Model Answers
M.Sc. (Third Semester) Examination, 2014
Paper-LZT 303 (B) (Fish Culture and Pathology)

Section A

Q. 1- Answer

(i)- (c)	(ii)- (a)	(iii)- (b)	(iv)- (a)	(v)- (a)
(vi)- (a)	(vii)- (b)	(viii)- (c)	(ix)- (d)	(x)- (b)

Section B

Q2. Construction and Layout of Different Types of Fish Ponds: The types of fish pond a farmer can build depend on water supply, soil, and topography. The two types of fish pond most often built are barrage ponds and diversion ponds. Many aspects of the construction of these ponds are the same. The main difference between these two types of pond is the water source.

Barrage Ponds: These ponds are usually filled by rainfall or by spring water. A spring, for example, sends water flowing through a small valley or down a slope into a low place. The pond is formed by collecting water at the base of the valley and in the low places.

Barrage ponds should not be built where the flow of water is too great as it is difficult to keep the water from breaking down the wall if the pressure of the water is too great.

Diversion ponds: These ponds are made by bringing (diverting) water from source like a stream or river. Channels are dug to carry the water from the water source to the pond.

Diversion ponds can be made in a number of ways. Sometimes a pond is dug in flat ground or can be made by slightly enlarging a natural depression in the land.

With a diversion pond, the water is always brought to the pond instead of running directly into the pond. Water can be diverted in a number of ways. For example, water can be diverted to a pond from an irrigation ditch which carries water to agricultural crops from a nearby well or lake.

A farmer may have one diversion pond, or if his space allows and the water supply is sufficient, he may have several. When a series of diversion ponds is built, they are built in one of two ways:

Rosary system. These ponds are built one after another in a string. In this system, all the ponds drain into each other and must be managed as if they were one pond.

Parallel System: In this series, each pond has its own inlet and outlet. Therefore, each pond can be managed as a separate pond.

Many aspects of fish farming are determined by experimenting with pond operation, but much can be done by good planning before fish pond construction.

Therefore, the farmer must look at his sites and consider the types of ponds he can build from the viewpoint of the number, size, and depth of the ponds he is going to need. If, for example, the farmer thinks he has a good area for a diversion pond, but hits solid rock at I m and needs a pond 2m deep, he can find this out before he invests a great deal of time and money.

The Number of Ponds. The number of ponds depends on the possible sites and on what the farmer plans to do with his fish ponds. If he is going to raise fingerlings to market size, he will need one or a few "rearing" ponds. If a farmer plans a larger operation in which he will breed fish for the eggs and fry, he will need space for nursery pond, rearing pond, and a pond for brood stock.

- Nursery ponds can hold eggs and fry until they are fingerling size;
- rearing ponds hold the fingerlings until they are market size;
- brood ponds hold the fish to be used for breeding.

It is possible to breed fish in a corner of a large, single pond, and a farmer interested in raising fish for his own use may want to do this. But a farmer interested in marketing fish probably will want at least two large ponds. If he has two medium-large ponds, he can use one for rearing fingerlings and one for brood-stock. Eggs and fry can be taken care of in very small ponds or even containers.

The Size of Ponds. The size of ponds depends upon the same factors topography, water supply, and need. Nursery ponds usually are smaller than rearing ponds because the fry are very small.

The size of nursery ponds depends on the fish species being cultured. In fact, eggs and fry can even be kept in washtubs, oil drums or any other such container which holds enough water for the number of fry and is supplied with enough oxygen.

As the fish grow, they need more space. So rearing ponds are usually bigger than nursery ponds, and brood ponds are bigger than rearing ponds. Sometimes a farmer will have to choose between one large pond or several smaller ponds. His site would allow him to decide either way.

Here are some advantages of small and large ponds:

Small Ponds:

- harvest easily and quickly
- drain and refill quickly
- treat for disease easily
- are not eroded by wind easily

Large Ponds:

- cost less to build per hectare of water
- take up less space per hectare of water
- have more oxygen in the water
- can be rotated with rice or other crops

For most farmers, a few small ponds are better than one or two large ponds. Farmers must also manage their agricultural crops, and it is difficult for them to manage large ponds.

Also, most farmers Just do not have a lot of land. A good size for a single fish pond is probably between 1 and 5 acres.

Small ponds are easier to care for and construct. As a farmer gains experience, he can go on and build larger ponds. Starting small is a good idea until the farmer feels he knows what he is doing and is successful.

