Aquaculture. FAO Fisheries Technical Paper, 295 pp.

Huisman., EA Zonneveld, N Bouwns, AHM, Editors, 1979. Aquacultural research in Aisa. Management Techniques and nutrition pudoc, Wageningen, Netherland, 271 pp.

National Research Council, 1988. Nutrient Requirement of Warm waters Fishes and Shell fishes. National Academy of Sciences, Washington DC. 102 pp.

Linder, MC 1985. Nutritional Biochemistry and Metabolism with Clinical Applications. Elsevier Science Publishing Company, Inc. New York, 436 pp.

Course Viva

FIMS 2112

Viva-voce

1CH

YEAR 2 TERM II

Major Subjects

FIMS 2201 Introduction to Genetics and Molecular Biology 3 CH

Introduction: Historical background, different branches and their importance, scope and development, some basic terms and symbols.

Mendelian genetics: Mendel's laws and modification of Mendelian inheritance, dominance interaction of gene.

Chromosome and Gene: Gene and gene concept, genotype and phenotype of organisms, evidence to indicate genes are located on the chromosome.

Linkage and recombination: Discovery of linkage, linkage maps, detection of linkage, genetic interference and coincidence and crossing-over, mutation and chromosomal aberrations, epistasis.

Allele: Definition, characteristics, example and importance of multiple alleles and pseudoalleles.

Inheritance: Quantitative inheritance, cytoplasmic inheritance, inheritance of extra-nuclear genes, maternal inheritance, Sex determination, mechanism of sex determination, Balance theory of sex determination and sex-linked, sex-limited and sex influenced inheritance.

Nucleic acids: Occurrence, isolation, purification and molecular weight determination, Chemical composition, structure and characteristics of DNA, Chemical, enzymatic and PCR methods of DNA sequencing: Recombinant DNA General features and mechanism of DNA replication, Watson-Crick model, hereditary nature of DNA, DNA repair mechanism, Structures of RNA and their sequences.

Transcription: Prokaryotic and eukaryotic transcription, RNA polymerase, mechanism of RNA splicing and processing, mRNA structure.

Translation: Genetic code, specificity, colinearity of gene and protein structure, post translational modifications.

Protein synthesis: Structure, type and function of eukaryotic ribosome, location and functional site of ribosome, Protein synthesis mechanism- isolation, elongation and termination, Control of translation in both prokaryotes and eukaryotes.

Books/References:

Gardner, JE and Snustad, P D 1981. Principles of Genetics. Jhon Willy and Sones, Inc. New York

Snustad, P D Simmons, K J and Jenkins, J B 1997. Principles of Genetics. John Willy & Sons,.Inc.New York

Ayala, FJ and Aiger, Jr JA 1980 Modern Genetics. The Benjamin-Cummings publishing Company, inc. Menlo Park, California.

Falconer, DS 1981. Introduction to Quantitative Genetics, Longman, London and New York.

Champan, AB, Editors, 1985. General and Quantitative Genetics. Elsevier Science publishers BV Amsterdam, Oxford. New York, Tokyo.

Goodenough, U 1981 Genetics. WJ Mackay Ltd. Lordswood, Chatham Kent, Great Britain.

Lehninger, L A Nelson, D L and Cox, M M 1988. Principles of Biochemistry. Worth Publishers,

DeRoberties, E D P and DeRoberties, EMF 1988. Cell and Molecular Biology. Wavertev

FIMS 2203

Fisheries Microbiology

3CH

Taxonomic classification of microorganisms: Mold, yeast, bacteria, mycoplasma, Chlamydia and virus. General characteristics of prokaryotes and eukaryotes.

Bacteria: Morphology and structure (cell wall, cell membrane, capsule, pilli, flagella, spores, cytoplasm, and nuclear material). Cultural and physiological characteristics. Description of important genera.

Viruses: General characteristics, classification, morphology and structure, viral reproduction.

Microbial growth and nutrition: Microbial ecology, Microbial growth curve, factors affecting microbial growth (water activity a_w , pH, temperature, redox-potential E_h , nutrient, microbial interactions, antimicrobial agents)

Aquatic microorganisms: Microorganisms of freshwater and marine environment. Factors effecting growth of aquatic microorganisms and their activities related to aquatic animals. Economic importance of aquatic microorganisms.

Contamination and spoilage of fresh fish: Microorganisms of cold, temperate and tropical regions. Sources of contamination, causes of spoilage, factors affecting kinds and rates of spoilage, evidence of spoilage, chemical changes caused by microorganisms in fish.

Spoilage of fishery products: Frozen fish, canned fish, cured fish, fermented fish and surimi based products.

Effect of processing on microorganisms: Effect of low and high temperature, curing and others processing methods.

Extremophiles, Micro-organisms and water pollution, Micro-organisms and industry, Micro-organisms and public health.

The economics of microorganisms.

FIMS 2204

Fisheries Microbiology Lab/Field Work

1CH

Important terminology and guideline for exercise in the practical classroom.

Study of different types of microscopes (principles and operation)

Study of culture media: Ingredients, types, and preparation of culture media.

Culture of microorganisms: Broth culture, pour plate culture, spread plate culture, streak plate culture, stab culture and shake culture.

Microscopic observation of bacteria: Gram's stain, spore stain, flagella stain, Ziehl-Neelsen's stain, Hiss's methods and Albert's staining.

Quantitative estimation of bacteria: Consecutive decimal dilution method and most probable number method.

Field visit for sample collection from selected fish landing centers, fish markets and processing plants and bacteriological analysis and preparation of report.

Books/References:

Frazier, W. C. and Westhoff, D. C. 1990. Food Microbiology. 3rd edition. McGraw Hill Book Co., New York. London.

Nickerson, J. T. and Sinskey, A. J.. 1993. Microbiology of Food and food processing. Elsevier, New York, Oxford, Amsterdam

Ravindran, K. N., Nair, I. A., Perigreen, P. A. Paniker and Thomas, M.. 1985. Harvest and Post-harvest Technology of Fish. Society of Fisheries Technologists, India.

Reinheimer, G. 1985. Aquatic Microbiology. John Wiley & Sons. New York, Brisbane, Toronto.

Ward, D. R. and C. R. Hackney. 1991. Microbiology of Marine Food Products. A AVI Book, Van Nostrand Reinhold, New York.

Collins, C. H. and Lyne, P. M., 1976. Microbiological Methods (4th ed.) Butterworths & Co. Ltd., London

Barrow, G. L. and Feltham, R. K. A. (Ed.) 1993. Cown and Steel's Manual for the Identification of Medical Bacteria, Cambridge University Press.

Miwa, K. and Low, Su Ji. 1992. Laboratory manual on analytical methods and procedures for fish and fish products (2nd ed.). Marine Fisheries Research Department, SEAFDEC, Singapore.

Marvin L. Speck (Ed.) 1984. Compendium of methods for the microbiological examination of foods. American Public Health Association. Washington, D. C

FIMS 2205

Application of GIS in Fisheries

2CH

Introduction: Definition, history and components of GIS.

Spatial data: Mapping concepts, features and properties, maps and their influence on the character of spatial data. Data types: point, line and polygon. Vector and raster data, advantages and disadvantages. Other sources of spatial data. Census and survey data, aerial photographs, satellite images. Field data sources. Surveying and GPS.

Data input, verification, storage, and output: Methods of data input, editing, presentation, updating and storage.

Data analysis: Measurement in GIS. Lengths, perimeters and areas. Reclassification, buffering and distance. Vector to raster and raster to vector transformation. Integrating data into GIS – map overlay, spatial interpolation and their use in fisheries.

Multi criteria evaluation (MCE): Fish habitat suitability modelling (FHSM) for different fish species, mapping fish species and plankton distributions in lake, estuaries and sea using available information and satellite images. Detection of existing fish farming locations using satellite images.

Use of GIS for aquaculture planning and development.

Case Study: Fish habitat suitability modeling in different environmental conditions.

Books/References:

Star, J. and Estes J. (1990). Geographical Information Systems: An Introduction. Prentice Hall, Englewood Cliffs.

Mathews Hugh and Foster Ian (1995). Geographical Data, sources, presentation and analysis. Oxford University Press.

Heywood, I, Cornelius S. and Carver S. (1998). An introduction to Geographical Information Systems. Longman, London.

Aguilar, M.J. and Nath, S.S. (1998). A strategic reassessment of fish farming potential in Africa. Food and Agriculture Organisation, Rome, Italy.

Antenucci, J. C. et al. (1991). Geographic Systems. A guide to the Technology. Van Nostrand Reinhold, New York.

EGIS (1997). Floodplain fish habitat study, Water resources planning organisation (WARPO), Ministry of water resources, Government of Bangladesh, Dhaka, Bangladesh.

Hugh Mathews and Ian Foster (1995). Geographical Data, sources, presentation and analysis. Oxford University Press.

Ian Masser and Michael Blakemore (1991). *Handling Geographic Information: Methodology and Potential Application*. Longman Scientific and Technical, John Wiley and Sons, Inc. New York.

FIMS 2207

Freshwater Aquaculture

3CH

Aquaculture system: Management approach, extensive (traditional), improved traditional, semi-intensive and intensive culture. Monoculture, polyculture, composite fish culture and integrated aquaculture.

Pond aquaculture: Site selection, pond construction, drying, liming, fertilization, productivity, stocking and post stock management.

Nursery management: Pond preparation, fertilization, insect control, stocking and post stocking management.

Natural fish seed collection, seed production and transportation: Natural fish seed collection, bundh spawning, induced spawning, methods of packing and transport of fry and live fish, causes of mortality of fry and brood fish during transportation, use of anaesthetics, antiseptics and antibiotics in live fish transport.

