Model Answers
M.Sc. (First Semester) Examination, 2015
Paper-LZT 101 (Non Chordata and Chordata)

Section A

Q. 1- Answer

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

Section B

2. **Conjugation**:-The temporary pairing of two individuals of different mating types for the purpose of exchange of nuclear material is called conjugation.
1. Unfavourable conditions induce conjugation in vorticella
2.Before conjugation *Vorticella* undergoes longitudinal binary fission
3. Longitudinal binary fission in *Vorticella* results in two unequal individuals
4.The larger one is called macroconjugant, the smaller one is called microconjugant
5.Macroconjugant is stationary where as microconjugant is motile
6.Microconjugant fuses with the macroconjugant of different mating type
7.The macronuclei of macroconjugant and microconjugant disintegrate
8.The micronucleus of macroconjugant undergoes meosis(meosis-I and meosis-II) and is divided into four nuclei
9. The micronucleus of microconjugant undergoes meosis(meosis-I and meosis-II) ,one mitosis and divided into eight nuclei
10.Among the four nuclei of the macroconjugant three are disappeared
11. Among the eight nuclei of the microconjugant seven are disappeared
12.The remaining nucleus of each conjugant divides into two unequal nuclei
13.The smaller nucleus is male-pronucleus and larger is female-pronucleus
14.The male pronucleus of the microconjugant enters into the macroconjugant and fuses with the female pronucleus of the macroconjugant
15.The cytoplasm of microconjugant and macroconjugant are also unified along with the pronuclei, this is called amphimixis
16.The nucleus that is formed due to the amphimixis is called synkaryon
17.The macroconjugant along with synkaryon is called zygote
18.The synkaryon of the zygote undergoes three series of successive mitotic divisions to form eight nuclei
19.Of the eight nuclei seven become macro nuclei and one become micronuclei
20.The zygote with seven maro and one micro nuclei undergoes a series of three successive post conjugation fissions to form seven daughter vorticellae.

3. In freshwater and terrestrial molluscs, there is no free swimming larval stage. Both trochophore and veliger stages are passed inside the egg and a tiny snail hatches out of the egg. Early larva is symmetrical with anterior mouth and posterior anus and gills lie on the posterior side. As the larva develops shell its visceral mass starts twisting in anticlockwise direction to rearrange the visceral organs so that they are accommodated inside the coils of the shell and openings of organs are shifted to the anterior side where the shell opening lies.

During torsion visceral and pallial organs change their position by twisting through 180°. Posterior mantle cavity is brought to the front position. Gills and kidney move from left to right side and in front which helps in breathing. In nervous system the two pleurovisceral connectives cross themselves into a figure of 8, one passing above the intestine and the other below it. Alimentary canal twists in the visceral mass and opens by anus on the side of the head on the anterior side. After torsion the foot can be withdrawn after the head.

During torsion head and foot remain fixed and rotation takes place in the visceral mass only behind the neck so that the visceral organs of the right side come to occupy the left side and vice versa. Before torsion the visceral mass points forward and the mantle cavity is posterior in position. This position is called exogastric. After torsion the position becomes endogastric in which visceral mass points backwards and intestine lies in the whorls of the shell and anus opens on the anterior side.

Ninety percent of the torsion is affected by the right retractor muscle which is quite prominent in the larva while the left retractor muscle is rudimentary. Rest of the 10% of torsion is caused by the differential growth of the visceral mass. Torsion takes place quickly and is completed from 15-30 minutes.

Anticlockwise rotation of the visceral mass causes dextral (right handed) coiling of the shell, which happens in majority of the cases. However, rarely clockwise rotation of visceral mass also takes place, which causes sinistral (left handed) coiling of the shell.

Effects of Torsion: As gastropod shell has only one opening, it has to serve as entrance as well as exit for all visceral organs. Both mouth and anus must open on the anterior side. Mantle cavity also must open on the anterior side for easy respiration. Respiratory current opposes locomotion after torsion which increases availability of water inside the branchial chamber. Visceral mass has to undergo rearrangement so that openings of kidneys, gonads and anus should migrate to the front side which is the only opening of the shell. The small chemoreceptor osphradium also migrates to the front side so that it could chemically analyse water current entering the mantle cavity. The bulky buccal mass migrates to the anterior side that provides stability during locomotion. Torsion allows foot to be retracted after the head for better protection of head.

4. Crustaceans are Arthropods whose body is covered with chitinous exoskeleton for protection. But the same exoskeleton does not allow body growth and hence must be shed in order to allow growth. The larval stages feed and grow in order to become adults and must undergo moulting or ecdysis to grow. After each moulting they change their structure and size and hence are different from the previous stage. Therefore, each species of crustaceans demonstrates several successive larval stages before it becomes adult. These larval stages are described below.

NAUPLIUS LARVA

Discovered by Muller in 18th century, the Nauplius larva is the first fundamental stage in all crustaceans that sometimes hatches from the egg and sometimes passes inside the egg. Body is oval in shape and unsegmented with a large cephalothorax and rudimentary abdomen. There are three pairs of appendages, namely, antennules, antenna and the mandible; the last two pairs are biramous and are used for swimming. There is a single median eye. It has a well developed digestive system for feeding on planktons. In Branchiopoda and Copepoda, Nauplius hatched from eggs.

METANAUPLIUS LARVA

In some Branchiopods such as *Apus,* the nauplius larva transforms into metanauplius, which is slightly larger than nauplius and has cephalothorax and abdomen and a caudal furca.