Depth of Ponds: The depth of ponds depends upon the fish being grown. Fish species like different kinds of food, and the depth of the ponds affects the kinds of food produced by the pond. A common carp, for instance, eats worms and other bottom organisms and must have a pond that is not deeper than 2m. But when the carp are fry, they eat only plankton, the tiny free-floating plants and animals suspended throughout the water. So nursery ponds for carp fry are often only O.5m deep. Other fish feed at other levels in the ponds depending on their life stage and on their own food preferences. A very deep pond will not produce as much food because the sunlight cannot light the water below a certain depth and the plankton will not be able to make oxygen for the fish. On the other hand, a very shallow pond might be turbid, covered by water plants easily, and become very hot. Most pond owners make sure that the water depth at the edges of the pond is at least 75cm to discourage water plants. It is best if the pond is about 75cm deep at the shallow end and up to 2m deep at the deepest end. This will give the best results with most pond fish.

Q3: Liming: Whether the pond is old or new, a layer of lime should be placed on the bottom of the pond. This process is called liming. Lime is placed in the pond two weeks before the water is put into the pond.

The advantages of liming are:

· To kill most microorganisms, especially parasites, due to its caustic reaction.
· To raise the pH of acidic water to a neutral or slightly alkaline value.
· To increase the alkaline reserve in the water and mud which prevent extreme change in pH.
· To promote biological productivity, since it enhances the breakdown of organic substances by bacteria, creating increased oxygen and carbon reserves.
· To precipitate suspended or soluble organic materials.
· To decrease biological oxygen demand (BOD).
· To increase light penetration.
· To enhance nitrification due to the requirement of calcium by nitrifying organisms.
· To neutralize the harmful action of certain substances like sulphide and acid.
· To indirectly improve fine textured bottom soil in the presence of organic matter.

A farmer who is not sure whether the soil of his new fish pond has acids in it because he had no place to get his soil tested, or because he has never farmed the land -- is always safer if he puts lime on the bottom of the pond.

Lime comes in several forms:

- Ground limestone
- Agricultural lime;
- Hydrated (builders) lime
- Quicklime.

Of all these types, hydrated lime is cheapest to use because it is more concentrated.

Quicklime must be used carefully: it can burn if it touches the skin and is harmful if breathed into the body. Farmers should be warned to use quicklime only with extreme care.

Lime should be put on the pond bottom at the following rates for a new pond:

- Ground Limestone 1140kg per hectare
- Agricultural Lime 2270kg per hectare
- Hydrated Lime 114kg per hectare
- Quicklime 200kg per hectare

Q4. Fish is the cheapest and most easily digestible animal protein and was obtained from natural sources from time immemorial for consumption by human beings. However, due to over exploitation and pollution, the availability of fish in natural waters have declined considerably forcing scientists to adopt various methods to increase its production. Fish farming in controlled or under artificial conditions has become the easier way of increasing the fish production and its availability for consumption. Farmers can easily take up fish culture in village ponds, tanks or any new water body and can improve their financial position substantially. It also creates gainful employment for skilled and unskilled youths. The technology developed for fish culture in which more than one type of compatible fishes are cultured simultaneous is the most advanced and popular in the country. This technology is known as Composite Fish Culture.

Objectives:

This technology enables to get maximum fish production from a pond or a tank through utilization of available fish food organisms in all the natural niches, supplemented by artificial feeding. Any perennial fresh water pond/tank retaining water depth of 2 metres can be used for fish culture purpose. However, the minimum level should not fall below one metre. Even seasonal ponds can also be utilised for short duration fish culture.

Composite fish culture in India:

Depending on the compatibility and type of feeding habits of the fishes, the following types of fishes of Indian as well as Exotic varieties have been identified and recommended for culture in the composite fish culture technology:

	Species	Feeding habit	Feeding zone
	Indian Major Carp		
a.	Catla	Zoo plankton feeder	Surface feeder
b.	Rohu	Omnivorous	Column feeder
c.	Mrigal	Detritivorous	Bottom feeder
	Exotic carps		
a.	Silver carp	Phytoplankton feeder	Surface feeder
b.	Grass carp	Herbivorous Surface	Column and marginal areas
c.	Common carp	Detritivorous/Omnivorous	Bottom feeder

Q 5: Bacterial Diseases of Fishes:

