FISHERIES (ALTERNATIVE A)*

(For candidates in Ghana only)

1. PREAMBLE

Fisheries is important to the economic development of West Africa and this syllabus has been structured to guide the assessment of learners' knowledge and enterpreneural skills in fisheries and related vocations. It is also to guide the assessment in practically oriented knowledge and skills in fisheries.

2. AIMS AND OBJECTIVES

The syllabus will seek to assess candidates on

(1) the importance of fisheries in the socio-economic development of West Africa.
(2) the dangers of over fishing practices.
(3) the regulations governing fishing practices in the country.
(4) the differences between freshwater, brackish water and marine habitats and resources.
(5) skills in fish farming.
(6) basic entrepreneurship skills in fisheries related vocations and business.
(7) the effects of water pollution on fishery resources.
(8) fish preservation and processing techniques.
(9) basic biology of fishes.
(10) basic fish health management.

3. REQUIREMENTS

(1) Schools offering fisheries must have at least an aquarium and a fish pond/concrete tank.

(2) The study of fisheries should be supplemented by visits to well established fish farms, fisheries research institutions, fishing companies and other institutions related to fisheries.

(3) Candidates should keep practical notebooks which should contain records of activities based on laboratory and individual observations carried out in aquaria and fish farms, field trips and also records of specimens collected.

(4) Schools should prepare an album of fishery organisms, fishing gear and craft and different fish rearing facilities and equipment for teaching purposes.

4. EXAMINATION SCHEME

There will be three papers, Papers 1, 2 and 3 all of which must be taken. Papers 1 and 2 will be a composite paper to be taken at one sitting.

PAPER 1: Will consist of fifty multiple choice objective questions, all of which must be answered within 1 hour for 50 marks.

PAPER 2: Will consist of six essay-type questions. Candidates will be required to answer four questions within 2 hours for 20 marks each.

PAPER 3: Will be a practical paper for school candidates or alternative to practical work test for private candidates. It will consist of three questions all of which must be answered within 2 hours for 60 marks.

DETAILS SYLLABUS

CONTENTS	
A. INTRODUCTION TO FISHERIES	
1. Fisheries and national development	
(a) Meaning of fisheries	Explanation of the term fisheries
(b) Types of fisheries	Knowledge of the following is required: Culture fisheries (aquaculture) Capture fisheries (fishing) - subsistence fisheries - artisanal fisheries - commercial fisheries - industrial fisheries
(c) Importance of fisheries to national development	Role of fisheries in the national economy e.g. food, employment, income generation, social and cultural life.
2. Fishery organisms and their habitats	
(a) Identification and description of common fishery organisms	Assessment should cover the features of: Fin fishes (e.g. herring, tuna, tilapia, *Clarias*, *Heterobranchus*) Crustaceans (shrimp/prawns/lobster, crabs) Molluscs (clam, scallops, oyster, cuttle fish/squid)
(b) Fishery habitats	Knowledge of the characteristics of habitats: freshwater (river, lake), brackish water (estuary, lagoon) and marine (pelagic, demersal) should

	be covered.
(a) Identification and description of the characteristics of invasive alien species in fishery habitats	Knowledge should cover species such as *Eichorniacrassipes* (water hyacinth), *Cyperus papyrus* (Papyrus reed), *Salviniamolesta*(kariba weed), *Limnocharisflava*(Limnocharis), *Pistiastratiotes* (water lettuce), *Azollafiliculoides* (water fern), *Enteromorphaflexura*(filamentous algae) *Ceratophyllum* sp. (Hornwort). Characteristics should include the morphology of the species, mode of propagation, growth and development.
(d) Effects of invasive alien species in fisheries	Analysis of the effects of aquatic invasive alien species on fishery habitats, fishery organisms and fishers.
(e) Prevention and control of invasive alien species in fishery habitats	Assessment to include preventive measures such as awareness creation, screening at entry points and enforcement of plant protection and regulatory laws and control measures both physical and biological
3. Grouping of fishery organisms	Assessment should cover the grouping of the following fishery organisms under freshwater, brackish water and marine habitats: *Tilapia, Clarias/Heterobranchus, Chrysichthys, Heterotis,Lates, Bagrus, Alestes, Synodontis,* Prawns, Crabs, Grey mullet, Shrimps, *Sardinella*, Sea bream, Cassava fish, Tuna, Mackerel, Anchovy, Shark, Cuttle fish/squid, Clam, Ray, Sea urchin.
B. FISHING ACTIVITIES	
1. Fish landing	