Aquatic weeds: Common aquatic weeds and methods of their control. Preparation of compost with aquatic weeds, algal bloom and its control.

Aquatic Insect and their control.

Culture of important freshwater species: Carp, prawn, catfish, tilapia, eel, snakes-heads and small indigenous species (SIS).

Cage and pen aquaculture: Site selection, design and construction of cages and pens, species selection, stocking, feeding and harvesting.

Impacts of aquaculture on environment.

Identification of common aquatic weeds and algae of aquaculture.

Identification of seeds of important aquacultural fish and shrimp species.

Preparation, fertilization and management of a nursery pond.

Preparation, liming, fertilization and management of a stocking pond.

Use of anesthetics in handling of fish.

Transportation of fry, fingerlings and live fish.

Case study: Visit to fish/Prawn hatchery and fish farms and preparation of cage study report.

Books/References:

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

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

Pillay, T. V. R. 1993. Aquaculture: Principles and practices, Fishing News Books Black well Scientific Publications Ltd. Osney Weed Oxford OX2 OEL, U.K. 592 pp.

Anonymous, 1997. Training on Integrated Fish Farming to the Thana Fisheries Officer, Fisheries Research Institute, Mymensingh.

Axelord, H. R. 1980. Schultz, L. P. 1983. Hand book of Tropical Aquarium Fishes, Neptune, New Jersey, T. F. H. Publications Inc. Ltd. 718 p 3rd rev. ed.

Chondar, S. L. 1980. Hypophysation of Indian Major Carps. Shatish Book Enterprise Motikatra, Agra-3, India, 146pp.

Edwards, P., D. C. Little and H. Demaine (eds.). 2002. Rural Aquaculture, CABI Publishing, CAB international, Wallingford, Oxon OX10 8DE, U. K. 358 pp.

FAO (Food and Agricultural Organization) 1990. Farming Systems. Developments, Guidelines for the conduct of training course in farming systems development. FAO- United Nations.

Jhingran, V. G. 1977. Fish and Fisheries in India. Hindustan Publishing Delhi.

Jhingran, V. G. and R. S. V. Pullin 1985. A Hatchery Manual for Common, Chinese and Indian Major carps. Asian Development Bank, ICLARM, Manila, Philippines.

Karim, M. A. 1975. An Introduction of Fish Culture in Bangladesh, Ruby Press, Mymensingh, Bangladesh.

Kurian, C. V. and Sebastian, V. O. 1982. Prawns and Prawn Fisheries of India. Delhi, Hindustan Publishing Corporation (India) 186p. 2nd rev. ed.

Muir, J. F. and Roberts, R. J. (Eds.) , Recent Advances in Aquaculture, Vol. I, II, III and IV, Croom Helm, London.

Pillay, T. V. R. 1994. Aquaculture Development: Progress and Prospect. Fishing News Books Black well Scientific Publications Ltd. Oxford.

Pullin, R. S. V. and Lowe-McConnel, R. H. 1982. The Biology and Culture of Tilapias, ICLARM Conference Proceedings 7. 432 p. International Center for Living Aquatic Resource Management, Manila, Philippines.

Islam, M. A. 1985. Macher Chash Babosthapana. Bangla Academy, Dhaka. 277 pp.

Islam, M. A. 1989. Macher Chash Babosthapana. Bangla Academy, Dhaka. 174 pp.

Islam, M. A. 1992. Macher Pukurer Pani. Academy, Dhaka. 229 pp.

FIMS 2209

Introduction to Oceanography

3CH

The Origin of Earth, Earth and Ocean, Plate Tectonics, Continental margins and ocean basins: The Topography of Ocean Floors, Continental Margins, Deep Ocean Basins. Origin and history of basin of the Bay of Bengal, continental shelf and slope and abyssal plain, Bottom topography and sediments load of the Bay of Bengal.

Marine resources: Types of Marine Resources, Physical Resources, Marine Energy Resources, Biological Resources, Non extractive Resources, The Law of the Sea

Sediments: Classifying Sediment by Particle Size and by Source, Distribution of Marine Sediments, The Sediments of Continental Margins, The Sediments of Deep-Ocean Basins, The Economic Importance of Marine Sediments.

Physical properties of sea water: Salinity, conductivity, temperature, density, light and pressure, etc. Typical distribution of salinity, temperature, density, sigma T and pressure in the ocean.

Seawater chemistry: The Water Molecule, The Dissolving Power of Water, Seawater, Dissolved Gasses, Acid-Base Balance.

Estuarine sedimentation and coastal processes. Types of estuary: salt wedge estuary, highly stratified estuary, slightly stratified estuary, vertically mixed estuary, inverse estuary, intermittent estuary, water & salt circulation in the estuary.

Coasts: Classifying Coasts, Primary Coasts, Secondary Coasts, Beaches, Large-Scale Features of Secondary Coasts, Estuaries, Human Interference in Coastal Processes.

Atmospheric circulation and weather: Composition and properties of the atmosphere, weather and climate, atmospheric circulation, wind patterns, storms.

Ocean circulation: forces that drive currents, surface currents, wind-induced vertical Circulation, thermohaline circulation.

Waves: definition, classification and different types of waves, origin of surface waves, forms and characteristics, growth and dissipation of wind waves, breakers and surfs, wave refraction and defraction, wave measurement and analysis. Tsunami, internal waves, wave dynamics and wind waves, interference and rogue waves.

Tides: tidal waves, storm surges, seiches, equilibrium theory of tides, dynamic theory of tides, tides and marine organisms. Tsunami

Currents: Atmospheric circulation, global wind pattern, Ekman spiral, Ekman transport, major surface current system of the world ocean, geostrophic current, upwelling. surface ocean currents, deep-ocean circulation, water flow in semi-enclosed seaways, Currents in estuaries

Mixing processes in the sea: wave action, internal waves, currents, viscosity, eddy diffusion and upwelling, results of circulation.

Poles and tropics: oceanography of the extremes: defining the polar and tropical regions, polar and tropical ocean.

FIMS 2210 Introduction to Oceanography Lab/Field Work 1CH

Study of Marine Zonation with its living community, study of oceanographic research equipment with application

Determination of Salinity and other chemistry of Seawater.

Calculation of Tide, Wave, and current.

Study of source, types, Texture and dynamics of marine and coastal sediment,

Study of Benthic community structure of coastal and marine environment

Books/References:

Pickard, GL 1963. Description Physical Oceanography. Pergamon Press, London.

Yasso, WE 1965. Oceanography. Holt, Rinehart and Winston, Inc., New York.

King. CAN 1966. An Introduction to Oceanography. McGraw Hill Book Co, New York.

Pickard GL and WJ Emery, 4th enlarged, 1982. Descriptive Physical Oceanography. Pergamon Press, Oxford.

Weisberg, J and H Parish. 1974. Introduction to Oceanography. McGraw-Hill Kogakusha, Ltd., Tokyo.

FIMS 2211 Principles of Marine Biotechnology 2CH

General Introduction and scope of biotechnology and its branches. Role of biotechnology in human life. Biological warfare. Safety and ethical issues.

DNA Technology: Basic strategy of gene manipulation and analysis of marine organisms. Application of DNA technology. Gene, growth and others, transformation among animals. Transgenic fishes.

Biosensors: Recent developments in biosensors and their uses. Characteristics of biosensors. Biochemical application of biosensors in environmental and clinical pollution detection.

Biotechnology in pollution control: Introduction to pollution of the sea. Use of commercial blend of microorganisms and enzymes in wastewater treatment. Immobilize cells in waste treatment. Potential application of recombinant DNA technology in waste treatment.

Protein biotechnology: Industrially significant proteins and their sources, microorganisms, plants and animal tissues. Proteins employed in health care industry. Recombinant protein technology. Protein technology.

Enzyme biotechnology: Introduction to enzymes and their uses in medical, chemical and food industry, leather industry, detergents, textile, paper industry, antibiotics, biocatalysts and fermentation process. Industrial approach to enzyme production, extraction of natural products, detoxifying agents.

Hazard and public health issues: Pathogens and parasites transmission in marine and estuarine ecosystem, Shell fish poisoning, Poisonous vertebrates of the sea and their uses

Health and nutrition: Food from the sea weeds, fishes and *Spirulina*

Products: Products from sea animals, Glues

Books/References:

Glazer, AN and Nikaido, H Microbial Biotechnology

Maier RM pepper, IL and Gerba, CP environmental Microbiology

Atlas, RMA and Bartha, R Microbial Ecology

Frank, F Protein Biotechnology

Walsh, G and Headon, D Protein Biotechnology

Bohak, Z and Sharon, N Biotechnological applications of proteins and enzymes

Course Viva

FIMS 2214

Viva-voce

1CH

YEAR 3 TERM I

FIMS 3101

Inland Fisheries Resources Management

3CH

Inland fisheries resources (physical, biological and other), Present situation and statistics, projection of future production; Involvement of human resources, governmental and nongovernmental organizations

Fisheries biodiversity and resources of rivers, floodplains, *haor*, *baor*, *beel*, lake, and estuary in Bangladesh; Economic importance and contribution of fisheries resources; diversity of fish habitats and fish species, variability in flooding,

Objectives, positive and negative impacts to capture and culture fisheries arising from flood action plan projects; impacts of existing FCDI structures, roads, agro-chemicals, water pollution, fish disease, overfishing etc.

Impact evaluation-the economic assessment fish resource model, fish production system, expected changes in project impact area, the institutional setting market conditions, social impact assessment.

Habitat improvement, necessity, types, removal of obstruction, modification of existing obstacles, dams, shelter, lotic and lentic waters.