1. **Yersiniosis** (enteric red mouth disease) is a serious acute or chronic bacterial disease of intensively cultured salmonids. The etiologic agent is *Yersinia ruckeri*. Signs are darkening and hemorrhage of the mouth (red mouth), skin, anus, and fins. Chronic signs are associated with inappetence, exophthalmos, swelling, and degenerative changes of internal organs. Mortality rates are variable but are exacerbated by poor water quality and related stressors. Diagnosis is by isolation and identification of pure cultures of the organism obtained from the internal organs of infected fish. Fish that survive remain carriers and may cyclically shed bacteria, particularly when exposed to stressful conditions and water temperatures of 15–18°C. Depopulation of infected fish and avoidance of introduction of infected fish can be recommended, but preventive vaccination is the usual procedure in endemic areas.

Yersiniosis can be treated successfully with antibiotics, which should be selected based on a sensitivity test. Therapy should be continued for at least 14 days.

2. *Aeromonas salmonicida*, a gram-negative, nonmotile rod, is the causative agent of **goldfish ulcer disease** and **furunculosis** in salmonids and is a very important disease of koi and goldfish. The disease also occurs in freshwater and marine species other than the groups mentioned above. In the acute form, hemorrhages are found in the fins, tail, muscles, gills, and internal organs. In more chronic forms, focal areas of swelling, hemorrhage, and tissue necrosis develop in the muscles. These lesions progress to deep crateriform abscesses that discharge from the skin surface. Liquefactive necrosis occurs in the spleen and kidney. Diagnosis is made by isolating and identifying a pure culture of the organism from infected tissue. Avoidance through use of good quarantine practices, and vaccination when appropriate, is preferable to treatment. Successful treatment is possible, based on appropriate antibiotic therapy. Blood culture is an effective and nonlethal method for effective identification and sensitivity testing of *A salmonicida* isolates from valuable koi. Commercial vaccines are available for prevention of *A salmonicida* in salmonids and koi, but information on efficacy in koi is limited.
3. *Flavobacterium columnarae*, is responsible for **columnaris disease** in warm water species of fish. A presumptive diagnosis can be made from visualization of typical organisms on wet mounts of infected skin or gill tissue. Columnaris disease can be confirmed by isolation of the organism on Ordal's or other cytophage media. Sensitivity tests are difficult to perform because *F columnarae* will not grow on Müller-Hinton media. If the disease is diagnosed early in the course of infection, treatment with potassium permanganate or hydrogen peroxide may be effective. If the disease becomes chronic, it may have become systemic, in which case treatment with florfenicol or terramycin is recommended. Columnaris disease can be prevented by reducing organic loading and avoiding traumatic injuries. A similar organism affecting marine fish was previously grouped with *F columnarae*, but has been given its own genus and is now named *Tenacibaculum maritinum*.
4. **Bacterial gill disease**, caused by *F branchiophilum*, is most frequently reported in young cultured salmonids or fish cultured under conditions of high organic loading. It has been seen occasionally in aquarium fish. It may be initiated by crowding and poor water quality, particularly high organic loads, high ammonia levels, and silt. Gills appear swollen and mottled, with patchy areas of bacterial growth that can be confirmed by microscopic examination of direct gill smears. Hyperplasia, adhesions, and deformity of the gill lamellae can be seen. In young fish affected with the disease, mortality is high and morbidity sustained. Prevention efforts include improving water quality and avoiding overstocking. A single treatment with potassium permanganate, followed by addition of salt to the system (2–5 ppt) may be beneficial in controlling losses, but sanitation is critical for longterm resolution of the problem. Antibiotic therapy may be used as needed to control secondary bacterial problems.
5. **Bacterial kidney disease** is economically important in cultured salmonids. The cause is *Renibacterium salmoninarum*, an obligate intracellular bacteria that is one of the few gram-positive organisms that causes disease in fish. Clinically, infected fish appear lethargic and darkened. Typical lesions include grayish, localized, or conglomerate granulomata in the viscera, especially the kidney or body wall; exophthalmos; blindness; and emaciation. A presumptive diagnosis can be based on visualization of small gram-positive rods in kidney imprints. Definitive diagnosis requires isolation and identification of the bacteria by using a selective medium that contains cysteine and incubating at 15°C for 3–6 wk. *R salmoninarum* is transmitted both horizontally and vertically, and fish that survive an epizootic remain carriers. Infected female fish should be injected with erythromycin (11–20 mg/kg, IM) 14–60 days before spawning to prevent vertical transmission. Erythromycin (100

mg/kg for 10–21 days) is effective when administered in feed early in the course of an outbreak; however, it is not FDA approved for this use. Obtaining disease-free stock and preventing contamination by infected wild fish are the best preventive measures.

