# Model Answers
# M.Sc. (First Semester) Examination, 2014
# Paper-LZT 101 (Non Chordata and Chordata)

## Section A

**Q. 1- Answer**

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

## Section B

**Q.2.** The occurrence of more than one type of structurally and functionally different individuals within a population is called polymorphism. The class Hydrozoa of phylum Coelenterata includes a large number of colonial species that contain more than one form of individuals which are called zooids.

Coelenterates have two basic zooids, polyp and medusa. All other types of zooids are modifications of these two types of zooids.

**Polyp** has a tubular body with a mouth surrounded by tentacles at one end. Other end is blind and usually attached by a pedal disc to the substratum. Polyps are typically sessile. Polyps are concerned with feeding, protection and asexual reproduction.

**Medusa** has a bowl or umbrella shaped body with marginal tentacles and mouth is centrally located in a projection called manubrium on the ventral concave surface. Medusae are generally motile and concerned with sexual reproduction.

**Modifications of Polyp**

**a. Gastrozooids** : The nutritive polyps are called gastro zooids. They alone take up nutrition in the colony. They are tubular. A mouth is present at the tip of the hypostome. Near the base of a gastrozooid usually a single, long and contractile tentacle arises. It shows batteries of nematocysts. Lateral branches are present called tentilla.

**b. Dactylo zooids**: They are called feelers or tasters. They resemble the gastrozooids. They do not show mouth. Their basal tentacle is unbranched. In Physalia, the tentacle is very long. In velella and Porpita the margin of the colony bears long and hollow tentacles. These zooids are protective in function. They bear batteries of nematocysts.

**c. Gonozooids** : The reproductive zooids are called gonozooids. They have no mouth. In Physalia the gonozooid shows branched stalk, bearing clusters of gonophores (gonopalpon). Gonozooids produce medusae called gonophores.

**Modifications of Medusa**

**a. Pneumatophores:** It functions as a float. It is an inverted medusa bell. The walls are two layered and highly muscular. The epidermal lining becomes glandular to form a gas gland. The gas gland secretes gas into the air-sac. The pneumatophore is small in Halistemma, very large in Physalia and disc-shaped in porpita.

**b. Nectocalyces** : These are swimming-bells. Mouth, manubrium, tantacles and sense organs are absent. They are helpful in swimming.

c. Bracts : They are also known as hydrophyllia. They are leaf like. In Halistemma a bract covers the zooids of a cormidium.

**Polymorphism in Siphonophora:**

The polymorphic tendency reached its peak in coelenterate organisms belonging to order 'Siphonophora' of class 'Hydrozoa'. Many siphonophora organisms will show complicated structures. These forms or zooids are developed from polyps or medusae. These individual zooids are attached to a common stalk called Coenosarc.

In Siphonophora many examples can explain polymorphic tendency.

**Physalia:** It is called *Portuguese-Man-of war'*. It shows a big float called pneumatophore. Below this pneumatophore stalk is absent. All the zooids are arranged below the float.

**Pneumatophore :** It is big and colourful. It is filled with gas. It contains gas glands. They secrete gas. With the help of the float the colony floats on the water.

**Gastrozooid:** It is a modified polyp. It has a mouth at its tip. It has a long tentacle at its base. The tentacle bears nematocysts. They are helpful in capturing the prey.

**Dactylozooid** : It is a modified polyp. It has a mouth and tentacle. It bears a number of nematocysts. Dactylozooid is defensive in function.

**Gonozooid** : They produce medusae which take up sexual reproduction.

**Q.3. Metamorphosis**: It is a biological process by which an animal physically develops after birth or hatching, involving a conspicuous and relatively abrupt change in the animal's body structure through cell growth and differentiation.

**Basic Larval Forms of Spiny skinned Marine Invertebrates (Echinoderms).**

The phylum Echinodermata has different types of larval forms that are unique to the classes. The larval forms may appear different with respect to their size, shape and number of arms but they are all ciliated and bilaterally symmetrical. The larval forms undergo metamorphosis to become radially symmetrical adult. The development pattern resembles that of chordates.

Different classes of echinoderms show structurally different larval stages and their comparisons can reveal their evolutionary ancestry.

**Bipinnaria Larva:** Bipinnaria is the larval form of the class Asteroida. This is the second stage in the development of the starfish. The bipinnaria is bilaterally symmetrical and free swimming larval form. It has a pre oral lobe anteriorly and three pairs of lateral lobes. There are two bands of cilia, a pre oral band that borders the pre oral lobe and the post oral band that borders the three pairs of lateral lobes. The bipinnaria swims about and feeds on the microscopic organisms. After some weeks it gets transformed into the next larval stage called the brachiolaria.