Fisheries management of baor, haor, Kaptai lakes, brackish water, establishment of new fishing grounds.

Management of natural populations, necessity, methods, regulation of fishing effort, monitoring and control of fish stocks, depletion of natural brood stock, artificial propagation, open water stocking, survival of stocked fish up to maturity and first spawning.

Hilsha management and conservation: Importance of hilsha fishery, species diversity and distribution, biology, reproduction and breeding ground. Differences between Jatka and Chapila. Production constraints and management implementation strategies.

Fisheries regulations, purpose, types effective application, protection of spawners, protection of progeny, regulatory authority.

Problems of management, prediction of abundance, natural balance and environmental monitoring, role of nutrients.

Open water fisheries policy of Bangladesh, CBFM, INRM, Jalmahal policy.

Books/References:

Bennett, GW 1965. Management of Artificial lakes and Ponds. Reinhold Publishing Corp, New York.

Lagler, KF 1956. Freshwater Fishery Biology. Second Edition, William C. Brown, Co. Dubuque, Iowa, USA.

Rounsefell, GA and Everhart, WH 1983. Fishery Science. John Willey and Sons, New York.

Everhart, WH and Youngs, WD 1981 Principles of Fishery Science. Cornwell University Press, Ithaca and London.

FCPO. 1992. Guidelines for Environmental Impact Assessment, EIA. Ministry of Irri. Water Dev. & Flood Control, The Peoples Rep. of Bangladesh, Dhaka.

FAP 17 1992. Fisheries Impact Assessment. ODA, Dhaka.

Hoggarth, DD 1997. Fisheries dynamics of modified flood plains in NW Bangladesh. ODA, Fish Manag. Sci. Prog. Mymensingh. Bangladesh.

Halder, GC. 2008. 2nd Edition. Hilsa Fisheries Conservation, Development and Management Technique. Department of Fisheries, Bangladesh. Matshya Bhaban, Ramna, Dhaka.

WorldFish Centre. 2009. Community Based Fisheries Management (CBFM): Project Report and Policy Documents

FIMS 3103

Fish Harvesting and Handling

3 CH

Introduction: principles and theory of fishing, MSY, modern trends in fishing, fishing implements other than nets.

Fishing gears, classification, materials, terminology, numbering systems, relative efficiencies of nets of different materials, net preservation, net making and mending, knot-less nets, gears and their operation, trawling gears, seine, purse-seine, gill and trammel net and long lines.

Fishery reconnaissance: location and detection of fish and shell fish, plankton monitoring, hydrographic observation, fishing charts, echosounding, infra-red photography.

Fish escapement behavior, response to stimuli, attraction concentration, frightening by artificial lures, light and sound. Illegal fishing, ghost: dynamite fishing

Fishing crafts: types, traditional and mechanized, their operation in Bangladesh.

Aquaculture harvesting: pond draining, seining, trapping, hooks and lines.

Methods of harvesting pelagic, demersal and midwater fishes, harvesting of shrimps. fishing grounds in the Bay of Bengal, present status of fishing problem of trash fish and joint ventures in fish harvesting.

Fish handling: handling of fresh fish and shrimps on board and shore, ideal: careful handling of different types of catches, characteristics of fresh condition, appearance eyes, odour, flesh, gills, skins, prevention of mechanical damage in fish, washing slime, evisceration sanitation of decks, box and transport vehicles, facilities for mechanical handling.

FIMS 3104

Fish Harvesting and Handling Lab/Field Work

1CH

Acquaintance with the different types of fishing crafts and gears in Bangladesh, examination of net materials, marketing and mending of nets, techniques of net preservation,

Harvesting techniques of commercially important inland and brackish water fish and shell fish of Bangladesh.

Freshness test of fish and shell fish, appearance, eye condition, odour, flesh, gill condition, skin.

Visit to local whole sale market and fish landing centre.

Books/References:

Brandt, AV, 1984. Fish Catching Methods of the World, Third Edition, Fishing News, Books, Ltd. Surrey England.

Borgstrom G, Editor, 1965. Fish as Food Vol. I-IV Academic Press London.

Donald, Editor, 1968. The Freezing Preservation of Foods. The Avi Publishing Company INC.

FAO 1975. Ice in Fisheries, FAO Fisheries Reports No 59. Revision 1: 57 p.

Garrer E. 1962. How to Make and Set Nets. Fishing News, Books, Ltd., London 59p.

Kristijonsson H, ed. 1962. Modern Fishing Gears of the World. Vol. I-III. Fishing News, Books, Ltd. London.

Peter GJA, Editor, 1971. On Testing the Freshness of Frozen Fish. Fishing News, Books, Ltd. London.

Rabindran, Editor, 1985. Harvest and Postharvest Technology of Fish. Society of Fisheries Technologies, India.

Sainsbury, JC 1975. Commercial Fishing Methods and Introduction to vessels and gears. Fishing News, Books, Ltd., London.

Stanshy, ME 1963. Industrial Fishery Technology Reinhold Phbl. Corp New York.

Clusas, IJ, Editor. 1985. Fish Handling, Preservation and Processing in the Tropics. Part-I & II. Tropical Development & Research Institute, London.

FIMS 3105

Fish Genetics

3CH

Genetics of qualitative phenotypes:

Single autosomal genes: Complete dominant gene action; In Complete dominant gene action; Additive gene action

Dihybrid inheritance; Two or more autosomal genes; Non-epistatic interaction; Epistatic interaction

Sex linked genes; Y-linked genes; X-linked genes

Genes with multiple alleles

Pleiotropy

Linkages

Population genetics

Selection

Genetics of quantitative phenotypes:

Variation of quantitative phenotype and its parts;

Additive genetic variance and selection; Heritability; Selection programs; Dominant genetic; variance and hybridization; Cross breeding; Heterosis; Inbreeding; Genetic drift

Biotechnology

Sex reversal and production of monosex populations

Chromosomal manipulations: haploid, diploid, triploid, tetraploid, gynogenesis and androgenesis

Genetic engineering

Electrophoresis

Genetics of brood stock management

FIMS 3106

Fish Genetics Lab/Field Work

1CH

Separation and identification of serum protein from fish using PAGE

Isolation of genomic DNA from fish spleen and kidney

Isolation of plasmid DNA from E coli

Agarose gel electrophoresis of plasmid DNA

Amplification of DNA by polymerase chain reaction, PCR

Books/References:

Purdom, C.E. 1993. Genetics and Fish Breeding. Chapman & Hall, London.

Ryman, N and Uttey F, Editors. 1987 Population Genetics and Fishery Management, University of Washington Press, Seattle and London.

Douglas, T 1986 Genetics for fish Hatchery Managers. AVI publishing Company. Inc. Westport., Connecticut.

Ayala, FJ and Aiger, Jr. JA 1980 Modern Genetics. The Benjamin:Cummings publishing Company, inc. Menlo Park, California.

Falconer, DS 1981. Introduction to Quantitative Genetics, Longman, London and New York.

Gardner, EJ 1975. Principle of Genetics, John Wiley and Sons, Inc. New York. London, Sydney, Toronto.

Champan, AB, Editors, 1985. General and Quantitative Genetics. Elsevier Science publishers B.V. Amsterdam, Oxford. New York, Tokyo.

Goodenough, U 1981 Genetics. W.J. Mackay Ltd. Lordswood, Chatham, Kent, Great Britain.

FIMS 3107

Fish Parasitology

3CH

Introduction to parasitology: Definition. Symbiosis and its types, infestation and infection.

Parasitic fauna of freshwater and marine fishes: Classification of protozoan, helminthes, copepod and annelid parasites of fishes; their characteristics and examples.

Ecology of parasites: Host-parasite-environment relationship, types of parasitism.

Life cycles of representative protozoan and metazoan fish parasites: key to their control.

Common protozoan parasitic diseases of fishes: causative agents, clinical and pathological signs, prevention and control measures.

Common metazoan parasitic diseases of fishes: causative agents, signs, pathology, prevention and control measures.

Hosts reaction to parasites: cell and tissue reactions. Immunity in fishes against parasitic infestation and infection. Principles of immunization against protozoan and metazoan parasitic diseases in fishes.

Physiological factors of parasitic diseases: stress and susceptibility of fish to parasitic diseases. Infestation to infection and diseases.

Fish consumption and public health: Fish as carrier of human diseases - zoonotic diseases. Prevention and control of zoonotic diseases.

FIMS 3108

Fish Parasitology Lab/Field Work

1CH

Calibration of the microscope for measurements

Study of museum specimens of fish parasites.

Plan data accessation for examination of vertebrate host

Technique of investigation of fish host for parasitological study

Collection, fixation, and preservation of parasites.

Permanent preservation of parasites: staining, dehydration, clearing and mounting

Key out, identification and description of collected parasites

Field trip: to a fish farm and preparation of report on parasitological investigation.

Books/References:

Cheng. T. C. 1982. General Parasitology Academic Press, Inc.

Dogiel, V.A. 1962. General Parasitology. Oliver and Boyd, Edinburgh, U. K.

Kabata, Z. 1985. Parasites and diseases of fish cultured in the tropics. Taylor and francis, London.

Woo, P.T.K. (Ed.) 1995. Fish diseases and disorders. Vol. I. Protozoan and metazoan infections. CAB, international.

Esch, G.W., Bush, A. O. and Aho J. M. 1990. Parasite communities : Patterns and Processes. Chapman and Hall, London.

Kennedy C.R.1975. Ecological Animal Parasitology. Blackwell Scientific Publications, Oxford.

Williams, H.H. and Jones, A. 1994. Parasitic Worm of fish. Tayler and Francis, Basingstocke.

