MORPHOLOGY & TAXONOMY OF ANGIOSPERMIC PLANTS

MORPHOLOGY OF ANGIOSPERMS

INTRODUCTION

Angiospermic or flowering plants show a great variety of shape, size and form. The size ranges from the minute *Wolffia* and *Lamna* (0.1*cm*) to the tall *Eucalyptus* (up to 100 *metre*) and large sized Banyan (*Ficus bengalensis*). In habit, they range from herbs and shrubs to trees.

Morphology (Gr. *Morphos* = Form; *logos* = Study) is the branch of science which deals with the study of form and structure. In botany, it generally means the study of external features, forms and relative positions of different organs on plants.

It is virtually impossible to recognise and know all the flowering plants even for a professional taxonomist. However, a student of botany takes the help of **morphology** for recognition, identification and classification of plants. Some distinct morphological features are most significant in the study of phytogeography, phylogeny and evolution.

Parts of a flowering plant : Flowering plants consist of a long cylindrical axis which is differentiated into underground root system and an aerial shoot system. The root system consists of root and its lateral branches. The shoot system has a stem, a system of branches and leaves. The different parts of a plant are called **organs**. Organs are differentiated into two types, vegetative and reproductive. Vegetative organs take part in nourishing and fixing the plant, viz., root, stem, leaves. Reproductive organs are required in multiplication. They comprise flowers, fruits and seeds (formed inside fruits). Organs similar in basic internal structure and origin which may appear different and perform different functions are called **homologous organs**. The relationship amongst these organs is called **homology**. Organs performing a similar function or having a similar external form but different internal structure and origin are termed as **analogous organs**. The relationship in analogous organs is called **anology**.

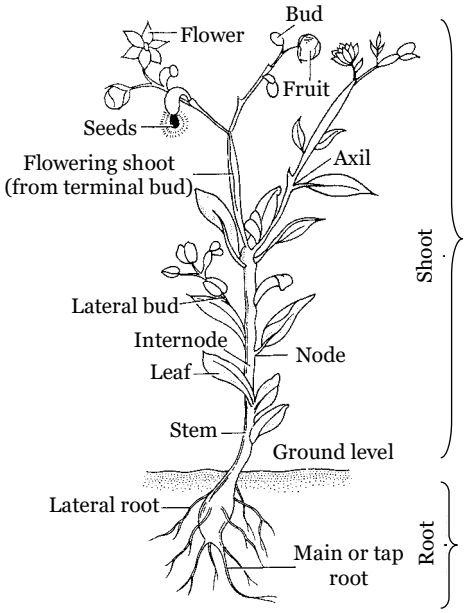


Fig : Morphology of a angiosperm plant

1.1 THE ROOT

The root is usually an underground part of the plant which helps in fixation and absorption of water. The root with its branches is known as the root system.

(1) **Characteristics of the root**

(i) The root is the descending portion of the plant axis and is positively geotropic.

(ii) It is non-green or brown in colour.

(iii) The root is not differentiated into nodes and internodes.

(iv) As a rule the root does not bear leaves and true buds.

(v) Usually the root tip is protected by a root cap.

(vi) The root bears unicellular root hairs.

(vii) Lateral roots arise from the root which are endogenous in origin (arises from pericycle).

(2) **Parts of the root :** From the tip of the root upwards, the following parts can be traced in root.

(i) **Region of root cap :** The tip of the root is called calyptra or root cap. It is for protection of root tip against any injury. It is formed from meristem called calyptrogen. *Pandanus* is the only plant with multiple root caps. In the aquatic plants like *Pistia*, *Lemma* and *Eicchornia* instead of root caps, they have root pockets for buoyancy. The root caps are absent in parasites and mycorrhizal roots.

(ii) **Region of cell elongation :** The region of cell division lies partly within and partly beyond the root cap. This is the meristematic region of the root which produces new cells by cell division.