**Ophiopluteus Larva:** Ophiopluteus larva is the larval form of class Ophiuroidea. The larval form is bilaterally symmetrical and free swimming. It has four pairs of arms. There are antero-lateral arms, post oral arms, postero dorsal arms and postero lateral arms. Ciliated bands border the edges of the arms. The postero lateral arms are the longest and directed forwards. Like other larval forms the archenteron forms the alimentary canal and the coelomic pouches develop as a result of evagination of the endoderm layer. The mouth opening is on the ventral surface and the blastopore becomes the anus.

**Echinopluteus**: It is bilaterally symmetrical. The larva has oval body and long paired ciliated arms that are supported by calcareous skeletal rods. **Preoral arm** is present but posterolateral arm is absent. The other three arms are anterolateral, postoral and posterodorsal arms. Mouth, anus and gut are well developed.

**Q 4. Diagnostic features of chordates:** Chordates are characterised by a rod-like notochord and a hollow nerve cord on the dorsal side of the gut, and pharynx being perforated with gill slits for respiration.

**Characteristic feature and affinities of Herdmania:**

**Characters:**

1. Exclusively marine and cosmopolitan
2. Mostly sedentary
3. Solitary or colonial
4. Adult body degenerate, unsegmented without paired appendages and tail
5. Body covered with tunic, made of tunicin
6. Notochord in tail of larva only
7. Digestive tract complete
8. Respiration through gills
9. Circulatory system open
10. Hermaphrodite
11. Excretion by neural gland
12. Retrogressive metamorphosis
13. Asexual reproduction by budding

**Affinities:**

With Non-chordates

- Sessile like porifera and coelenterates
- Filter feeders like sponges and porifera
- Colonial mode of life
- Typhlosole in intestine

With hemichordate

- Same structure of pharynx perforated by gill slits
- Same development of nervous system

With cephalochordate

- Filter feeders
- Large pharynx
- Sessile
- No appendages

With vertebrate

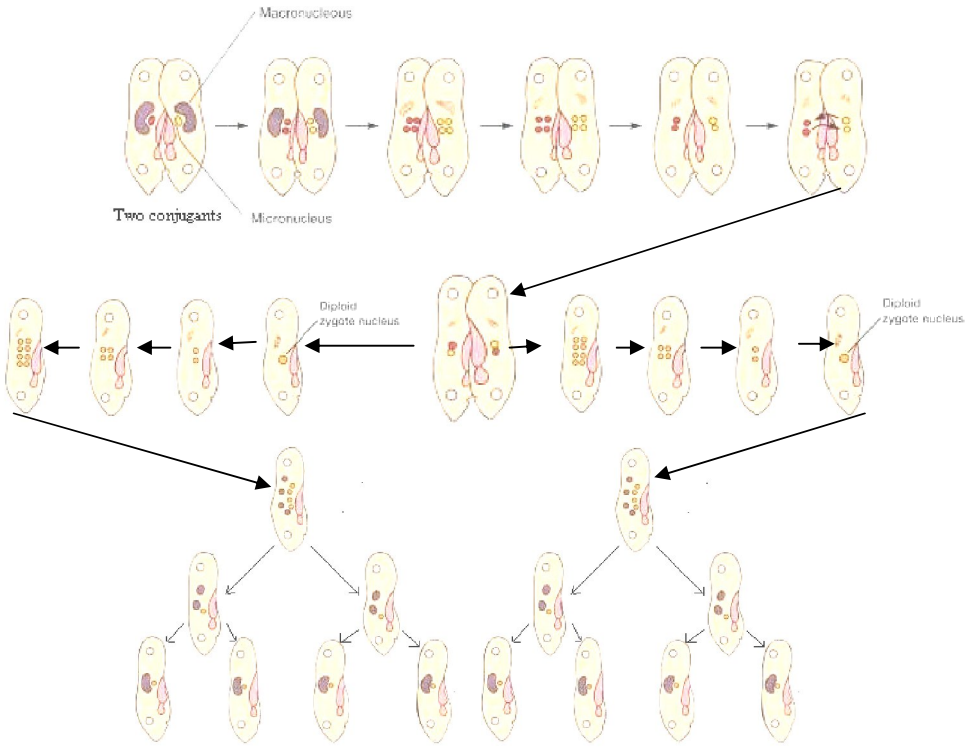
- Tadpole larva
- Basic chordate features

**Q. 5. Conjugation:** Temporary union between two paramecia of different clones for the exchange of nuclear material and multiplication is called conjugation.

