1. Make neat and labelled diagrams of the following:

i) Types of ovules,
   Ans: Ovules have been separated into six categories based on their shapes:

   **Orthotropous (Atropous)**
   This is where the body of these ovules is straight so that the chalaza, where the nucellus and integuments merge, the funicle, which attaches the ovule to the placenta, and the micropyle are all aligned.

   **Anatropous**
   In this case, the ovules become completely inverted during development so that the micropyle lies close to the hilum. The hilum is a scar that marks the point where the seed was attached to the fruit wall by the funicle.

   **Hemi-anatropous**
   The body of these ovules becomes at a right angle in relation to the funicle, so it looks like the ovule is lying on its side.

   **Campylotropous**
   The body of this type is bent and the alignment between the chalaza and micropyle is lost. The embryo sac is only slightly curved.

   **Amphitropous**
   The body of the ovule is very much curved that the embryo sac and the ovule itself take the shape of a horseshoe.

   **Circinotropous**
   The funicle in this case is especially long that it creates a nearly full circle around the ovule whose micropyle is ultimately pointing upwards.

ii) Apomixis types,
   Ans: Types of Apomixis
   Three types of apomixis are generally recognized – diplospory, apospory and adventitious embryony. These apomictic processes are depicted compared to sexual processes in the formation of a common Polygonum-type embryo sac.

   **Diplospory**
   - In diplospory, the unreduced embryo sac is derived from the megaspore mother cell either directly by mitotic division or by aborted meiotic events.
   - Three major types of diplospory have been reported, named after the plants in which they occur, and they are the Taraxacum, Ixeris and Antennaria types.

   In the Taraxacum type, meiotic prophase is initiated but then the process is aborted resulting in two unreduced dyads one of which gives rise to the embryo sac by mitotic division.

   In the Ixeris type, two further mitotic divisions of the nuclei to give rise to an eight-nucleate embryo sac follow equational division following meiotic prophase. The Taraxacum and Ixeris types are known as meiotic diplospory because they involve modifications of meiosis.

   **Apospory**
   - In apospory, the nuclear cells that give rise to the apomictic embryo sac, termed aposporos initials, are distinct from the ameiotic megasporocyte.
   - They are similar in appearance to the ameiotic megasporocyte and may differentiate close to the ameiotic megasporocyte and develop into an apomictic embryo sac.
   - Once the aposporos initial cells differentiate they immediately enter mitosis to produce an embryo sac. Some ovules can contain multiple embryo sacs and, depending on the species, the structure of the embryo sac may be quite different from that seen in the sexual process.
   - The initiation of the apospory embryo sac can occur together with a sexual one or it can displace or inhibit sexual embryo sac formation.

   **Adventitious Embryony**
   - In this process, embryos initiate parthenogenetically outside of an embryo sac structure.
   - Adventitious embryony is most commonly initiated later in ovule development from nucellar and integumentary tissues.
   - In general, fertilization in the adjoining sexual embryo sac and subsequent endosperm formation is necessary to form viable seeds. The developing embryos closest to the embryo sac grow towards it, presumably to obtain nutrient and other developmental signals from the embryo sac.

   There are some few further types of apomixis which are discussed in brief below.

   **Recurrent and Non-recurrent Apomixis**
   - In recurrent apomixis, both the egg-cell and embryo are diploid and the embroyosac is developed from the megaspore mother cell.
   - In non-recurrent apomixis, both the egg-cell and embryo are haploid and embryo is developed directly from an egg-cell without fertilization.

   **Vegetative Apomixis**
   - In this apomixis type, vegetative bulbils or buds are produced in the inflorescence instead of flowers.
   - They are easily reproducible and are seen in certain plants like Fragaria, Agave, Poa bulbosa, etc.

iii) Cross-section of fruit of Pyrus malus, and