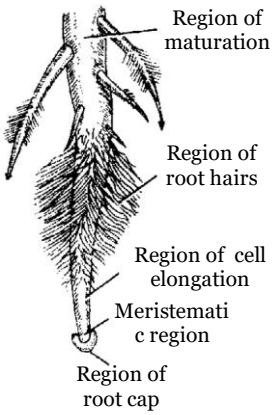


Fig : Regions of the

(iii) **Region of root hairs :** This region is present above the region of elongation. In this region the epidermal cells produce many tubular, unicellular outgrowths called root hairs. This is also called Piliferous region. Water absorption mostly takes place through this region. The root hairs are absent in many aquatic plants.

(iv) **Region of maturation :** Above the root hair zone, mature region is present. This region consists of permanent cells. Lateral roots are produced endogenously from the mature region. Conduction of water and mineral salts takes place through this region.

(3) **Types of root system :** The root system is generally of two types :

(i) **Tap root system**

(ii) **Adventitious root system**

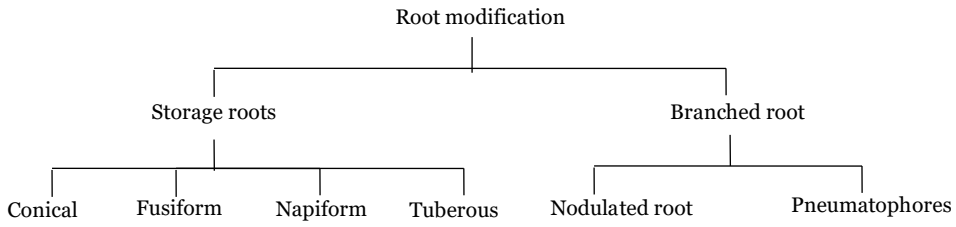
(i) **Tap root system :** The tap root system develops from radicle of the germinating seed. It is also called the normal root system. The radicle develops into a primary root which grows vertically downwards and become the tap root. The tap root is the true root that produces many lateral roots endogenously which grow obliquely. The tap root system is present in **dicotyledonous plants**.

(ii) **Adventitious root system :** The root system that develops from any part of the plant body other than the radicle is called the adventitious root system. It is mostly seen in monocotyledonous plants. In grasses, fibrous root system is present. It is a type of adventitious root system. In this case the primary root formed from the radicle disappear soon. Then many slender roots develop from the base of the stem as cluster of fibres, hence called the fibrous root system. Shrub like monocots needs additional support because of the adventitious root. *e.g.*, Stilt root in sugarcane.

1.2 Modification of roots

Sometimes the root performs other functions other than fixation, absorption and conduction so get modified structurally. Both tap roots and adventitious roots may undergo such modifications. There are many types of root modifications.

(1) **Modification of tap roots**



(i) **Storage roots :** In some plants, the primary tap roots are modified for storing reserve food materials. The secondary roots remain thin and they are absorptive in function. The storage roots are usually swollen and assume various forms :

(a) **Conical :** The swollen root is broad at the base and tapers gradually towards the apex giving a shape of **cone**, *e.g.*, *Carrot.*

(b) **Fusiform :** The root is swollen in the middle and narrow towards both its base and apex giving a shape of spindle, e.g., Radish (*Raphanus sativus*). Half or less than half portion towards the base of fusiform root is formed by hypocotyl.

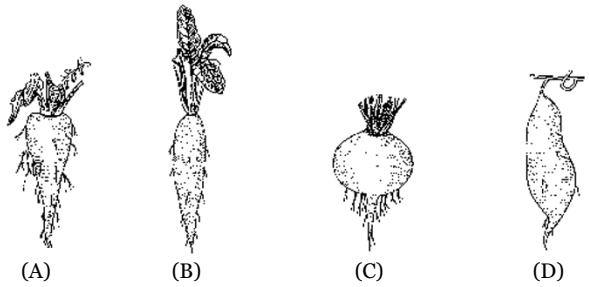


Fig : Modifications of tap root : (A) Conical root of carrot, (B) Fusiform root of radish, (C) Napiform root of turnip, (D) Tuberous root of tapioca

(c) **Napiform :** The root is nearly globular or spherical in shape. The basal portion of root is much swollen which suddenly tapers towards the apex giving a top-shaped appearance, e.g., Turnip (*Brassica napus*, vern, Shalgam) and Beet (Beta vulgaris, vern. **Chukandar**).

