THE OPEN UNIVERSITY OF SRI LANKA
B.SC DEGREE PROGRAMME – LEVEL 5
COURSE TILE – INSECT BIOLOGY
COURSE CODE – ZLU3186/ZLE5186
NO BOOK TEST - 01
DURATION: ONE HOUR (01)

Registration No:.....

Date: 24.02.2014 **Time: 4.15pm – 5.15pm**

ANSWER ALL QUESTIONS IN PARTS A&B.

- **Part A consists of two sections with thirty five blanks and the blanks should be filled with suitable word/s.**
- **Part B is a structured essay question consisting of ten parts from 2.1 - 2.10. Answers should be written in the space provided.**

At the end of the examination the whole paper should be handed over to the examiners.

Part A

1. Fill in the blanks in the article given below with the most appropriate word/s.

1.1. Insects & Man

Insects have an important role as part of the biosphere – the living **(1)** ..... and they make up four-fifths of all animal **(2)**..... But what difference do they make to our lives?

Insects as a problem

Many insect species **(3)** ..... with us for food. Many of these have been encouraged due to human activities, but then they become a **(4)**..... We plant crops which some insect species love, they thrive on them - and that's when we start to call them **(5)**.....

Humans have caused some insect species to be moved from one part of the world to another - deliberately or by **(6)**..... The Large White butterfly is an example of a butterfly which was introduced to the USA and is now a pest on cabbages there.

Another example is the Europian Corn Borer, *Ostrinianubilalis*, a Pyralid moth which is an important pest of corn in the Midwest of the USA. The species was introduced there from Europe in the early 20th century and now costs US farmers over a billion dollars a year.

If the introduced insect species has no **(7)**..... enemies in their new **(8)**....., they can become a real problem. A recent UK example is the Harlequin ladybird (*Harmoniaaxyridis*), which has found its way to Britain and eats other ladybirds. In other countries where it has been deliberately introduced to control insect pests -a process called **(9)**..... Control. it has become a real problem, threatening to wipe out many native insects.

Some insects can sting, bite, or transmit disease to **(10)**..... Sometimes this is because they find us tasty –1 **(11)**..... for example gain nourishment by sucking **(12)**....., and in the process they can transmit **(13)**.....diseases, such as (**14**)..... which is caused by the protozoan *Plasmodium falciparum* being transmitted in the **(15)**..... of the *Anopheles* mosquito.

The flea *Chenopsyllacheopsis* had a profound effect on human history when it travelled from Africa in the ships of the Middle Ages, spreading the Black Death (also known as the Bubonic Plague) across Europe. It took four hundred years for the European population to recover from the effects of the Black Death. The illness is now known to be caused by the

bacterium *Yersinia pestis*, which was carried by the flea, which in turn was carried by the black rat on ships.

So, when it comes to insects, it's important to understand the consequences of human actions.

Many pests - such as the Colorado Beetle or the Gypsy Moth - can be controlled by spraying with **(16)**..... pesticides, which kill most insect species on the crop. But - would you rather eat perfect food sprayed with chemicals, or food where the pests are controlled by more natural means?

Insects as an opportunity

Insects are very **(17)**..... as pollinators. Bees are perhaps the best example of this. Honey Bees (*Apis mellifera*) aren't bred in captivity just for the honey they produce - they are vital to pollinate crops. Without them, many crops would fail, as **(18)**..... is needed before many crops and fruits that we eat can be formed.

Not to mention that tiny midge that pollinates the cocoa plant. Without it, there would be no chocolate!

Other examples of useful insects are the Silkworm Moth, *Bombyxmori*, from which **(19)**..... is obtained. This species has been reared by humans for such a long time that it has become domesticated - it would be unlikely to survive in the wild if released today.

Insects are also useful as models in scientific research. The Fruit Fly *Drosophila melanogaster* is a good example. It breeds rapidly, and can produce very many generations per year in the laboratory, so it is ideal for the study of genetics and evolution. In fact, many genetic discoveries of great importance to medicine have been made using this little fruit fly.

Insects can be useful to the gardener too - ladybirds, for example, are the gardener's friend because they eat **(20)**..... Hoverflies and wasps also prey on other insects in the garden. These species are called **(21)** ..... Others that are natural enemies to garden pests include parasitoids, which lay eggs in the **(22)**..... insect so as to provide food for its developing young.

Many kinds of insects are also food for songbirds and other birds and (23) animals. When there aren't enough insects around, the result is fewer birds and mammals.

1.2. Insect mouthparts

The development of insect mouthparts from the primitive chewing mouthparts of a grasshopper in the centre (A), to the lapping type (B) of a bee, the siphoning type (C) of a butterfly and the sucking type (D) of a female mosquito. These are antennae; compound eye; labium; labrum; mandibles; maxillae; and hypopharynx.

Insects (Class **(23)**.....) exhibit a range of mouthparts, adapted to particular modes of feeding. The earliest insects had chewing mouthparts. Specialisation has mostly been for piercing and sucking, although a range of specialisations exist, as these modes of feeding have evolved a number of times (for example, mosquitoes (which are flies) and aphids (which are true bugs) both pierce and suck, however female mosquitoes feed on animal blood whereas aphids feed on plant fluids). In this page, the individual mouthparts are introduced for chewing insects. Specialisations are generally described thereafter.