sites and facilities	
(a) Types of fish landing sites	Assessment should cover the identification and location of the following landing sites in your country: beaches, harbours, lagoons, river banks, lake shores.
(b) Facilities and activities at fish landing sites	Knowledge in the use of the following facilities is required: winch, cold store, ice plant, fuel station, slipway, dry dock, jetty and breakwater. Description of activities at fish landing sites: - unloading fish from vessels - fuelling vessels - loading of ice into vessels - beaching of vessels for repairs - repairs and maintenance of vessels/gear - fish processing - fish marketing
(c) Sanitation practices at fish landing sites	Assessment should cover knowledge and skills of proper disposal of wastes generated at fish landing sites including oil spills and vessel parts.
2. Fishing gear and craft.	
(a) Classification and description of fishing gear	Active fishing gear: - cast net - seine net - trawl - dredges - scoop net Passive fishing gear: e.g. - hooking devices - stationary nets - tangle nets - traps Merits and demerits of using the various gear are also required.
(b) Construction and maintenance of fishing gear	Assessment should include knowledge of materials for construction and repair of fishing gear. Basic ways of maintaining fishing gear is also required.
(b) Description and maintenance of	Fishing craft should include canoes, trawlers

fishing craft	and purse seiners. Accessories such as oars, sails, outboard and inboard engines, winches, sonar and radar should also be covered.
(d) Fishing methods	Description of active and passive fishing methods used in inland, coastal and deep sea fishing is required.
(e) Harmful fishing practices	Assessment should cover the description of harmful fishing practices and an analysis of their effects.Ways of preventing harmful fishing practices and minimizing their effects are also required.
C. FISH BIOLOGY	
1. Identification and classification of fishery organisms	
(a) Identification of common fishery organisms by species	Common and scientific names are required.
(b) Classification of common fishery organisms	Common fishery organisms should be classified under phylum and class for Mollusca, Arthropoda and Echinodermata. Phylum Chordata should be classified to the subclass level.
2. Structure and function of fishery organisms	
(a) Fish body measurements	Ability to measure total, standard and fork lengths, and weights should be assessed.
(b) External structures and features of fishery organisms	Assessment should cover a mollusc (cuttle fish), crustaceans (shrimp/prawn, crab), cartilaginous fish (shark, ray) and bony fishes (tilapia, *Clarias*).
(c) Internal organs of bony fishes and their functions	Assessment should cover organs such as gills, alimentary canal, heart and blood vessels, kidneys and gonads.

3. Life processes in fishes	
(a) Locomotion	Assessment should cover role of muscles and fins in movement and the maintenance of balance (pitching, rolling, yawing).
(b) Feeding and digestion	Assessment should include knowledge of ingestion, digestion, absorption and egestion in fishes.
(c) Blood circulation	Assessment should cover composition, circulation and functions of blood.
(d) Gaseous exchange	An understanding of the mechanism of gaseous exchange is required.
(e) Excretion	Knowledge of osmo-regulation and the excretory process and products is required.
(f) Reproduction	Knowledge and understanding of the stages in the reproductive process: gamete formation, spawning, fertilization and parental care are required. Identification of male and female tilapia should be assessed. Examination of eggs of gravid/berried fish is required.
(g) Growth	Knowledge and understanding of the life cycle in fishes and the factors affecting growth (e.g. temperature, dissolved oxygen, nutrients, food availability, competition) are required.
4. Fish ecology	
(a) Environmental conditions in fish habitats	Knowledge and understanding of the environmental conditions and their effects on fish populations (temperature, dissolved oxygen, salinity, pH, turbidity, light, nutrients, upwelling phenomenon) are required. Measurement of environmental conditions using water test kits on water from pond, river/stream, lagoon, lake and sea is required.
(b) Ecological	

processes within fish habitats	Knowledge of the following processes is required: - feeding behaviour - predation, competition - food chain, food web - food pyramid - fish mortality - adaptation of fishes to their environment
(c) Pollution in water bodies	The causes (poisons, sewage, debris, household refuse etc), effects, prevention and control of pollution are required. Effects of pollution on fish populations should be covered.
5. Fish genetics and evolution	
(a) Principles of Genetics	Assessment should cover knowledge and understanding of chromosomes, genes, genetic crossings, genotype and phenotype as applied to fish. Application of the principles of genetics to fish breeding, e.g. development of super male tilapia and Genetically Improved Farmed Tilapia (GIFT) should be assessed.
(b) Inheritance of genetic characteristics	Explanation of the concept of inheritance of external characters in fishes e.g. skin colour is required.
D. AQUACULTURE	
1.0 Introduction to aquaculture	
(a) Meaning and importance of aquaculture	
(b) Types of aquaculture	
(c) The state of aquaculture	Assessment should cover the culture of organisms including fish, clams, shrimps and sea weeds. Assessment should be limited to the state of aquaculture in your country: Numbers and sizes of farms, types of cultured