(d) **Tuberous :** The storage root having no definite shape is called tuberous, *.e.g.*, *Mirabilis jalapa* (4 O'clock plant), *Trichosanthes* (vern. Parwal), *Echinocystis lobata* (The tuberous root is lobed and weighs as much as 22 *kg*.).

(ii) **Branched roots :** They are following types :

(a) **Nodular roots :** The primary tap roots and its branches of leguminous plants, *i.e.*, plants belonging to sub-family papilionatae of the family leguminosae (e.g., Pea, Gram, Ground nut, Beans etc.), bear nodule like swellings, called root nodules.

They are red in colour due to the presence of **leg-haemoglobin**. The nodules are inhabited by nitrogen fixing bacteria called *Rhizobium leguminosarum*. It converts atmospheric nitrogen into nitrates and supply them to the plant. In turn *Rhizobium* gets nutrients and shelter from the plant. This type of

association between the bacterium and leguminous plant for mutual benefit is known as symbiosis and the organisms involved are called **symbionts**. This association is also called mutualism which is obligatory for both *i.e.*, for bacteria and leguminous root.

(b) **Pneumatophores or Respiratory roots :** Roots also breathe and as such they also require air for gaseous exchange. Normally, the soil has a large number of small air spaces between the soil particles. This air is utilized by the plants for their respiration. But the roots of some plants growing in saline marshes (mangrove plants) suffer from the lack of oxygen. This is due to the water logged condition of the soil. To cope with this situation some root branches grow vertically upwards. They become aerial and negatively geotrophic. These roots bear many minute pores called pneumathodes towards their upper ends. Gaseous exchange takes place through pneumathodes. Such aerial, porous negatively geotrophic roots which help in gaseous exchange are called breathing or respiratory roots, breathing roots or pneumatophores roots or pneumatophores *e.g.*, *Sonneratia, Heritiera, Rhizophora, Avicennia* and *Ceriops* etc. and are found in sundarbans of West Bengal.

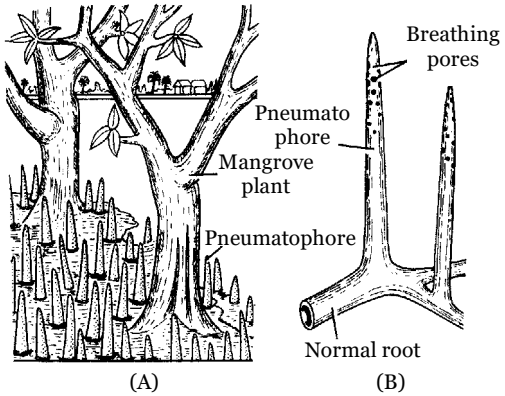


Fig : Pneumatophores :
(A) Plants showing pneumatophores
(B) Part of pneumatophores showing breathing pores

(2) **Modification of adventitious roots**

Root

For physiological or vital
- (a) Storage roots
  - (1) Tuberous roots
  - (2) Fasciculated roots
  - (3) Nodulose roots
  - (4) Moniliform roots
  - (5) Palmate roots
  - (6) Annulated roots
- (b) Epiphytic roots
- (c) Parasitic roots
- (d) Saprophytic roots
- (e) Photosynthetic roots
- (f) Reproductive roots

For mechanical functions
- (a) Stilt roots
- (b) Prop roots
- (c) Buttress roots
- (d) Climbing roots
- (e) Floating roots
- (f) Contractile roots
- (g) Root thorns

(i) **For physiological or Vital functions**

(a) **Storage roots :** The roots where adventitious roots become swollen to store food. They are following types :

❑ **Tuberous roots :** These adventitious roots are swollen without any definite shape e.g., *Ipomoea batata* or (sweet potato).