Kennedy, C.R. 1976. Ecological Aspects of Parasitology. North Holland, Amsterdam.

Roberts R. J. 1989. Fish Pathology (2nded.) Baillere Tindal, London, UK.

Chandratchakool, P., Tuabull, J. F. and Limsuwan, C. 1994. Health Management of Shrimp Ponds .Aquatic Anima lHealth Reseaech Institute Bangkok, Thailand.

Lom, J. and I. Dykova. 1992. protozoan parasites of fishes. Development in aquaculture and Fisheries Science, 26. Elsevier, Amsterdam.

Hoffman, G.L. 1967. Parasites of North Americal Freshwater Fishes.University of California Press, Burkeley.

Cable. R.M. 1963. An illustrated Manual of Parasitology. Allied Pacific Private Limited, India.

Tonguthai,K., Chinabut, S., Somsiri, T., Chanratchakool, P. and Kanchanakhan, S. Diasnostic Procedures for Finfish Diseases. AAHRI, Department of Fisheries, Kasetsart Univ. Campus, Bangkok, Thailand.

Yamaguti, S. (1958, 1959, 1961, 1962, 1963) . Systema Helminthum . Vol. I – V. Interscience Publishers Inc.

FIMS 3109

Rural Sociology

2CH

Introduction: Definition, origin and growth of sociology and rural sociology. Scope, nature and importance of rural sociology.

Rural Society: Definition and elements of Society, Rural society, Peasant society, Agrarian society, Tribal society etc.

Rural Community: Community sentiment, rural demography, rural-urban settings, village community, rural cultures, rural festivals, Institution.

Society and Environment: Influence of geographical environment (plains, hills, deserts, rivers, coasts, charlands etc.) on rural livelihood.

Social stratification: Features of caste system and class system.

Rural Family & Kinship: Characteristics of family and rural family, social importance of family, type and functions of family, changes in the rural family, problems in family, disorganization of modern family, joint family, advantages and disadvantages of joint family. Kinship: Kinds of kinship

Social Mobility, Social Progress and Social changes: dimensions of social mobility, determinants of social mobility. Influence of social values on progress, criteria of progress, and principles of Social progress. Factors of social changes.

Rural power structure, gender issues and rural development: Rural leadership, basis of power in rural society, changes in the traditional power structure. Gender inequality and discrimination, changes in rural society and women empowerment. Definition and models of rural development, Comilla Model, BRDB, NGO approach. Women involvement and rural development.

Books/References:

Koenig, S 1957. Sociology, Barnes and Noble Inc. New York.

Spencer, M 1981. Foundation of Modern Sociology. Prentice Hall Canada Inc.

Broom and Seiznick, 1963. Sociology, Text with adopted reading, Harper and Row Publishers.

Horton, PB and Hunt, CL 1964. Sociology, McGraw-Hill, Inc. Book Company, New York, Den Francisco, Toronto, London.

Sharma, R. K. 1996. Fundamentals of Sociology. Atlantic Publishers and Distributors, New Delhi.

Sharma, R. K. 2004. Rural Sociology. Atlantic Publishers and Distributors, New Delhi.

Browne, Ken. 1998. An Introduction to Sociology. Polity Press, London.

Rogers, E.M. *et al.* 1998. Social Change in Rural Societies: An Introduction to Rural Sociology, Prentice-Hall, London.

Giddens, Anthony. 1998. Sociology, 3rd edition, Polity Press, London.

Devi, Laxmi. 1998. Rural Sociology. Anmol, India.

Chitambar, J.B. 1993. Introductory Rural Sociology. Wily Eastern Ltd, India.

Minor Subject

ENLA 3101

Environmental Law of Bangladesh

2CH

Domestic Environmental Problems and Regulatory Regime in Bangladesh:
Major Domestic Environmental Problems of Bangladesh: Food and Agricultural Sector, Land, Water and Air Sector, Forest and Fisheries Sector, Urban and Rural Sector.

Historical Perspectives: Development of Environmental Laws in Bangladesh, Overview of the Domestic Environmental Legal Framework of Bangladesh. Domestic Environmental Law and Policy Making Process in Bangladesh.

Sectoral Laws and Policies Relating to Environment in Bangladesh:

Pollution, Land, Air and Water, Related Laws and Policies in Bangladesh, Waste Disposal Related Laws and Policies in Bangladesh

Forestry Related Laws and Policies in Bangladesh, Wild Life Related Laws and Policies in Bangladesh, Fishery Related Laws and Policies in Bangladesh.

Biodiversity Conservation Related Laws and Policies in Bangladesh, Other Sectoral Laws and Policies in Bangladesh.

Enforcement of the Environmental Laws and Policies:

Environmental Court in Bangladesh, Powers, Functions and Procedures of the Environmental Courts, Effectiveness of the Environmental Courts, Public Interest Litigation in Bangladesh, Its Role in the Protection and Conservation of Environment in Bangladesh.

Institutional Issues: Role of the Governmental and Non-governmental Organizations in the Protection and Conservation of Environment in Bangladesh Including Ministry of Environment and Forest, Department of Environment, Department of Forest, Bangladesh Environmental Lawyers Associations and other Environmental NGOs etc.

Books/References:

Mohiuddin Farooque & S. Rizwana Hasan: Law Regulating Environment in Bangladesh, BELA, Dhaka, 1996.

Mohiuddin Farooque: Law and Custom on Forests in Bangladesh, Issues & Remedies, BELA, 1997.

Hossain Md. Iqbal, International Environmental Law: Bangladesh Perspective, 1st Edition, DIU, 2004.

Mohiuddin farooque: Regulatory Regime on Inland Fisheries in Bangladesh, BELA, 1997.

Poribesh Odhidaptar: Poribesh Ain Shonkolon, Dhaka, 2002.

B.C.A.S. Guide to the Environmental Conservation Act, 1995 & Rules, 1997; Dhaka, 1999.

A. R. Masud: The Fish Law, Anupam, Dhaka, 2003.

IUCN-Bangladesh: Natural Resources Conservation Strategy.

A. Atiq Rahman (Ed): Environment and Poverty, B.C.A.S., 1998, Dhaka.

Jona Razzaque: Public Interest Environmental Litigation in India, Pakistan and Bangladesh, Kluwer Law Publication, 2004.

Governing Legislation:

The Environmental Court Act, 2000, Act No. XI of 2000

The Environmental Conservation Act, 1995, Act No. I of 1995

The Marine Fisheries Ordinance, 1983, Ordinance No. XXXV of 1983.
The Bangladesh Wild Life, Preservation, Order, 1973, President's Order No. 23 of 1973.
The Private Forest Ordinance, 1959, East Pakistan Ordinance No. XXXIV of 1959.
The Protection of Conservation of Fish Act, 1950, East Bengal Act No. XVIII of 1950.
The Forest Act, 1927, Act No. XVI of 1927.

Course Viva

FIMS 3112

Viva-voce

1CH

YEAR 3 TERM II

FIMS 3201

Fisheries Extension

3CH

Introduction: Fisheries extension, its principles, functions and objectives, need for fisheries extension works for fisheries development, gradual growth of extension work in Bangladesh, Rural development and sustainable livelihood

Organization for extension work, main features, categories of personnel, supervision and co-ordination in extension work.

Education, motivation and learning, types and purpose concept of need, Maslow's need theory, communication in extension for fisheries.

Extension teaching methods and teaching aids, individual methods, group and mass methods, visual and audio-visual aids, importance and use. PRA, RRA

Innovation-decision process and transfer of technologies, diffusion, models, factors affecting the transfer of technologies.

Leadership, concept and types and groups, recognition for good leadership, programme planning and evaluation, concept, procedures and importance.

Extension problems for fisheries development and their possible solution, rural youth in extension work, past and present programmes for development of fisheries and related agricultural development activities, awareness programme for bio-diversity, fishing right, conservation, common property fisheries etc.

FIMS 3202

Fisheries Extension Lab/Field Work

1CH

An orientation to different organization related to fisheries development project, GO, NGO's & Donor agencies.

Preparation of questionnaire: interview schedule for collection of data from village on fisheries and preparation of survey report.

Preparation of training programme and practice training, lecture, small group discussion, Philips 66 methods, symposium, panel discussion, brain storming and demonstrations.

Extension field trip to rural areas to observe rural development activities in the field situation, thana, districts, with emphasis on fisheries.

Books/References:

Dahama. OP 1976. Extension and Rural Welfare Agra: Ramprasad and Sons.

Kamatch, MC, editor, Extension Education in Community Development. New Delhi: Directorate of Extension, Ministry of Feed & Agriculture, Government of India.

Mosher, AT 1978. An Introduction to Extension. New York Agricultural Development Council.

Oakley, P and Garforth C 1985. Guide to Extension Training. Food and Agriculture Organization of the United Nations, Rome.

Regers, E M 1983. Diffusion of Innovations, New York: The Free Press of Glenco.
Roy, GL 1991. Extension Communication and Management. Calcutta: Naya Prokash.

Singh, Ranjit, 1987. A Text Book of Extension Education. Ludhiana. Indao : Shahitya kala Prakashan.

Supe, SV 1983. An Introcution of Extension Education. New Delhi: Oxford & IBH Publishing Co. Pvt. Ltd.

Wilson, MC and Gallup, G 1955. Extension Teaching Methods. Washington, DC USDA, Federal Externs Service.

Kashem.MA 1992 Samorasaran Bijnan, Extension Science. Dhaka: The Bangladesh packing Press.

FIMS 3203

Coastal and Marine Aquaculture

3CH

Introduction, objectives, history, present status, role and scope of coastal aquaculture in Bangladesh. Types of aquaculture systems, and levels of aquaculture industries.