	species, practices, infrastructure/facilities, levels of production, prospects and challenges. Factors/problems affecting aquaculture should include: few specialists in the field, high cost of pond construction, high cost of feed, difficulty in obtaining fingerlings, difficulty in accessing credit and difficulty in land acquisition. Solutions to problems facing aquaculture in the country should be covered.
2. Aquarium activities	
(a) Construction of an aquarium	Assessment should cover knowledge and skills involved in the identification of materials required, design and construction of an aquarium.
(b) Management of an aquarium	Assessment should cover knowledge and skills involved in the identification of suitable species, capture, transport and stocking of aquarium fish. Keeping records of daily management activities and costs is also required.
3. Fish farming	
(a) Introduction to fish farming	Assessment should include the importance of fish farming, levels of fish farming (extensive, semi-intensive, intensive) and types of fish farming (monoculture, polyculture, integrated culture) Knowledge of the facilities for growing fish (earthen ponds, cages, concrete tanks, raceways, fish pens) is required.
(c) Construction of fish culture facilities	Knowledge and skills in the selection of suitable sites for construction of ponds, cages and pens is required. Criteria for the selection of sites for the construction of ponds, cages and pens should include topography, soil type, water quality and quantity and security. Skills in site clearing, marking, excavation, formation of walls, fitting drainage structures and grassing should be included.

(c) Management of fish ponds	
(i) Stocking of ponds	Knowledge and skills required should include species selection, fingerling packaging and transport and stocking. Criteria for selection of fish species should include feeding habits, availability of fingerlings, growth rate and adaptability.
(ii) Pond maintenance	Knowledge of maintenance activities on fish ponds to be assessed should include: - the control of water level - repairing leakages - predator and weed control - fertilizer application
(iii) Water quality control and monitoring	Knowledge and skills in monitoring of water quality should cover: - pH - dissolved oxygen - turbidity - ammonia content - temperature Knowledge of measures to improve water quality such as stirring, lime application and fertilizer application is required.
(iv) Fish feeds and feeding	Knowledge about types of fish feeds and their nutrient content e.g. formulated feeds, agricultural by-products, pelletized and floating feeds is required. Skills in the formulation of nutritionally balanced fish feed/diets, procedures for feeding fish, feeding times and quantities should be covered.
(v) Harvesting of fish ponds	Types of harvesting (partial and total) using various fishing gear and methods should be assessed. Draining and refilling of fish ponds as measures

	of pond preparation after harvest should be covered.
(d) Fish diseases (i) Types and causes	Assessment should be limited to the following: Gill rot - fungus Furunculosis - bacteria Ich - protozoa
(ii) Symptoms	Assessment should be based on the identification of symptoms: Gill rot - red/whitish spots on gills Furuncolosis - ulcers on skin Ich - white spots on skin and fins
(iii) Prevention, control and treatment	Knowledge of the following methods is required: chemotherapy, sterilization, minimal handling of fish, suitable diet and disinfection. Assessment should also include knowledge of aquatic conditions which favour fish diseases.
E. FISH UTILIZATION	
1. Nutritive value of fish: Nutritive composition of fin fish, crustaceans and molluscs	Knowledge of the nutrients in fishery organisms - proteins, lipids, mineral salts, water and vitamins - and experiments to test for protein and lipids in fish are required.
2. Fish processing and preservation (a) Meaning of fish processing and preservation (b) Importance of fish processing and preservation	Meaning of fish processing: Explanation should include activities carried out to prepare fish for consumption and marketing. Meaning of fish preservation: Explanation should include activities carried out to extend the shelf life of fish. Distinction between fish processing and fish preservation is also required Reasons for fish processing and preservation should include prevention of spoilage, increase