❑ **Fasciculated roots :** These are tuberous roots arising in cluster from the base of the stem. e.g., *Dahlia*, *Ruellia* (Menow weed), *Asparagus* (Asparagus fern) etc.

❑ **Nodulose roots :** These roots become swollen at their tips due to accumulation of food e.g., *Maranta* sp. (Arrowroot), *Curcuma amanda* (Mango – ginger).

❑ **Moniliform or Beaded roots :** These adventitious roots are swollen at frequent intervals. This gives the root a beaded appearance. e.g., *Portulaca* (Rose moss) *Momordica* (Bitter gourd) *Cyperus* (Guinea rush).

❑ **Palmate tuberous roots :** In *Orchis* there is a pair of succulent tuberous root, one of which perishes every year while another new one is formed by its side. Such orchid roots may sometimes be of palmate shape, therefore, called palmate roots.

❑ **Annulated roots :** The roots of a medicinal plant, Ipecac (*Cephaelis ipecacuanha*) yields emetine that looks like discs placed one above another, therefore, called annulated.

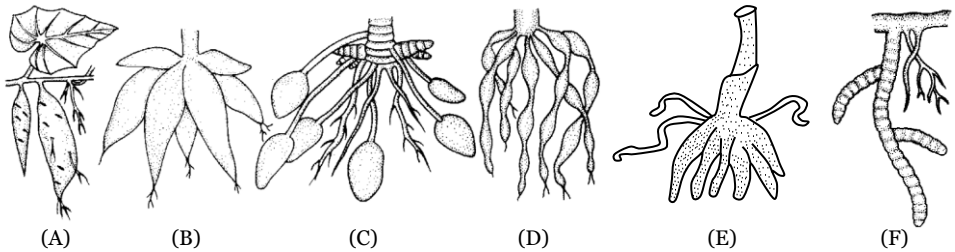


Fig : Modification of adventitious root (for food storage) : (A) Tuberous root of sweet potato (B) Fasciculated roots of dahila, (C) Moniliform root of Momordica, (D) Nodulose roots of mango ginger, (E) Palmate roots of Orchis, (F) Annulated roots of Ipecac

(b) **Epiphytic roots :** These roots are also called 'hygroscopic roots'. These roots develop in some orchids which grow as epiphytes upon the trunks or branches of trees. They hang freely in the air and absorb moisture with the help of special sponge like tissue called velamen. Velamen is modification of epidermis. e.g., *Venda, Dendrobium* etc.

(c) **Parasitic or Haustorial roots :** Plants which depend on plant partially or totally for their food material are known as parasites. The roots of parasitic plants, which penetrate into the host tissues to absorb nourishment, are called haustorial roots. The haustorial roots of *Cuscuta* (Dodder, vern. Amarbel) penetrates the host upto phloem and xylem to absorb organic food, water and minerals. The haustorial roots of partial parasite – *Viscum* (Mistletoe) penetrate upto xylem of host to absorb water and minerals.

Parasite which absorb their nutrients from the host stem are known as stem parasites while those which absorb their nutrients from the host root are know as root parasite.

(d) **Saprophytic roots :** They are also called mycorrhizal roots as here roots are associated with fungal hyphae either superficially (ectomycorrhizae) or internally (endomycorrhizae) for absorption of water and minerals. e.g., *Monotropa* and *Sarcodes.*

(e) **Photosynthetic or Assimilatory roots :** These are green, aerial, adventitious roots which prepare food materials by photosynthesis are called photosynthetic roots or assimilatory roots e.g., *Taeniophyllum, Trapa* and *Tinospora*. In some epiphytes like *Taeniophyllum,* the stem and leaves are absent. The entire plant is represented by thin green, ribbon like roots which contain velamen. These roots absorb moisture from the atmosphere and manufacture food materials by photosynthesis. Since

the roots are green and perform photosynthetic activity, these roots are called photosynthetic roots or assimilatory roots.