It also has a single median eye. Antennule is uniramous and sensory but antenna is large, biramous and locomotory in function. Mandibles reduce in size and are used for chewing food. In addition, 2 pairs of maxillae and 2 pairs of maxillipedes make their appearance in metanauplius for handling food.

PROTOZOEA LARVA

In the case of marine prawns and lobsters, eggs hatch into protozoea which has a large cephalothorax and elongated unsegmented abdomen with a caudal fork and a pair of small uropods. Antennule is uniramous and segmented while antenna is biramous. There is a single median eye. Mandibles are small and masticatory in function. There are 2 pairs of maxillipedes for food gathering. Three pairs of thoracic limbs make their appearance as buds. Cephalothorax is covered by a carapace.

ZOEA LARVA

Zoea is the common larva of decapods and hence it has variations in its features in different species. It has a large cephalothorax that is covered with a helmet-like carapace that also sports spines and it protruded into a rostrum in front. There is one pair of compound eyes. Antennule and antenna are short and sensory in function. First and second maxillipedes are large and biramous, used for swimming. Thoracic appendages are still in bud form and non-functional. Abdomen is 6-segmented, without appendages and has a caudal furca on the tip along with a telson.

In some Malacostraca, zoea changes in to metazoea, which grows abdominal appendages for swimming.

MYSIS LARVA

In shrimps and some lobsters zoea transforms into mysis that resembles *Mysis* in general features. It has a cylindrical and elongated body bearing a cephalothorax and 6-segmented abdomen. Carapace is produced in front into a pointed rostrum. Antennule and antenna are sensory in function. There are 6 pairs of biramous thoracic appendages for locomotion and 6 pairs of abdominal appendages for swimming, out of which the last one is modified as uropod. There is a pointed telson on the tip of abdomen.

PHYLLOSOMA LARVA

In spiny lobsters, the egg hatches into phyllosoma larva in which body is divisible into head, thorax and abdomen. There is a pair of stalked compound eyes and a pair each of antennules and antenna as sense organs. Body is dorsoventrally flattened and transparent. The first maxillipede is rudimentary and the second one is uniramous. The third maxillipede is large, biramous and is used for swimming. The abdomen is small, segmented and does not bear appendages. Three pairs of thoracic appendages are very long and their tips are flattened oar-like for swimming near the surface of water.

MEGALOPA LARVA

In crabs, zoea is transformed into megalopa, which bears a large cephalothorax and small abdomen bearing small pleopods. Telson is very small. Antennule and antenna are small and sensory in function and there is a pair of stalked eyes. The first pair of thoracic legs is large and chelate as in adults. The rest of the 4 pairs of thoracic legs are thin and long and are used for crawling. In hermit crab the megalopa larva is slightly different and is called Glaucothea. Its abdomen carries pleopods and the tip of abdomen bears a hook-like telson.

SIGNIFICANCE OF LARVAL STAGES

The larval stages are significant in scientific studies as they show evolutionary relationships among different groups of crustacean. Nauplius and metanauplius stages are common to all crustaceans whether they are outside or inside the eggs. They show common ancestry of all crustaceans from similar ancestors. The larvae are important for the species as they help in the dispersal of the animals to distant places.

5. 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 ORGANISMS OF URODELA:
a) Protection by Nests :-
i) 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.

6. 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

7. 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.

8. Charecteristic Features and Affinities of Mammals

- The various traits which are used to define mammals include: the presence of hair; the integument system which contains specialized secretory glands; the skeletal and muscular systems; the heart and brain structure.
- Mammals contain specialized glands which have various functions: secretion of chemical compounds used for communication; glands that produce milk; glands that produce perspiration used for thermoregulation; and glands that produce sebum, which is used for lubrication.
- Mammals have four-chambered hearts that are defined by the ability to regulate the heart beat with the presence of specialized pacemaker cells.
- A mammal's hair has many purposes, including insulation, sensory perception, protective coloration, and social signaling.
- Mammals possess many unique skeletal structures including a single lower jaw bone that joins the skull at the squamosal bone and three bones in the inner ear.

Affinities:

With Amphibians:

Mammals were the last major group of animals to evolve for the terrestrial conditions, whereas amphibians were the first vertebrate group to take the challenge of living out of water.

• Mammals are warm-blooded, but amphibians are cold-blooded.
• Mammals have hairs on skin, whereas amphibians have a bare and moistened skin.
• Mammals have mammary glands to feed the young but amphibian newborns are not breast-fed.
• Mammals show a very high parental care for the offspring, but it is low among amphibians.

• Mammals reach large body sizes, and sometimes those could be exceptionally large. However, amphibians are much smaller than mammals.
• Mammals have conquered most of the Earth while the majority of amphibians are restricted to wet and damp environments because of the high demand of water

With Reptiles: Mammal and reptile have inhabited the earth for millions of years now. Mammals and reptiles are both oxygen-breathing vertebrates that need nourishment for living. Both have the same organ components such as brain, heart, stomach, lungs, among others. Mammals and reptiles are both tetrapods, meaning they both have four limbs.

Differences:

The main difference between mammals and reptiles is the way they regulate body heat. Mammals can produce body heat while reptiles need external heat source such as the sun. That is why most reptiles will bask in the sun to get warm. Mammals give birth to live young while reptiles lay eggs. The mammal youngling is very dependent to its parents for protection and nourishment while a reptile hatchling doesn't need any parent in order to live as they can fend for themselves the moment they hatch. Moreover, mammals have hairs and furs while reptiles have scales.

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