**Conjugation in Paramecium:**

- During the process of conjugation two senile paramecia from two different mating types come together and closely appose one another.
- They attach at the region of cytopharynx by their ventral surfaces. The individual participating in this act are called the conjugants.

- The pellicle at the site of the union disintegrates and the cytoplasm of the two conjugants merges with each other.
- The macronuclei of both the conjugants disintegrate slowly. The micronucleus of each conjugant divides meiotically to produce four haploid nuclei.
- Of the four haploid nuclei formed three from each conjugant disintegrate so that one nucleus remains in each.
- The remaining nucleus in each conjugant divides unequally to form a small migratory pronucleus and a large stationary pronucleus.
- Now the migratory pronucleus of one conjugant passes into the other conjugant and fuses with stationary pronucleus of that conjugant.
- Thus a diploid synkaryon or conjugation nucleus is formed in each conjugant.
- The two conjugants now separate. Each separated individual is called exconjugant.
- The synkaryon of each exconjugant divides thrice by mitosis so that each exconjugant has eight nuclei. Of these eight nuclei four enlarge in size to become macronuclei. The remaining four behave as micronuclei.
- Three of the four micronuclei disintegrate so that each exconjugant contains four macronuclei and one micro nucleus.
- Then each exconjugant along with its micro nucleus divides in such a way that each of the resulting individuals has two macronuclei and one micro nucleus.
- Again these individuals divide so that the final daughter nucleus has one macro nucleus and one micro nucleus. These last two divisions are mitotic divisions.
- By the end of conjugation eight daughter paramecia form both the conjugants with rejuvenated vigor are formed.




Conjugation in Paramecium

**Q. 6.** In biology, paternal care is parental investment provided by a male to his own offspring. Parental care, by males or females, is presumed to increase growth rates, quality, and/or survival of young, and hence ultimately increase the inclusive fitness of parents

Amphibians include anurans, urodelans and apodans. Parental care is found in all these groups of amphibians.

Parents protect the eggs and early developmental stages in two ways.

1) They construct nests

2) Direct Nursing.

A. PARENTAL CARE IN APODA

The female Icthyophis dig a hole in the moist soil near a pond. Then it deposit eggs in it. Around this egg mass the mother coil and protect the egg mass from the enemies.

B. PARENTAL CARE IN E ORGANISMS CF URODELA:

a) Protection by Nests :- Sibarian salamander construct a gelatinous bag like structure attached to an aquatic plant below the water. In this bag eggs are stored.

ii) California salamendar , Autodax lay eggs in a dry hole on the soil or in a hole on a tree. The parents also live in the hole and protect the eggs.

**b) Direct Nursing by Parents**

I) Mother Amphiuma coil around the eggs and protect them.

ii) In Desmognathus, the dusky Salamander mother carry the eggs on its neck.

iii) Salamandra salandra, (the European fire salamander):- The mother will retain few eggs in its body. It liberates the larvae into water. They complete their development in the water.

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**C. PARENTAL CARE IN ANURA AMPHIBIANS:**

a) **Protection by Nests**:

Many frogs and toads build nests in which the eggs are laid and developed. This is a primitive method of parental care. In these organisms the larva comes out in a very early embryonic stage which requires some kind of protection in the very early stages of development, hence the parent will build nests.

I) In Brazilian free frog, **Hyla Faber** female construct the nest in the shallow waters of a pond. The female dig a hole of 8 to 10cm depth. The mud which comes out of it is used by the to construct a wall around the hole. This wall is raisd'above the level of water. Female hyla make the inner surface of this nursery smooth. The eggs and larval forms are protected inside this structure.

ii) **Rhacophorus malabaricus L**ays eggs on leaves of a tree hanging over a pond. Larvae after hatching from these eggs fall into the pond water and undergo metamorphosis.

iii) **Hyla resinfectris** use holes of the trees for egg laying. It line the hole with beewax brought from bee comb. Female animal lays eggs in this hole when filled with rain water.

vi) **Hyla nebulosa** lays its eggs in a nest made by dry leaves. The eggs hatch and develop into small adults. Larval form is absent.