(f) **Reproductive roots :** Some fleshy adventitious root develop buds which can grow in to new plants. These are called reproductive root. These roots serve as means of vegetative propagation. *e.g.*, Sweet potato, *Dahlia* etc.

(ii) **For mechanical function**

(a) **Stilt roots :** The aerial, adventitious obliquely growing roots that develop from the lower nodes of the stem to give additional support are called stilt roots. This roots bear several large overlapping root caps called multiple root caps. *e.g.*, *Sugarcane, Pandanus, Rhizophora, Sorghum* and *Maize*. *Pandanus* (screw pine) is a common sea shore plant.

They also help in the absorption of water and minerals from the soil. In monocots, these roots arise in whorls from a few basal nodes of stem.

(b) **Prop roots :** These adventitious aerial roots arise from horizontal aerial branches of the trees like *Ficus bengalensis* (Banyan). Initially, they are hygroscopic in function, become red in moist condition and possess root-caps at their apieces. They grow vertically downward, penetrate the soil, become thick and assume the shapes of pillars. They provide support to the spreading branches of tree. Sometimes the main trunk dies and it is replaced by prop roots which assume the shapes of trunks.

In India, the biggest banyan tree having large number of prop roots are found at Indian Botanical Gardens, Kolkata and Kadiri (Andhra Pradesh).

(c) **Buttress roots :** The horizontal plank like aerial, adventitious roots that develop at the base of the stem to give additional support are called buttress roots or ballast roots, e.g., *Terminalia* and *Salmalia*. In some huge and heavy trees, plank like roots develop at the base of the stem on the soil surface. These roots give additional support and act like ballasts. Hence these roots are called ballast roots.

(d) **Climbing roots :** The aerial adventitious roots that arise from the nodes or internodes of weak stemmed plants to climb up their support are called climbing roots, e.g., *Pothos, Piper betel, Vanilla* and *Hedera*. Many weak stemmed plants climb up their supports in order to expose their leaves efficiently to sunlight. In *Pothos* and *Hedera*, climbing roots develop all over the stem. In *Vanilla*, single tendril like root arise at each node. Hence they are called tendrillar roots. In *Piper betel*, many short branched, adventitious roots arise at each node. These roots are called clinging roots.

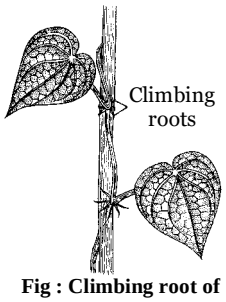


Fig : Climbing root of Piper betel

(e) **Floating roots :** These roots develop from the nodes of floating aquatic plants like *Jussiaea* (=Ludwigia). They store air, become inflated and spongy, project above the level of water, make the plant light and function as floats.

(f) **Contractile or Pull roots :** Some roots of plants with underground stems contract or swell so that the aerial shoots are kept in a proper depth in the soil. These roots are called contractile or pull roots, e.g., *Canna, Crocus, Allium, Lilium, Freesia,* etc.

(g) **Root thorns :** In aroids like *Pothos* and many palms (*Acanthorhiza* and *Iriartea*) the adventitious roots become hard and pointed hence called root thorns.

1.3 The stem

The stem develop from the plumule of the germinating seed. Normally it is the aerial part of the plant body. The stem with it's branches, leaves, buds, flower and appandages is known as shoot system.

The stem shows the differentiation of nodes and internodes. The place where the leaf develops on the stem is called the **node**. The portion of the stem between two successive nodes is called the **internode**.

(1) **Characteristics of stem**

(i) Stem is an ascending axis of the plant and develops from the plumule and epicotyl of the embryo.