Q6: Common Carp

The common carp, *Cyprinus carpio*, is a favourite warm water pond fish. Common carp are used as a pond fish because they:

- Spawn easily in ponds.
- Do not get sick easily.
- Tolerate wide ranges of temperature and pH
- Eats all kinds of food, from zooplankton to decaying plants.
- Have a very good growth rate.
- Accept supplementary foods.

Common carp generally are a grey-green colour. However, they also can be gold, yellow, orange, pink, blue, green, or grey. They spawn all year round in warm waters, and they can be made to spawn by the pond owner, If they do not spawn naturally. Common carp are good to eat when they are cooked properly. They can be grown in ponds by themselves (monoculture) or in ponds with Chinese or Indian carp (polyculture).

Tilapia

The Tilapia genus (family Cichlidae) contains at least 14 species, which are all good pond fish. The colour of the fish differs only slightly depending upon species; tilapias are generally dark brown to black in colour.

The most common species grown in ponds is the *Tilapia mossambica*. It has been introduced throughout the world and is easy to find in most places. *Tilapia*:

- Are hardy fish
- Resistant to disease
- Breed easily in ponds
- Grow rapidly
- Taste good
- Can withstand wide temperature ranges.

Tilapla are herbivorous: some species eat higher plants; some eat phytoplankton. *Tilapia* reproduce every month or so, once they become sexually mature. They then take very good care of their own eggs and fry in ponds. If the farmer plans to breed and raise fry, this fish is a good choice because the fish themselves take care of the fry at a stage where many fish of other species die easily.

The major problem with raising tilapia in fish ponds is that they become sexually mature at a small size, and begin to reproduce instead of to grow further. It may be necessary to separate the tilapia by sex before they are old enough to reproduce or it may be necessary to introduce catfish into the pond to control the population of small fish.

Q 7. Sewage is universally considered as a valuable organic fertilizer as it contains abundant quantities of nutrient elements. In general way, the term sewage is used for a combined liquid waste discharged from all domestic, municipal and industrial sources within a given area.

However, a more scientific and proper definition of sewage can be given as “a cloudy fluid arising out of domestic wastes containing mineral and organic matter either in solution or having particles of solid matter floating or in suspension or in colloidal or pseudo colloidal form in a dispersed state”.

The use of sewage effluent for raising fish productivity was recognised much earlier in countries like China, Taiwan, Malaysia, Thailand and Indonesia, however in India this potentiality of sewage was noticed much later. Rearing of fish in sewage fed ponds have become very popular nowadays in West Bengal and other states like Uttar Pradesh, Madhya Pradesh, Maharashtra,’ Tamil Nadu, Kerala, Karnataka and Bihar as they are utilizing sewage effluent for pisciculture.

Characteristics of sewage:

Sewage discharge of different places may vary in their chemical composition and physico-chemical nature according to dietary habit of people, composition of trade waste and water consumption of a particular place. Besides, its organic and inorganic constituents, sewage contain living bodies, especially bacteria and protozoa.

The water content of sewage may vary from 99% to 99.9%. The carbon and nitrogen ratio of sewage is around 3:1. Sewage produced from industrial areas may have more organic carbon. Indiscriminate use of synthetic detergents in urban areas accounts for the presence of an appreciable amount of these chemicals in urban sewage discharge. Besides, carbon and nitrogen, minute quantities of zinc, copper, chromium, manganese, nickel and lead are also present in sewage. Gaseous component of sewage includes ammonia, carbon dioxide and hydrogen sulphide.