Site selection: Selection of site for different types of aquaculture, basic criteria for suitable site. Design and construction of culture facilities in shore areas. sea farming zones

Species selection: Basic criteria for suitable species, genetic selection of cultivable species, commonly cultivable species of fishes, crustaceans, mollusks and seaweeds, indigenous and exotic species, Biological features of commonly cultured crustaceans and mollusks.

Seed production: Wild seed collection, sorting, preservation and transportation of natural seed, larval rearing of marine finfishes, prawns and other marine organisms.

Farming techniques: Farming techniques in various zones of sea , pen culture, cage culture, raft culture etc.

Culture techniques of marine fishes, shrimp, crabs, mussels, clams, oysters, abalone, scallop, squid, green turtle and seaweed. Pearl culture-life cycle of pearl oyster, techniques of pearl culture.

Preparation and management of sea farm: Control of predators, aquatic vegetation, and weed fishes, biofouling, fertilization, harvesting.

Mangrove fisheries: mangrove ecosystem, energy flow in mangrove swamp, prospect of fisheries and fish culture in mangrove areas.

FIMS 3204

Coastal and Marine Aquaculture Lab/Field Work 1CH

Designing of a coastal shrimp and fish farm.

Transportation of larvae and PL of shrimp.

Nursing of brackish water fish and shrimp fry.

Decapsulation and hatching of *Artemia* in laboratory condition.

Case study: Visit to a shrimp hatchery and a coastal aquaculture farm and report writing.

Books/References:

Landau, M 1992. Introduction to Aquaculture. John Wiley & Sons, Inc. New York, 440 pp.

Tucker, J W 2000. Marine fish culture. Kluwer Academic Publishers

Milne, P H 1972. Fish and Shellfish Farming in Coastal Waters. Fishing News Books Ltd. London 208 pp.

Korringa, P 1976. Farming Marine Fishes and Shrimps. Elsevier Scientific Publishing Company, Amsterdam, 208 pp.

Korringa, P 1976. Farming Marine Organisms Low in the Food Chain. Elsevier Scientific Publishing Company, Amsterdam, 264 pp.

Lutz, R A 1980. Muscle Culture and Harvest: A North American Perspective. Elsevier Scientific Publishing Company, Amsterdam, 350 pp.

Huner, JV and Brown, EV 1885. Crustacean and Mollusk Aquaculture in the United States. AVI Publishing Company, Inc. Westport,

Pillay, TVR 1973. Coastal Aquaculture in the Indo-pacific region, Fishing News, Books, Ltd. London 497 pp

Iverson, ES 1968. Farming at the Edge of the Sea, Fishing News Books Ltd. London. 301 pp.

Shepherd, CJ and N. Bromage, 1988. Intensive Fish Farming, Blackwell Science. Ltd. Oxford, 404 pp.

Lee DCC and JF Vichins, 1991. Crustacean Farming. Oxford, Fishing News Books:Blackwell Scient. Publ. Ltd.

McVey, JJ Moore 1983. CRC Hand Book of Mariculture. Vol. I: Crustacean Aquaculture.

Muir, JF and RJ Roberts, edited, 1982. Recent Advances in Aquaculture Vol. 1 Croom Helm, London. 453 pp.

Muir, JF and RJ Roberts, 1985 Recent Advances in Aquaculture Vol. 2 : Beckenham, U.K., croom Helm, 282pp.

Muir, JF and RJ Roberts, 1988. Recent Advances in Aquaculture. Vol. 3. Beackenhans, UJ Croom Helm 420pp.

Islam, A. 1988. Samudra Upakula Matsya Chash. Bangla Academy, Dhaka. 115 pp.

Mohan, M.J. (edited). 1980. Aquaculture in Asian Fisheries Society, Indian Branch Mangalore.

Muir, J.F. and R.J. Roberts (edited). 1982. Recent Advances in Aquaculture. Vol. 1. Croom Helm,

FIMS 3205

Fish Processing and Preservation

3 CH

Introduction: general principles of food preservation with special emphasis of fin fish and shell fish, proximate composition of fish and its application in fish preservation.

Post-mortem changes in fish: ATP degradation, rigor mortis, impact of rigor mortis on fish quality. Quality assessment of wet fish and fish products: sensory and biochemical qualities.

Chilling and icing of fish: Principles, types and nature of ice for adequate icing, method of icing on board vessel and during landing, transportation and sale. Adequate ice box for rural transportation and marketing of fish. Cool chain management. Changes in fish during chilling.

Freezing of fish: Mechanism of freezing of fish muscle tissue, types of freezing, freezing methods and equipment. Freezing of shrimp/prawn in Bangladesh: exportable shrimp/prawn products, commercial freezing of prawn, semi IQF of whitefish, quality requirements of frozen shrimp. Storage of frozen products. Design and planning of a cold storage and fish processing plant.

Drying and dehydration of fish: principles, commercial drying methods practiced in Bangladesh, drying of fish in special conditions, insect infestation and application of pesticides, constraints of traditional process and control measures. Improvement of traditional process. Salted-dehydration of jewfish. Environment and user-friendly processes in sun-drying. Irradiation in fish drying. Physico-chemical properties of dried fish.

Smoking of fish: principles, traditional smoking of shrimp in the coastal villages, constraints and improvement of traditional process. Smoking of finfish. Changes in fish during smoking.

Salting and marinating of fish: principles, types of fish salting and marinating, salting of ilish in different areas of Bangladesh, salt-fermentation of ilish, constraints and improvement of traditional process. Physico-chemical properties of salted fish.

Fermentation of fish: principles, preparation of fish sauce, traditional process of *shidhal* and nga-pi of Bangladesh, constraints and improvement of traditional process. Physico-chemical properties of fermented fish.

Canning of fish: principles of canning, can material, canning of tuna flake, canning of small pelagic fish. Examination of the cans. Changes in fish muscle during heat treatment.

Post-harvest loss of fish at different stages from harvest, transportation, processing to marketing. Loss reduction.

Packaging: function of packaging, package selection packaging materials, packaging regulations, future of packaging.

FIMS 3206 Fish Processing and Preservation Lab/Field Work 1CH

Acquaintance with fish processing laboratory, common glassware, chemicals and equipment. Safety use of lab equipment and chemicals.

Study of proximate composition of fish: moisture, ash, crude lipid and crude protein.

Study of icing of fish and assessment of the quality of wet fish by organoleptic method.

Preparation of fresh fish for wet fish market and value-addition of wet fish (dressing, filleting, loining, etc.).

Field visit to fish market and landing center to assess the condition of preservation and transportation and quality of fish and submission of report.

Field visit to fish/shrimp processing plant and submission of report.

Books/References:

AOAC. 1980. Official methods of analysis. Association of Official Analytical Chemists. Washington, D. C.

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.

G. M. Hall, 1997. Fish Processing Technology. Blakie Academic & Professional, London, Weinheim, New York, Melbourne, Madras

Gopakumar, K. (Ed.). 2002. Textbook of Fish Processing Technology. Indian Council of Agricultural Research, New Delhi.

Govindan, T.K. 1985. Fish Processing Technology. Oxford & IBH publishing Co., New Delhi.

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.

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; Aberdeen. Scotland, UK.

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.

Newsad, A.K.M.A. 2007. Participatory Training of Trainers: A New Approach Applied in Fish Processing. Bangladesh Fisheries Research Forum, Dhaka.

Stansby, M. E. 1963. Industrial Fishery Technology. Reinhold Publ Corp. New York.

Tanikawa, E. Motohiro, T, and Akiba, M. 1985. Marine Products in Japan, Koseisha Koseikaku Co., Ltd., Tokyo.

Zaitsev, V. P. 1965. Preservation of Fish Products by Refrigeration. U.S. Department of Commerce.

FIMS 3207

Fish Pathology

2CH

Introduction: General significance of fish disease. Sources and 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 viruses. Characteristics of major viral fish pathogens. Epizootiology, distribution etiology, clinical signs, pathology, and diagnosis.

Bacterial diseases of fish: 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.

FIMS 3208

Fish Pathology Lab/Field Work

1CH

Diagnostic procedure for fish diseases: (a) conventional laboratory techniques for viral, bacterial and fungal 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.

Books/References:

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. Iowa 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, Stirling.
- 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., Chanratchakool 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.

FIMS 3209 Fish Hatchery Operation and Management 3CH

Introduction, theories and principles, applied aspects of breeding, present methods and status of fish fry production in Bangladesh.

Fish reproductive endocrinology
Control of reproduction through hormone, environmental manipulations
Natural propagation and hormone induced breeding of fish,

Breeding techniques for Indian, Chinese and common carps, catfishes and other commercially important fishes of Bangladesh.

Hatchery design, operation and management of tilapia, shrimp and prawn
Assessment of maturity of the breeders, readiness, gamete formation
Fish hatchery-types, essential component, fry production methods, water quality monitoring, water supply and treatment, water pollutants.

Anesthetics in aquaculture.

Larval and Brood stock nutrition: Fish plankton interactions, utilization of plankton by fish, larval food requirement, food selectivity, utilization of plankton by fish larvae and fry, management of fry ponds; Live feed: microalgae culture method, culture of rotifers, cladocerans, brine shrimp and other fish food organisms, nutrient enrichment, formulated larval diets. Bloodstock diet.

Spawning and egg handling: natural and artificial spawning methods, control of spawning time, egg incubation, factors affecting egg development.

Types of incubators-hatching trays, catfish troughs, hatching baskets, hatching jars, circular incubators, monotone hatching box and vertical tray incubator.

Fry rearing: time of initial feeding, feeding frequency, feed particle size and feeding methods, rearing pond management.