The insect mouthparts show a multitude of exceptional good examples, to study and reconstruct the evolution of organs in the context of form and function. The mouthparts consist of a set of homologous organs, rebuilt according to their function of dietary intake. Their efficiency of dietary intake can be tested experimentally. Convergent evolution of many groups of insects lead from original biting-chewing mouthparts to different derived function types. For example they build proboscis at flower-visiting insects which are able to ingest food very efficiently or biting-sucking mouthparts, showing different function mechanisms at different groups of blood-sucking insects.

Chewing insects

Examples of chewing insects include dragonflies, grasshoppers and **(24)**..... Some insects do not have chewing mouthparts as adults but do as larvae, such as moths and butterflies.

Mandible

Chewing insects have two mandibles, one on each side of the head. The mandibles are positioned between the labrum and maxillae. They are typically the largest mouthparts of chewing insects, being used to masticate (cut, tear, crush, chew) food items. They open outwards (to the sides of the head) and come together medially. In carnivorous chewing insects, the mandibles can be modified to be more knife-like, whereas in herbivorous chewing insects, they are more typically broad and flat on their opposing faces (e.g., caterpillars). In male stag beetles, the mandibles are modified to such an extent that they do not serve any feeding function, but are instead used to defend mating sites from other males. In ants, the mandibles also serve a **(25)**..... function (particularly in soldier castes). In bull ants, the mandibles are elongate and toothed, used as hunting (and defensive) appendages. In bees, which feed primarily by use of a proboscis, the

primary use of the mandibles is to manipulate and shape wax, and many wasps have mandibles adapted to scraping and ingesting wood fibres.

Maxilla

Situated beneath the mandibles, paired maxillae manipulate food during mastication. Maxillae can have hairs and "teeth" along their inner margins. At the outer margin, the galea is a cupped or scoop-like structure, which sits over the outer edge of the labium. They also have palps, which are used to sense the characteristics of potential foods.

Labium

The labium is a quadrupedal structure, although it is formed from two fused secondary maxillae. It can be described as the floor of the mouth. With the maxillae, it assists manipulation of food during **(26)**..... or chewing or, in the unusual case of the dragonfly **(27)**....., extends out to snatch prey back to the head where mandibles can eat it.

In the honey bee, the labium is elongated to form a tube and tongue, and these insects are classified as having chewing and lapping mouthparts.

Hypopharynx

The hypopharynx is a somewhat globular structure, arising from the base of the labium. It assists swallowing.

Siphoning insects

This section deals only with sucking insects, not those that pierce prior to sucking. The typical example is the moths and **(28)**....., although as is always the case with insects, there are variations. Some moths have no mouthparts at all. All but a few adult Lepidoptera lack mandibles (the mandibulate moths have fully developed mandibles as adults), with the remaining mouthparts forming an elongated sucking tube, the proboscis.

Proboscis

One of the more defining characteristics of lepidopterans is their **(29)**..... proboscis. It is held coiled under the head when not in use. During feeding, however, it is extended to reach the nectar of flowers. The proboscis is a long tube that is formed by heavily modified maxillae, specifically the galea.

Piercing and sucking insects

A number of insect orders (or more precisely families within them) have mouthparts that pierce food items to enable sucking of internal fluids. Some are herbivorous, like aphids and leafhoppers, while others are insectivorous, like assassin bugs and mosquitoes (females only).

Proboscis

The defining feature of the order Hemiptera is the possession of mouthparts where the mandibles and maxillae are modified into a proboscis, sheathed within a modified labium, which is capable of piercing tissues and sucking out the liquids. For example, true bugs that feed on plants, such as shield bugs, feed on the fluids of plants. Predatory bugs such as assassin bugs have the same mouthparts, but they are used to pierce the cuticles of captured prey.

Stylet

In female mosquitoes, all mouthparts are **(30)**..... The labium encloses all other mouthparts like a sheath. The labrum forms the main feeding tube, through which blood is sucked. Paired mandibles and maxillae are present, together forming the stylet, which is used to pierce an animal's skin. During **(31)**....., the labium remains outside the food item's skin, folding away from the stylet. **(32)**..... containing anticoagulants, is injected into the food item and blood sucked out, each through different tubes.

Sponging insects

Labellum

The housefly is the typical sponging insect. The labium gives the description, being articulate and possessing at its end a sponge-like labellum. Paired mandibles and maxillae are present, but much reduced and non-functional. The labium forms a proboscis which is used to channel liquid food to the **(33)**..... The housefly is able to eat solid food by secreting saliva and dabbing it over the food item. As the saliva dissolves the food, the solution is then drawn up into the mouth as a liquid.

The labellum's surface is covered by minute food channels, formed by the interlocking elongate hypopharynx and epipharynx, which form a tube leading to the **(34)** ..... The food channel draws liquid and liquified food to the oesophagus by **(35)**..... action.

35 marks

Part B

Registration:.....

2. Answers should be written in the space provided.

2.1. Explain the following terms with regards to insects

a. Haletrs

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b. Instar

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c. Isoptera

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d. Tagmatization

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e. Oviparpous

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f. Insect integument

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2.2. List the characteristic features of Aperygotes

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2.3. Write the names of different types of insect cuticles

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2.4. List the different types of cuticular extensions

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2.5. Define the term "entomophagous insects"

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2.6. Distinguish between hemimetabolous and holometabolous insects

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2.7. List the features that contributed to the insects being dominant organism in animal Kingdom.

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2.8. Write the important features of wings in insects.

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2.9. Name the insect/s that can be used as biological control agents.

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2.10. Write the major features of the order- mantophasmatodea

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65 Marks