**b) Direct Nursing by Parents:**

i) In Alytes or mid-wife-toad the female expels a strand of eggs, which the male fertilizes externally. He then wraps them around his legs to protect them from predators in the water. When the eggs are ready to hatch the male frog moves to a near by pond and the larvae are released.

**ii. Gastrotheca** or New World brooding (or) Marsupial frog has a special pouch in its skin which opens to the outside through an opening near the cloaca. Fertilized eggs are transferred into this pouch. The eggs are stored where they 'undergo development.

**iii In** surinam toad the skin on the dorsal side of female becomes soft and spongy during breeding season. During copulation the oviducts comes out and eggs are forced out of the oviduct. Each egg sinks into a small pocket of the skin and gets coveted. The developing embryo has a tail and yolk sac. The tail may work like placental connection to draw nutrition from the mother. Nearly after 80 days small individuals comes out.

iv. In **Rhinoderma darwini** or little South American frog the fertilized eggs are transferred into vocal sacs of male frogs where further development takes place.

**Q. 7. Biting Apparatus and Biting Mechanism in Snakes**

There are altogether more than 2600 species of snakes all over the world including the marine forms, and, out of which only 300 species are poisonous. Number of species diminishes progressively throughout the world. In India, there are 330 species only and among them only 69 species are poisonous. As per record of the W.H.O., nearly 30000 to 40000 persons die of snake bite in the world every year.

**Biting mechanism:** The biting apparatus taking part in the biting process are — 1. Poison glands 2. Poison ducts, and 3. Poison teeth or Fangs.

There is one pair of poison glands each one is situated on either side of the upper jaw. The poison glands are actually the parotid glands. Each poison gland is sac like in appearance. They are held in position by some ligaments. With the help of anterior ligament, the gland is attached with the maxilla. The posterior ligament is present between the gland and the quadrate. In addition to these, fan-shaped ligaments are also situated between the side walls and squamoso-quadrate junction.

Each poison gland is provided with a narrow duct at its anterior portion which passes along the side of the upper jaw, loops over itself and finally opens at the base of the fang.

There is one pair of fangs in the upper jaw. They are enlarged maxillary teeth which are very sharp and pointed. There is great power of regeneration (when lost for some reason). On the basis of structure and position, the fangs are of the following types:

1) Proteroglyphous type: The fangs are comparatively small and they are present in front of the maxillae. The fang has a groove all along its anterior face. Examples : Cobra, Krait, Sea snakes and Coral snakes.

2) Stenoglyphous type: The fangs are movable and turned inside. Poison canal runs through the fang and opens at the tip. Examples: Vipers and Rattle snakes.

3) Opisthoglyphous type. The fangs are small and lie at the back portion of maxillae. The fang has a groove along its posterior face. Examples : Some colubrid snake (African tree snakes)

4) Aglyphous type: Aglyphous dentition is present in the non- poisonous snakes.

**Associated bones and muscles:** There are some important bones and muscles which are directly or indirectly associated with the mechanism of biting. In the skull, maxillae, quadrate, pterygoid, squamosals, ectopterygoids and palatines are movably articulated. Premaxillae are very much reduced. Sqamosals are loosely attached to cranium. The joint of quadrate and lower jaws acts as fulcrum. Quadrates are also loosely articulated with the cranium, pterygoid and lower jaw. Ectopterygoid is a transverse bone.

The important muscles are Digastric muscle, Anterior and Posterior temporalis muscles and Protractor-Pterygoid or Sphenopterygoid muscle. In addition to these, there are two more muscles associated with the poison glands. These are masseter muscle and Mandibular constrictor muscle.

The gastric muscle is attached with the squamosal bone anteriorly and with the base of the lower jaw (articular) posteriorly.
The Sphenopterygoid muscle is attached to the Sphenoidal region anteriorly and dorsal surface of the Pterygoid posteriorly. Anterior and Posterior temporalis muscles are attached to the side walls of the cranium and the lower jaw.

***Opening and Closing of Mouth (Process of biting)***

(i) When the digastric muscle contracts, the mandible is lowered and the skull along with the upper jaws goes up. As a result, the mouth opens.
(ii) The distal end of the quadrate is pushed forward which thrusts the pterygoid, palatine and transverse bar.
(iii) Contraction of the Sphenopterygoid muscle also contributes to the above process and Pterygoid is pulled forward and ectopterygoid is pushed upward.
(iv) The upward movement of ectopterygoid brings about a rotation of maxilla on its own axis and as a result fangs are erected.
(v) The mouth closes by the contraction of anterior temporalis and pterygoid muscles. Fangs pierce into the skin of the victim.
(vi) Muscles associated with the poison gland (masseter and mandibular) contract and the poison is squeezed into the body of the victim through the poison ducts and fangs.