(ii) It is generally erect and grows away from the soil towards light. Therefore, it is negatively geotropic and positively phototropic.

(iii) The growing apex of stem bears a terminal bud for growth in length.

(iv) In flowering plants, stem is differentiated into nodes and internodes. A node occurs where leaves are attached to the stem. Internode is the portion of stem between the two nodes.

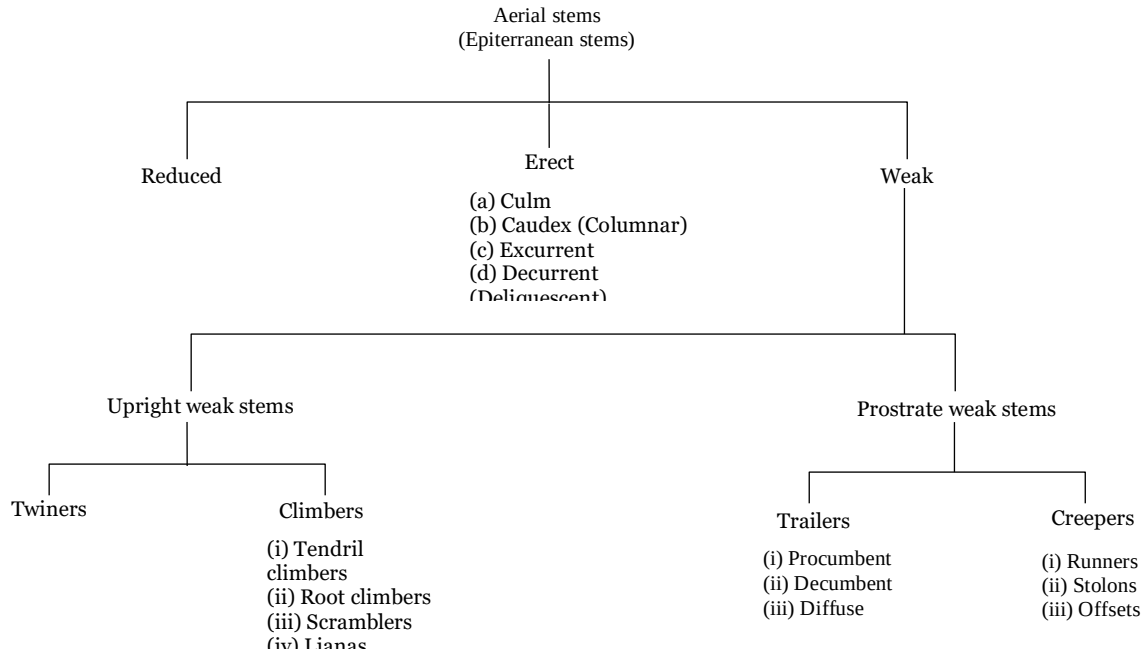
(v) The lateral organs of stem (*i.e.*, leaves and branches) are exogenous in origin (from cortical region).

(vi) The young stem is green and photosynthetic.

(vii) Hair, if present, are generally multicellular.

(viii) In mature plants, stem and its branches bear flowers and fruits.

(2) **Diverse forms of stem**



(i) **Reduced stems :** In some plants, the stem is in the form of a reduced small disc which is not differentiated into nodes and internodes. *e.g.*, (a) A reduced green-coloured disc-like stem lies just above the base of fleshy roots of Radish, Carrot and Turnip ; (b) Green-coloured small discoid stem occurs in free-floating *Lemna, Spirodela* and *Wolffia*; (c) Highly reduced non-green discoid stem occurs at the base of Onion and Garlic bulbs, etc.

(ii) **Erect stems :** Majority of angiosperms possess upright, growing-ascending, vertically-erect stems. They are fixed in the soil with the help of roots. Erect stems belong to four categories :

(a) **Clum :** Erect stems with solid nodes and hollow internodes. The nodes are swollen giving the stem a jointed appearance e.g., Bamboo (*Bambusa arundinacea*) and wheat (*Triticum vulgare*).