	of shelf life, improvement of taste and adding value.
(c) General principles of fish processing and preservation	Knowledge of the principles should include the removal of microbes and water, slowing down enzymatic action, denaturing of enzymes, slowing down bacterial activity and preventing fat oxidation.
(d) Methods of fish processing	Assessment should be based on knowledge and skills in washing, scaling, gutting and filleting of fish. Identification of common fish processing equipment such as knives, scissors and mechanical equipment is required.
(e) Methods of fish preservation	Assessment should cover knowledge in the following: Traditional methods (e.g. smoking, cooking, salting, drying and frying.) Modern methods (e.g. freezing, canning, irradiation and use of chemicals – pickling.) Identification and description of common fish preservation equipment such as Chorkor smoker is required.
(f) Packaging of fish	Identification of materials for packaging fresh and preserved fish for local and export markets e.g. cartons, crates and baskets is required. Demonstration of methods of packaging fresh fish and fish preserved by smoking,
(g) Fish products and by-products	Major fish products to be identified: fish fillets, chunks and flakes, canned, smoked, dried, salted, pickled, marinated fish. Fish by-products to be identified should include fish oils, fish entrails (guts and gills) and fish bones. Uses of fish by-products should be covered.
(h) Fish spoilage (i) Signs of fish spoilage	Signs of fish spoilage to be detected should include sunken eyes, mucus on the skin and darkening colour of gills.
(ii) Causes of fish spoilage	Knowledge of the causes of fish spoilage should be limited to microbial, enzymatic and fat oxidation. The importance of proper handling of fish to

(iii) Effects of fish spoilage	delay spoilage should be included. Knowledge of effects such as loss of value, taste and income should be assessed. The public health hazard of consuming spoiled fish should be covered.
F. FISHERIES MANAGEMENT AND BUSINESS OF FISHERIES 1. Fisheries management	
(a) Meaning of fisheries management	Assessment should cover knowledge of measures taken to maintain fish stock levels for sustainable exploitation. The concept of Maximum Sustainable Yield (MSY) should be covered.
(b) Objectives and strategies offisheries management	Objectives of fisheries management should include maximizing sustainable catches and maintaining spawning stock. Strategies should include limiting the number of fishing units, fishing closures, regulating mesh sizes and catch quotas.
(c) Traditional fish stock management practices	Assessment should include the use of practices such as close seasons, taboos, non-fishing days and cultural festivals to maintain fish stocks.
(d) Data collection and analysis for fisheries management	Knowledge of basic data required for fisheries management e.g. fish catch, fishing effort, fish length and weight, fish age and gear type should be assessed. Skills in the analysis of the data are also required. Factors (such as climate and breeding) responsible for seasonal variations in fish catches (bumper and lean) should be covered.
2. Fishery policies and regulations	Explanation of the effect of upwelling on bumper harvest of fish should be assessed.
(a) Government policies and regulations on fisheries	Knowledge of government policies and regulations on fisheries e.g. subsidy on fishing inputs, role of stakeholders, fish imports should be assessed.

	Knowledge of the importance of fisheries policies and regulations e.g. preventing capture of juvenile fishes, protection of the environment is also required.
(b) International law and conventions	Meaning and economic benefits of the Exclusive Economic Zone (EEZ) should be covered. Assessment should include knowledge of endangered fishery organisms and international conventions which protect them e.g. IUCN Red List, Convention on Biodiversity (CBD), International Convention for the Conservation of Atlantic Tunas (ICCAT). The importance of international conventions should also be included.
3. Business of fisheries: Budget preparation and financial projections for a fishery business	Knowledge and skills in the preparation of budgets using expenditure and income items from culture and capture fisheries and other fishery related businesses (sale of fishing inputs, fish marketing and fish processing) are required. Cashflow projections are also required.
4. Fish marketing	Knowledge and skills in pricing of fish products in relation to demand and supply of fish product should be covered. Assessment should cover knowledge in quality control, packaging, storage and transportation of fish.
(a) The state of fishmarketing	Major fish marketing centres in the country should be identified, e.g. fishing harbours – Tema, Takoradi fish landing beaches – Elmina fish landing sites – Yeji other fish markets – Mankessim Problems of fish marketing and their solutions should be covered. Activities involved in fish import and export should be outlined. Explanation of the effects of bumper harvest on import/export and prices of fish should be assessed.