**Q. 8. Characteristic Features of Birds**

1. Body usually spindle shaped, with four divisions: head, neck, trunk, and tail; neck disproportionately long for balancing and food gathering.
2. Limbs paired; forelimbs usually modified for flying; posterior pair variously adapted for perching, walking, and swimming; foot with four toes (two or three toes in some)
3. Epidermal covering of feathers and leg scales; thin integument of epidermis and dermis; no sweat glands; oil or preen gland at base of tail; pinna of ear rudimentary
4. Fully ossified skeleton with air cavities; skull bones fused with one occipital condyle; each jaw covered with a keratinized sheath, forming a beak; no teeth; ribs with strengthening, uncinate processes; posterior caudal vertebrae reduced and fused as the pygostyle; pelvic girdle a synsacrum; aerythrocytes sternum usually well developed with keel; single bone in middle ear
5. Nervous system well developed, with 12 pairs of cranial nerves and brain with large cerebellum and optic lobes
6. Circulatory system consists of four-chambered heart with two atria and two ventricles; completely separate pulmonary and systematic circuits; right aortic arch persisting; nucleated erythrocytes
7. Endodermic
8. Respiration by slightly expansible lungs, with thin air sacs among the visceral organs and skeleton; syrinx (voice box) near junction of trachea and bronchi
9. Excretory system includes metanephric kidneys; ureters open into cloaca; no bladder; semisolid urine; uric acid main nitrogenous waste
10. Sexes separate; testes paired, with the vas deferens opening into the cloaca; females have left ovary and oviduct only; copulatory organ (penis) only in ducks, geese, paleognathids and a few athers
11. Fertilization internal; amniotic eggs with much yolk and hard, calcareous shells; embryonic membranes in egg during development; incubation external; young active at hatching (precocial) or helpless and naked (altricial); sex determined by females (females heterogametic).

**Affinities:**

**With Reptiles**

**Similarities**

- Both lay shelled amniotic eggs
- Birds are diapsids; most reptiles are diapsids
- Both have scales although in birds scales are limited to the leg region; feathers in birds aremodified scales
- Both have nucleated red blood cells
- Feathers and scales both made from protein keratin
- Both have hearts with a right systemic aortic arch
- Both have the same jaw structure made up of 5 fused bones
- Neither have sweat glands
- Both have one occipital condyle as compared to mammals which have two
- Both have only one middle ear bone
- Both have sclerotic rings, which are rings that go around their eyes and support them.
- Both baby birds and reptiles start out with an egg tooth designed to help them break out of their shell

**Differences:**

- Reptiles have a dry scaly skin in contrast to birds that have feather covered skins. Most of the reptiles shed their skin several times a year.
- Birds are warm blooded animals, while reptiles are cold blooded animals.
- All birds have two hind legs. They also have fore limbs in the form of their wings. The number of limbs or legs in reptiles is variable. Most of the reptiles have four legs, while other may have no legs at all.
- Birds do not have any teeth. Instead they have a hard beak or bill. In contrast reptiles have teeth.
- Birds live only on land, although some birds are able to swim in water. Some reptiles live on land while others live in water. Some reptiles live on land as well as water.

**With Mammals**

**Similarities:**

- Both belong to Phylum Chordata and sub-phylum Vertebrata (Presence of Vertebral column or backbones).
- Both are warm - blooded (it doesn't mean that their blood is hot or cold in cold blooded animal, it means that they can maintain their body temperature stable regardless of external temperature.
- Their heart is completely four chambered (two auricle and two ventricle).
- Both are omnivorous (feed on both plant and animal)
- Composition of blood is similar in both i.e. RBC's and WBC's both are present with hemoglobin as a respiratory pigment.
- Parental care seen in both of them

**Differences:**

- Mammals give birth to their young whereas birds lay eggs.
- Birds have feathers whereas mammals have only fur or hair.
- Birds have porous or hollow bones. In contrast, mammals have denser bones.
- Birds have wings while mammals have paws, hands, and hooves.

- Mammals produce sound using a larynx, but in birds this organ does not produce sounds. Instead, birds have a syrinx which serves as voice box.
- Mammals feed their young milk produced by the mammary glands. On the other hand, the young birds are fed by the parents regurgitating partially digested food.