Transportation of live fry and fingerlings, adults- equipment, water quality, handling, loading and stocking and shipping.

FIMS 3210 Fish Hatchery Operation and Management Lab/Field Work 1CH

Location and removal of pituitary gland,
Preservation of pituitary gland and administration of the extract,

Induced breeding of fish-brood fish care and maintenance, selection of breeders, selection of inducing agent and hatching techniques,

Culture of algae, plankton in mini earthen and concrete tanks,

Use of incubators and hatching of eggs and

Visit to commercial and shrimp hatcheries.

Books/References:

Hickling, CF 1962. Fish Culture. Faber and Faber, London.

Huet. M. 1972. Text Book of Fish Culture: Breeding and cultivation of fish. Fishing News Books Ltd. Farnham, Surrey. England.

Jhingran VG and RSV Pullin. 1985. A Hatchery Manual for the Common, Chinese and Indian Major Carps. Asian Development Bank and International Centre for Living Aquatic Resources Management, Manila, Philippines.

Al-Hajj. AB and ASD Farmer, 1984. Shrimp hatchery manual. Safut, Kuwait Institute for Scientific Research, 85p.

Fast, AW and LJ Lester, 1992. Marine Shrimp Culture : Principles and Practices.

Riper, RG IB McEllwain, LE Orme, JP McCraren, LG Fowler and JR Leonard. 1982. Fish Hatchery Management. US Department of Interior Fish Wild Life service, Washington, DC.

Quiition, ET 1989. Prawn, Hatchery Design and Operation, SEAFDEC Aquaculture Ext. Man, 9: 47p. 2nd ed.

Rounsefell, GA and WH Everhart, 1953. Fishery Science: It's methods and applications, John Wiley & Sons. Inc. New York.

Waynarovich, E and L Horvath. 1980, The artificial propagation of warm-water finfishes manual for extension, FAO.

Ameen, M 1993. How to grow more fish. The Noakhali experience NEPHP. Nokahali, Bangladesh.

FIMS 3211

Fish Population Dynamics and Stock Assessment

3CH

A. Population dynamics:

Definitions: Population structure, sex ratio, age distribution, age specific birth and death rates.

Estimation of stock and estimating abundance: Introduction, indices (relative density), absolute density and mark-recapture method-single and multiple recaptures.

Length frequency analysis: Ford Walford's plot and Von-Bertalanffy growth equation.

Reproduction and recruitment: GSI, HIS, condition factor and relative condition factor. Length at sexual maturity (L_m) and length at recruitment (L_r).

Mortality: Basic principle of mortality, total mortality, natural mortality and fishing mortality, length based catch curve.

Virtual population analysis (VPA): Basic principle.

B. stock assessment:

Yield per recruitment model, surplus yield model (MSY , f_{msy} , MEY , f_{mcy}) and biomass model for stock assessment.

FIMS 3212 Fish Population Dynamics and Stock Assessment Lab/Field Work 1CH

Population determination of pond fish by mark and recapture method

Study of fecundity, GSI, HIS, Feeding Stuff

Study of catch per unit effort, CPUE

Age determination of aquatic animals

Estimation of growth rates and back calculations

Studies of length-weight relations and the condition factors of fishes.

Books/References:

King, M 1995. Fisheries Biology, Assessment and Management. Fishing News Books, UK.

Gulland, JA 1962. Manual of Sampling Methods for Fisheries Biology, FAO Fisheries Technical Paper no. 26 Rome 70 pp, Download also available at www.fao.org.

Cushing, DH 1968, Fisheries Biology- a study in population dynamics, Univ of Wisconsin Press Madison, USA, 200 pp.

Royce, WF 1984. Introduction to the Practice of Fishery Science, Academic Press,

Bagenal, T 1978. Methods for Assessment of Fish Production in Freshwaters, IBP Handbook No 3, Blackwell Science.

Rounsefell, GA and Everhart, WH 1953. Fishery Science, its methods and applications. John Willey and Sons. New York, USA., 444 pp.

Course Viva

FIMS 3214

Viva-voce

1CH

YEAR 4 TERM I

Major Subjects

FIMS 4101

Biological and Chemical Oceanography

3CH

The sea as a biological environment: Classification of the marine environment, General character of population of the primary biotic divisions.

Life in the ocean: Evolution and Life in the Ocean, Physical Factors Affecting Marine Life, Classification of the Marine Environment, Classification of Oceanic Life.

Marine communities: The Diversity of Communities, Organisms Within Communities, Change in Marine Communities, Examples of Marine Communities, Symbiotic Interactions and Dependencies

Primary productivity, plankton, and plants: The Capture and Flow of Energy, Primary Productivity, Plankton, Larger Marine Plants. Phytoplankton in relation to physico-chemical properties of the sea, Methods of floatation, Factors influencing phytoplankton production. Bloom formation

Ecological groups and some of their adjustments and conditions of life, benthos, nekton and zooplankton, and their relationships with the physicochemical properties of the sea, light, salinity, temperature, ocean current and dissolved oxygen. Factors affecting the growth, distribution and seasonal changes, Food and feeding habits, vertical distribution and migration of zooplankton.

Phytoplankton-zooplankton relationship, Fish-plankton relationship, Phyto-zooplankton models, N-P-Z model.

Foodweb in Oceanic Environment: Evaluation of Food-web ecosystem using different isotopes, Paleontological ecosystem.

Marine animals in relation to physico-chemical properties of the sea.

Chemistry of sea water: Constancy of composition, dissolved gases, Distribution of phosphate, nitrogen compounds and silicate in the sea, Factors influencing the distribution of nutrient elements. Dissolved gases in the sea water, oxygen and carbon-di-oxide. Elements present in the sea water.

Biogeochemical cycling, modeling of biogeochemical cycle.

Ecosystem Modelling in Marine ecosystem: Conceptual Models, Box Models, Statistical Models, Coupled Hydrodynamic models: Transport Models.

FIMS 4102

Biological and Chemical Oceanography Lab/Field Work

1CH

Determination of pH, Eh, carbonate, bi-carbonate and hydro-carbon.

Measurement of Primary Productivity (Oxygen method & Isotopic method)

Study of Food-chain in Estuarine and Marine ecosystem

Nutrient analysis from water and sediment of marine environment, Measurement of Nutrient Flux, Estimation of Nutrient Budget.

Measurement of Radioactivity from soil, water, sediment and biotic components.

Books/References:

Davis, CC 1955. The Marine and Freshwater Plankton. Michigan State Univ. Press. East Lansing. Michigan.

King. CAN 1966. An Introduction to Oceanography. McGraw Hill Book Co, New York.

McConnaughey, BH 1970 Introduction to Marine Biology. Toppan Company Ltd. Tokyo, Japan.

Parsons, TRM Takahashi and B Hargrave, 3rd ed. 1984. Biological Oceanographic Processes Pergamon Press, Oxford U.K.

Weisberg, J. and H. Parish. 1974. Introduction to Oceanography. McGraw-Hill Kogakusha, Ltd., Tokyo.

A practical Hand Book of Seawater Analysis. J.D.H Strickland and T.R. Parsons

FIMS 4103

Aquaculture Engineering

3CH

Introduction: importance, involvements of engineering, mechanical, structural, hydrological, electrical and biological:chemical, principles related to aquaculture practices, initial considerations, requirements for fish, shrimp, crabs etc.

Criteria for site assessment and selection: Engineering, biological, chemical and social criteria, other considerations-topography and its survey, soil types consistency and mechanical properties.

Design and construction: criteria for designing and construction of pond, tank, raceway and other impoundments, layout and construction of small and large scale hatcheries, sluices, monks and spillway, material analysis and coasting.

Water source: water re-cycling, water flow:level measurements, types of flow, fluid static, pressure intensity and measurement, waste water treatment, water quality improvement, metabolic rate, DO consumption and excretion, turbidity.

Pumps and aerators: Classification, installation, operational mechanism, capacity and number requirement of pumps, use of pumps in fish culture, types and functions of common air pumps, Types, function and uses of different categories of filters, screens and aerators, for aquafarm.

Aquaculture farm: Common infrastructure, planning, design and construction of embankments, dykes and water control structures, grass planting and fencing.

FIMS 4104

Aquaculture Engineering Lab/Field Work

1CH

Soil, classification, properties

Quantification of water requirements, water discharge calculation: Open channel flow, closed (pipe system) flow

Pond construction earth work: Dike calculation, excavation volume calculation (new pond/watershed pond)

Case study for fresh and brackish water pond construction, water supply,

Construction of cage: design, material

Case study of hatcheries: carp and shrimp

Construction: mini earthen, concrete ponds and hatchery, re-circulating system in laboratory

Layout of typical fish and shrimp hatchery, Hatchery models

Practice of feed formulation methods.

Books/References:

Halver JE, editor, 2000. Fish Nutrition. 3rd Edition. Academic Press Inc. New York, 798 pp.

Hepher, B 1988. Nutrition of Pond Fishes. Cambridge University Press 388 pp.

Steffens, W 1989. Principles of Fish Nutrition. Ellis Horwood Limited. Chichester, 384 pp.

De Silva, SS and Anderson, TA 1995. Fish Nutrition in Aquaculture. Chapman & Hall, London, 317 pp.

Goddard, S 1996. Feed Management in Intensive Aquaculture. Chapman & Hall, New York, 194 pp.

Tacon, AGJ 1990. Standard Methods for the Nutrition and Feeding of Farmed fish and Shrimp. Argent Laboratories Press, Washington, 208 pp.

New, MB AGJ Tacon and I. Csavas, 1997. Farm-made Aquafeeds. Daya Publishing House, Delhi, 434 pp.