(b) Major fisheries companies	Major companies involved in fisheries activities in your country should be named e.g. fishing – Kaas, Afko, Enyidado fish farming – Tropo farms, Crystal lake fish company cold storage – Felibat Ltd.
(c) Supply and value chains in the fishery industry	Assessment should cover knowledge of value chains in the fishery industry. The responsibilities of actors in the supply and value chain should be included.
(d) Food fish quality and safety standards	Quality and safety standards of various fish products should be mentioned.
G. PRACTICES IN FISHING COMMUNITIES AND FISHERIES INSTITUTIONS	
1. Fishing communities and cultural practices	
(a) Important fishing communities	Knowledge of the location of important fishing communities in your country is required e.g. freshwater fishing communities- Yeji, Dambai, Kwamikrom and Abotoase. marine fishing communities- Teshie, Elmina, Chorkor and Shama.
(b) Cultural festivals and taboos related to fishing	List of festivals should include: Bakatue of Edina Fetu of Oguaa Dzawuwu of Agave Knowledge of the influence of the festivals and taboos on the fishing industry should be covered, e.g. close season/fishing holiday.
3. Fisheries institutional framework and job opportunities	
(a) Fisheries training and research institutions	Identification, objectives and activities of the

	institutions e.g. Water Research Institute and University of Ghana are required.
(b) Job opportunities in the fishery sub-sector	Job opportunities in the fishery sub-sector should be identified, e.g. teaching/research, fish farming, fish pond engineer, fish import/export, fish processing, cold store operation and fishing gear/craft manufacturing.
(c) Business opportunities in fisheries	Factors required for establishing enterprises in fisheries - Identification of business opportunities - Identification of fishery product or service needed in a locality - availability of market for the product or service - demand for the product or service Resources should include land, capital, materials, structures, services, labour, technical know-how.
(d) Procedure for establishing enterprises in fisheries	Procedures should include the development of business plans, registration of business, management of the business, etc
(e) Extension services in the fisheries sub sector	Knowledge and understanding of the role of extension services in the fisheries sub-sector should be assessed, e.g. technical assistance to fish farmers and education of fisher folks on fisheries regulations.
1. Fishing gear: Identification, uses and maintenance	Assessment should cover drawing and labelling of different fishing gear.
2. Fish Identification: Identification and classification of common freshwater, brackish water and marine fishes	Assessment should cover the following fishery organisms: *Tilapia*, *Clarias/Heterobranchus*, *Chrysichthys*, *Heterotis*, *Lates*, *Bagrus*, *Alestes*, *Synodontis*, *Sardinella*, prawns/shrimps, crabs, grey mullet, sea bream, cassava fish, tuna, mackerel, anchovy, ray, shark cuttlefish/ squid and sea urchins.
3. Identification and	

description of characteristics of invasive alien species in fishery habitats	Assessment should cover the following alien species. *Eichorniacrassipes* (water hyacinth) *Cyperus papyrus* (Papyrus reed), *Salviniamolesta* (kariba weed) *Pistiastratiotes*(water lettuce) *Ceratophylumsp*(Hornwort)
4. Fish structure and function (a) External features: body form, fins, scales, lateral line etc.	Drawing and labelling of external features is required. Dissection, drawing and labelling of gills, swim bladder, alimentary canal and heart should be covered. Structure should be related to function.
(b) Internal stuctures: gills, swim bladder alimentary canal,heart, blood vessels, kidney and gonads.	
5. Environmental conditions in fish habitats	Measurement of the environmental conditions: temperature, dissolved oxygen, pH, and salinity is required.
6. Ecological processes within the aquatic environment	Construction of food chain, food web and food pyramid should be covered.
7. Characteristic features of fresh and spoiled fish	Knowledge of the following characteristics is required: Fresh fish - firm flesh, bright eyes, bright red gills and sea-weedy smell. Spoiled fish - sunken eyes, dark gills, mucus on skin and off odour smell.
8. Identification of micro-organisms and macro-organisms in spoiled fish	Assessment should cover organisms such as maggots, fungi and insects in spoiled fish.
9. Fish processing and preservation	Identification of common forms of (a) processed fish: e.g. gutted, filleted, skilled fish. (b) preserved fish: e.g. frozen, salted, canned and smoked fish. Identification and uses of common

	processing and preservation methods e.g. Chorkor smoker is required.
10. Fish by-products	Assessment should be based on the identification and uses of fish by-products.
11. Pond construction	Identification of suitable soils, material and equipment for pond construction.
12. Feed formulation and feeding	Identification of ingredients used for fish feed formulation and identification of types of fish feed are required. Methods of formulation of fish feed are also required.
13. Pond fertilization	Assessment should cover identification of types, uses and methods of application of fertilizers in fish ponds.
14. Fish diseases	Identification of gill rot, furunculosis and ich by their symptoms is required.