The chemical characteristics of sewage

- pH – 6.9 to 7.3
- Dissolved oxygen _ Nil
- Dissolved carbon dioxide – 20 to 96 ppm
- Free ammonia _ 12.0 to63.6 ppm
- Albuminoid ammonia _ 1.1 to16.0 ppm
- Hydrogen sulphide _ 2.4 to4.8 ppm
- Phosphate – 0.12 to 14.5 ppm
- Nitrite – 0 to 0.08 ppm
- Nitrate – 0.01 to 0.33 ppm
- Alkalinity – 170 to 490 ppm
- Chloride -115 t0 45Q ppm
- Suspended solids – 160 to 420 ppm

Use of raw sewage to fertilize a pond for fish culture is not recommended because of its detrimental effect to fish life. The harmful effects of raw sewage on aquatic life is because of its—

(i) High biochemical oxygen demand (BOD)

(ii)Low dissolved oxygen content ($D0_2$)

(iii) High carbon dioxide content

(iv) High ammonia and sulphur value

(v) High bacterial load

Treatment of sewage:

(a) Mechanical (b) Chemical (c) Biological

(a) Mechanical or Physical Treatment:

Mechanical treatment includes screening, filtration skimming and sedimentation. This help in removal of the coarse suspended particles of the sewage. The process helps in removing fats, oils, and grease and fine particles from the sewage.

(b) Chemical treatment:
Chemical treatment is meant to make sewage chemically fit for t culture of fish. This can be achieved by adding certain chemicals in the sewage to neutralize its harmful effects. Different chemical methods include deodonsation, sterlization chemical precipitation and coagulation.
(c) Biological treatment:
Biological treatment includes oxidation of organic substances present in the sewage into carbon dioxide, water, nitrogen, sulphates and other inorganic substances by using bacteria. Bacteria decompose the substances either aerobically or anaerobically.
For fish culture sewage water of stabilizing tank as well as the water after dilution can be utilized. Air breathing fishes are more suitable to be cultured in sewage treatment ponds as they can survive in water with lesser dissolved oxygen content. The fish like *Clarias batrachus, Heteropneustes fossalis, Channa spp., Tilapia mossambicus* and *Ctenopharyngodon idella* (grass carp) are the species of choice to be considered for culture in sewage treated ponds.

Q8
Significance of Manuring:
Fertilization is frequently used in the management of sport fishing ponds. However, these ponds are typically fertilized with inorganic compounds. Inorganic fertilizers are formulated using various chemicals containing nitrogen, phosphorus and potassium (N,P,K). These elements, especially phosphorus, stimulate the growth of microscopic plants called phytoplankton, which in turn, serve as food for microscopic animals. Nutrients are applied to increase pond productivity, that is, aquatic life. The greater abundance of plant and animal life supports larger populations of the desired species such as largemouth bass and bluegills.

The wastes produced by farmed aquatic animals usually support substantial phytoplankton blooms in production ponds without adding inorganic nutrients. But, organic fertilization has been used to improve pond productivity for the culture of several species. A wide variety of organic materials have been used to promote the growth of zooplankton and phytoplankton as well as other invertebrates and pond micro-organisms. Organic fertilizers include manure, cottonseed meal, soybean meal, rice bran, alfalfa meal and other processed grains or hays. Manure also contains high concentrations of ammonia and therefore, could be toxic to aquatic life if too much is added to a pond.

Organic fertilizers are primarily used to increase populations of aquatic invertebrates such as worms, crustaceans and insect larvae, as well as zooplankton. These organisms provide food for fish and other farmed aquatic animals. Organic fertilization has been used extensively to produce several species of juvenile game fish, including hybrid striped bass, red drum and largemouth bass.

(ii) Larvivorous Fishes: Fish have been widely used in public health, since as early as 1903. One of the most successful and widely used biological control agent against mosquito larvae is the top water minnow or mosquito fish *Gambusia affinis*. Fish other than *Gambusia* which has received the most attention as a mosquito control agent is *Poecilla reticulata*, the common guppy. Al the states have be n advised to upscale the use of fish as biological control method in rural areas. The following guidelines have be n prepared to guide the states in the use of fish for vector control.
Advantages of use of Larvivorous fish
- These fishes are self-perpetuating after its establishment and continuous to reduce
- mosquitoes larvi for long time.

- The cost of introducing larvivorous fish is relatively lower than that of chemical control.
- Use of fish is an environment friendly method of control.
- Larvivorous fish such as *Gambusia* and *Poecilla* prefer shallow water where mosquito larvae also breed.

Characteristics of Larvivorous Fish

- Should be small in size to survive in shallow water.
- Should be surface feeders and carnivorous.
- Should be able to survive in the absence of mosquito larvae.
- Should be easy to rear.
- Should be able to withstand a wide range of temperature and light intensity.
- Should be hardy and able to withstand transport and handling.
- Should be insignificant/useless as food for other predators.
- Should have preference for mosquito larvae over other types of food available at the water surface.