Lavens, P and P Sorgeloos, 1996. Manual on the Production and Use of Live Food for

Aquaculture. FAO Fisheries Technical Paper, 295 pp.

National Research Council, 1988. Nutrient Requirement of Warm waters Fishes and Shell fishes. National Academy of Sciences, Washington DC. 102 pp.

Linder, MC 1985. Nutritional Biochemistry and Metabolism With Clinical Applications. Elsevier Science Publishing Company, Inc. New York, 436 pp.

FIMS 4107

Research Methodology

3 CH

Introduction to research, methodology, data sources and collection, primary and secondary data collection, processing of data.

Designing of experiment: Randomized design and randomized block design, latin square design and split plot, planning and research.

Principles of sampling: simple random sampling, stratified random sampling, systematic sampling, standard error of estimates, sampling and non-sampling errors.

Sampling collecting equipments: laboratory equipments, chemicals, sample packing, labeling, field: laboratory records, work-sheets.

Sampling strategies and methodology design for: water parameters, sediments, planktons, and fish.

Accuracy of results: types of errors, replication and standard samples, scrutiny, degrees of accuracy and calculations, test of significance.

Presentation of results: research findings: data processing, data analysis, graphical representation and tabulation, reference citing.

Manuscript preparation: oral, Power point, presentation, poster presentation, abstract writing for conference.

Dissertation writing, for M.S., M. Phil. and Ph. D. degrees, research project: research proposal writing, scientific paper writing for National and International Journals.

FIMS 4109**Quality Control of Fishery Products****2CH**

General principles of quality control and quality assurance, modern approach of quality control, importance of fish inspection and quality control programmes, problems in quality assurance of fishery products.

Food laws and regulations: Food laws and competent authority. FDA, EC, Japanese, WTO and other importing country regulations on seafood processing and trade. Quality control and inspection system in Bangladesh. Regulatory standards for products and processing plants.

Quality deterioration and defects in raw material and products: chilled, frozen, dried, smoked, salted, fermented, canned, marinated and heat processed mince products. Causes and effects, means of preventing deteriorations and defects.

Quality assurance in hatcheries, farms and processing plant: hygiene and safety aspects of quality control, standard sanitary operating system and standard operating system in hatcheries, farms and processing plants. Inspection of fish. Quality management information.

Good manufacturing practice (GMP), Hazard analysis critical control point (HACCP), setting up HACCP system in production farm and processing plant, HACCP at source, quality systems and audit checking.

Traceability system in exportable foods: pre-requisites of traceability, traceability implementation in developing countries, certification and accreditation procedure, constraints/weakness and improvement of the system. Traceability protocols. Risk assessment: risk analyses, communication and management.

Quality of raw material and finished products: raw material collection system, maintenance of raw material finished product quality.

Methods of quality assessment: organoleptic, biochemical and bacteriological methods.

FIMS 4110**Quality Control of Fishery Products Lab/Field Work****1CH**

Study of sensory evaluation techniques: basic taste recognition test, basic colour recognition test, preference test and ratio profile.

Organoleptic, physical, biochemical and bacteriological evaluation of fresh, chilled and frozen fish and shellfish products.

Organoleptic, physical, biochemical and bacteriological evaluation of dried and salted dehydrated, salted and smoked products.

Preparation of process flow charts for fish/shrimp raising and product manufacture mentioning CCPs.

Preparation of HACCP plan: furnishing HACCP plan form

Development of traceability protocols in hatchery, nursery and growout farms/ponds, depot and transportation and processing plants.

Group work and presentation about GMP, HACCP and ISO 9000

Books/References:

Bonnell, A.D. 1994. Quality assurance in seafood processing: A practical guide. Chapman & Hall, New York and London.

Botta, J.R. 1995. Evaluation of seafood freshness quality, VCH Publishers (UK) Ltd, United Kingdom

Connell, J.J. 1985. Control of Fish Quality. Fishing News Book Ltd.

FAO 1994. Working Party on Fish Technology and Marketing. Proceeding of the workshop held at Cochin, India, 7-9 March. FAO Fisheries Report No. 514 Supplement. Indo Pacific Commission.

Germain, C. 2003. Traceability Implementation in Developing Countries, Its Possibilities and Its Constraints: A few case studies. Internet edition. FAO Unofficial Publication.

Gopakumar, K. (Ed.). 2002. Textbook of Fish Processing Technology. Indian Council of Agricultural Research, New Delhi.

Huss, H.H, 1998. Fresh Fish-Quality and Quality Changes. FAO Fisheries Series No. 29, Rome

Kramer, A. and Twigg., B.A. 1966. Fundamentals of Quality Control for the Food Industry. The Avi. Publishing Co. Inc., West port.

Kreuzer, R. (Ed). 1971. Fish Inspection and Quality Control. Fishing News (Books), Limited. London, EC4, England.

Michael T.M (Ed). 1988. Post-harvest Fishery Lossess. Proceeding of an International Workshop held April 12-16, 1997 at the University of Rhode Island, Kingston, RI. Published by ICMRD.

Reilly, P.I.J. and Parry, R.W.H. and Barile, L.E. (Ed) 1989. A proceeding of the international conference held at Bangkok, Thailand from November 13-17 on Post-harvest Technology, Preservation and Quality of Fish in South East Asia. International Foundation of Science.

Ross, M.H. 1993. Student Manual HACCP and Quality Control Programs. Kingsborough Community College, The City University of New York.

Rudolf Kreuzer (edited) 1971. Fish Inspection and quality control. Fishing News (books), Limited. London, EC4, England

Watts, B.M. and Elias, L.G. 1989. Basic sensory methods for food evaluation. International Development Research Centre, Ottawa, Canada K1G 3H9

Wiryanti, J. and Madakia, H. (Ed). 1997. Improved Quality Control for the Handling and Processing of Fresh and Frozen Tuna at sea and on shore. ASEAN-CANADA Fisheries Post-harvest Technology Project-Phase II.

FIMS 4111

Fisheries Resource Economics

2 CH

Basic concepts of economics, utility approach: marginal, average and total utility and their relationship, consumers' surplus, law of demand and the demand curve,

Indifference curve, budget line, marginal rate of substitution and price ratio, optimisation through cost minimisation, optimisation through consumers' surplus maximisation, price effect, income effect and substitution effect,

Elasticity of demand: factors affecting elasticity of demand, price elasticity, income elasticity and cross of demand, point elasticity and arc elasticity of demand.

Variable and Fixed Costs, average, marginal and total costs, short-run and long-run cost curves, relationship between marginal cost and price level, law of supply, elasticity of supply, changes of a supply curve, computation and interpretation of supply elasticity

YEAR 4 TERM II

FIMS 4201

Climate Change and Fisheries

3 CH

Introduction: the climate system, external forcing and the earth's energy balance, responses to external forcing, internal variability of the climate system, causes of climate change.

Greenhouse gases: Greenhouse gas emissions, science of greenhouse effect,

Scenarios of Climate Changes: Assessment Report Three (AR3), Assessment Report Four (AR4) by IPCC, Role of UNFCC

Changes: changes in atmospheric composition, radioactive forcing, changes in global-mean temperature, changes in the free atmosphere, precipitation changes, extremes of temperatures. Changes in variability, changes in precipitation extremes, mid latitude storms, hurricanes and tropical storms. externalities and climate change, sea level rise.

Predicting Future Climate: future emissions, future concentrations and radioactive forcing, future global-mean climate projections. Impact of climate change on freshwater, brackish water and marine fisheries.

Regional Climate Change for Bangladesh: impacts of global climate change, climate models, model evaluation, future climate.

Vulnerability to Climate Change and Adaptation Responses: flood changes in Bangladesh, for 2020, climate and other changes by 2030 and 2050, sea level rise and subsidence, impacts on the availability of coastal resources, fresh water resources, human health, ecosystems and biodiversity, climate change impact assessments, CCIA, development activities and climate change adaptation.

Global negotiations on climate change: lessons from Montreal and Kyoto protocols

Study on Recent Past evidences of Climate Change in the coastal area of Bangladesh

Books/References:

Cushing, D. H. 1982. Climate and Fisheries. Academic Press, UK. 375 pp.

Kremer, J. N. and Nixon, S. W. 1978. A coastal Marine Ecosystem. Springer-Verlag. Heidelberg, 217 pp.

Laevastu, T. 1993. Marine Climate, Weather and Fisheries. Fishing News Books, 224 pp.

FIMS 4203

Coastal Zone Management

3CH

Definition of Coastal Zone, Types of coastal landforms, Coastal ecosystems, Coastal forces and processes.

Land use pattern and human alterations of the coastal zone, Coastal management issues,: coastal storm mitigation, Shoreline erosion and sea level change, Protection of coastal waters, protection of coastal wetlands, Energy development and the coast, Biodiversity and Habitat conservation, Marine and fishery management, Coastal land use pressure, social equity in coastal planning.

Development impacts: Agriculture, aquaculture, forest industries, heavy industries, mining, Petroleum, Ports, tourism, settlements, waste disposal, shore protection works.

Stakeholders of coastal management, role of GO, coastal policy, CZM act, national marine sanctuary program. MPA's.

Coastal management strategies, sustainable use of resources, biological diversity, pollution control, protection against natural hazards.

Socio-economic concerns, alternative livelihoods, social impact assessment.

Management: aquaculture management, beach management, Coral reef management, Dredging management, Dune, mangrove forest, water quality management.

Monitoring Coastal Environments using Remote Sensing, GIS applications in Coastal management.

Books/References:

Timothy Beatley, David J. Brower, Anna K. Schwab. 2005. Introduction to Coastal Zone Management. 2nd Edition. Island Press. Washington D. C. 2009

John R Clark. 2005. Coastal zone management Hand book. CRC press

Darius Bartlett and Jennifer Smith, Eds. 2004. GIS for Coastal Zone Management: CRC press

Haq, B. U. et al. 1997. Coastal Zone Management: Imperative for Maritime Developing Nations. Kluwer Academic Publishers. 394 pp.

FIMS 4205 Biodiversity Conservation and Management of Marine Resources 3 CH

Biodiversity: Biodiversity defined and types, Scope of conservation and management of bioresources, Values of and threats in biodiversity, Role of various agencies in biodiversity conservation in Bangladesh, Ramsar Convention, Kyoto protocol, Earth Summit, World Environment Day, World Heritage.

Conservation: Concepts and definitions and types, Extinct, endangered and vulnerable animals of Bangladesh, Priorities and strategies for conservation. Conservation at population and species levels with reference to marine animals. Conservation of wild animals and fisheries act in Bangladesh, Concept of zoological garden, captive breeding, Ex-situ and In-situ gene bank, vacant niche and conservation.

Marine resources management: Resources defined, Zimmermann's concept Fisheries resources at the sea, Resources management, its importance, and researches in Bangladesh. Protection, ecological restoration and regulative management in sea. Fishing grounds of the Bay of Bengal, Laws of the Sea and EEZ.

Books/References:

Ameen, M. 1987. Fisheries Resources and Opportunities in Freshwater Fish Culture in Bangladesh., Zoological Society of Bangladesh, Dhaka, 244 pp.

Karim, M. 1978. Status and Potential of Bangladesh Fisheries, Ministry of Fisheries and Livestock, Govt. of Bangladesh, Dhaka, 125 pp.

King, M., 1995. Fisheries Biology, assessment and management. Fishing news Books, UK.

Primack, R.B. 1998. Essentials of Conservation Biology, 2nd edition, Sinauer Associates Inc., Boston, USA, 659 pp.

Rounsefell, G.A. and Everhart, W.H., 1953. Fishery Science, its methods and applications, John Willey and Sons, New York, USA. 444 pp.

Khan, M. B.A. et al., 1997. Report on the National Workshop on Fisheries Resources Development and Management in Bangladesh. Bay of Bengal Programme, Madras, India, 302 pp. also download available from, www.fao.org

Khan, M.G. and M. A. Latif. 1995. Potential, constraints and strategies for conservation and management of open water, brackish water and marine fisheries resources. Proc. Nat. Sem. on Fish. Res. & Dev. & Mang. DOF, FAO, ODA. Dhaka.

Shahidullah, M. 1985. The small scale marine fisheries development in Bangladesh and its present status. Proc. Mat. Sem. on Fish. Res. & Dev. & Mang. in Bangladesh. Dhaka.

FIMS 4207

Fisheries Marketing and Agribusiness

3 CH

Introduction: marketing concept, The strategy of marketing, market intelligence and its uses, global market research, fish marketing, status and issue, fish perishable commodity, deterioration of flesh, links in the chain of production and consumption.

Product line, product mix, 6 P's, market penetration,

Consumer: product usage, beliefs, choices, price-sensitivity, product search behaviour, consumer behavior

Structure of Market: characteristics of different markets, perfectly competitive market and imperfectly competitive markets, monopoly, duopoly, oligopoly and monopolistic markets, determination of equilibrium price and output in different markets, price discrimination and distortions.

Pricing: demand price analysis, penetration pricing, price-quality signaling, responding to competitions in price changing, mark-up, breakeven analysis. networking, forecasting and budgeting products.

Fish marketing and private sector in Bangladesh, village market, township markets, assembly center, urban wholesale and retail markets, personnels, buyers:agents, bepari:mahajon, competition, middlemen, aratdar:paiker exploitation of the fishermen,

Fisheries marketing in developing countries, problems, inadequate ice supply, unhygiene markets, role of BFDC, fish landing centers, auction, ice-plants, cold storage, freezer storage, fish vans,

Distribution: Channels, management, protecting trading relationships, logistics, communications: advertising, direct marketing. The distribution channel for fish and prawns, producer, broker, wholesalers, retailer, consumer. transporting and marketing.

Fisheries Co-operatives, aims and objectives, past and present status of fisheries co-operatives: samities, primary, central and apex. Marine fisheries development and co-operatives, Governmental and NGO support.

Farm business: factor substitution, product substitution, comparative advantage, opportunity cost, linear programming in farm management, farm accounting, inventory, depreciation, farm efficiency measures, banking system and financing: NPV, IRR.

Value chain analysis of fish and fisheries products.

Books/References:

Samuelson, P.A. and Nordhaus, W.D. 2002. Economics. 14th edn. McGraw-Hill, New York.

Shang, Y.C. 1981. Aquaculture Economics: Basic Concepts and Methods of Analysis, Westview Press, London.

Hill B. 1980. An Introduction to Economics for Students of Agriculture, Pergamon Press, London.

Lecomber, R. 1979. The Economics of Natural Resources. Mac-Millan, London.

Panayotou, T. 1987. Small-Scale Fisheries in Asia: Socioeconomic, Analysis and policy, IDRC-220c, Canada.

Randal A. 1987. Resource Economics: An Economic Approach to Natural Resources and Environmental Policy, Wiley. New York.

Stanton. Principles of Marketing

Phillip Kotler. Principles of Marketing

FIMS 4209 Aquatic Pollution and Environmental Impact Assessment 3 CH

Introduction: Definition, types and sources of pollution. Surface and ground water pollution, riverine, flood-plain, coastal, estuarine, mangrove, deep sea pollution. point and non-point sources. Types of chemical pollutants in water: inorganic, organic, nutrients, pesticides, heavy metals, radioactive materials etc.

Sewage: definition, sources and types of sewage, sewage treatment, eutrophication

Wastes: different kinds of wastes, biological and ecological changes of aquatic conditions due to domestic, industrial and agricultural waste discharge, Industrial wastes: sources of effluents, kinds of effluents, effects of effluents on aquatic organisms. Waste treatment: primary, secondary, tertiary. Use of organisms as an indicator of water pollution, measurements of response of aquatic organisms to pollutant and toxic substances.

Heavy metals, HM's: Sources, types. Effects of HM's on aquatic organisms. Bioaccumulation and biomagnification of HM's, cumulative concentrations, bioassays, biological indicator.

Agrochemicals: types, uses of agrochemicals and impact of agrochemicals. Acute, chronic and systemic effects, lethal and sub-lethal dose, LD50 etc, Organo- chlorine and organo-phosphate: DDT, Heptachlor, Lindane etc. POP's, PAH's and PCB's. Movement and fate of pesticides in aquatic environment and their toxicological and ecological effects. Metabolism of pesticides in biological system, detoxification of pesticides and their metabolites in the environment.

MBT, TBT, Dioxin, Phthalates, etc.

Oil pollution: definition, types and sources. Fate of oil and impact of oil on the aquatic organism. Removal technique.

Effect of pollution on aquatic environment, acute and chronic toxicity, lethal and sub-lethal responses. Toxic chemicals and other pollutants found in aquatic systems and their harmful effects on aquatic organisms and ecosystem. Water pollutions, monitoring of water quality in all types of waters, pollution abatement.

Pollution in the Bay Bengal: Causes, monitoring programmes, the metabolic response of organisms to pollutants, sewage pollution, hydrocarbons, pattern and chlorinated, heavy metals and radioactive materials.

Aquatic pollution issues, regional and international issues, monitoring of aquatic pollution. Pollution management policies. Prevention of pollution: regulations, agreements, protocols, guidelines, conventions

Books/References:

Krisnan Kannan. Fundamentals of Environmental Pollution. S. Chand & Co. New Delhi

Lloyd, 1992. Pollution and fresh water fish. Fishing News Books. Oxford UK.

Guide to Environmental Conservation Act 1995 and Rules 1997.

Holmgren, S. 1994. An Environmental Assessment of the Bay of the Bengal Region. BOBP:REP:67

G. R. Chhatwal. 1989. Environmental Analysis: Air, Water and Soil. Anmol Publications Pvt. Ltd. India.

S. M. Khopker. 1995. Environmental Pollution Analysis. New Age International (P) Ltd. India.

S. K. Banerjee. 1993. Environmental Chemistry. Prentice Hall India Pvt. Ltd. India.

Standley and Manahan. Environmental Chemistry. 4th Edition.

Stumm and J. J. Morgan. Aquatic Chemistry. 3rd Edition.

Roy Cheshter. Marine Geochemistry.

V. Valkovic. Trace Element Analysis.

B. C. Rana. Pollution and Biomonitoring

FIMS 4211 Marine and Estuarine Ecology 3 CH

Marine Ecology

Zonation of the sea, Major ecological divisions of marine habitats

Characteristics of abiotic and biotic marine environment

Marine biota and their distribution

Communities of the marine environment

Adaptation of marine organisms to different environment

Inter relationships between marine fishes with other abiotic and biotic factors.

Global warming effect on marine fauna and coral islands

Food chain, food webs and ecological niche in marine environment, energetics of a marine ecosystem.

Estuarine ecology

Coastal habitats, estuaries, mangroves, coral reef, seagrass, beaches, eslands, salt marshes, and sand dunes

Physico-chemical aspects of estuaries, Biotic communities of estuaries

Adaptations of estuarine fauna to changing abiotic factors in estuaries

Upwelling and productivity of estuarine ecosystem

Books/References:

Tait. R.V. 1972. Elements of Marine Ecology. Butterworths, London.

Project

FIMS 4214 Research Project 4CH

Course Viva

FIMS 4216 Viva-voce 1CH