(b) **Caudex :** The main stem remains unbranched and bears a crown of leaves at its top. e.g., Coconut (*Cocos nucifera*), Palm, etc.

(c) **Excurrent :** The main stem is trunk like. It is thickest at the base and gradually tapers towards the apex. The branches arise in acropetal succession, i.e., oldest at the base and youngest at the apex. The tree appears cone-shaped. e.g., *Casuarina, Eucalyptus,* etc.

(d) **Decurrent or Deliquescent :** The apical bud of main stem is weak as compared to the buds of lateral branches. Thus, the lateral branches are prominent and spreading. The main stem grows upto a certain height after which it gives

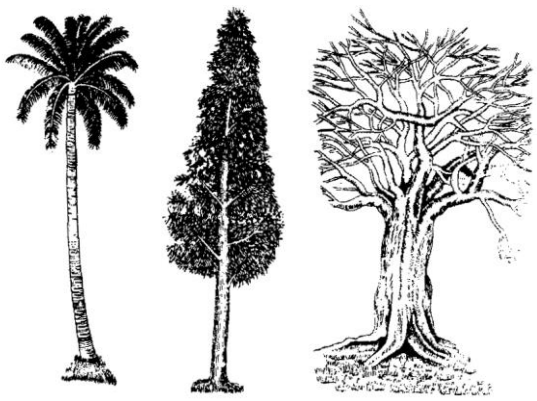


Fig : Forms of trees : (A) Caudex of a palm (B) Excurrent of *Polyalthia* (C) Deliquescent of *Ficus*

several branches. These branches dominate by giving the branches of several orders. The whole tree looks like dome-shaped. e.g., Banyan (*Ficus bengalensis*).

(iii) **Weak stems :** They are thin, soft and delicate which are unable to remains upright without any external support. They are of two types : upright weak stems and prostrate weak stems.

(a) **Upright weak stem**

- **Twiners :** The stems are long, slender, flexible and very sensitive. They twin or coil around an upright support on coming in its contact due to a special type of growth movement called nutation. They may coil the support to the right (anticlockwise from the top or sinistrorse) e.g., *Convolvulus* sp., *Ipomoea quamoclit Clitoria ternatea*, etc. or to the left (clockwise or dextrorse), e.g. Lablab.

- **Climbers :** The stem is weak and unable to coil around a support. They usually climb up the support with the help of some clasping or clinging structure. They are of four types :

(i) **Tendril climbers :** Tendrils are thread like structure which help in climbing the plants. They may be modified stem (e.g., *Vitis*), stem branches (e.g., *Passiflora*) and inflorescence (e.g., *Antigonon*).

(ii) **Root climbers :** Adventitious roots arise from the nodes and penetrate into the upright support so that the climber climbs up,e.g., Betel vine (*Piper betel*), *Tecoma*, *Ivy*, etc.

(iii) **Scramblers or Hook climbers :** These weak stemmed plants slowly grow over other bushes and rest there. They attain this position with the help of curved prickles (e.g., Rose), curved hooks on flowering peduncle (e.g., *Artabotrys*), prickles on stem (e.g., *Lantana*), spines (e.g., Climbing *Asparagus*) or spinous stipules (e.g., *Zizyphus*).

(iv) **Lianas :** These are woody perennial climbers found in deep forests. At first, they are just like ordinary twiners but once they reach to the top and get sunlight, become woody. e.g., *Tinospora, Ficus, Bauhinia, Bignonia*, etc.

(b) **Prostrate weak stem**

- **Trailers :** The stem creep on the ground but roots do not arise at the nodes.

They are of three types :

(i) **Procumbent :** The stem creeps on the ground totally e.g., *Tribulus, Bassela, Evolvulus.*

(ii) **Decumbent :** Branches, after growing horizontally for some length, grow vertically upwards, e.g., *Portulaca, Tridax, Lindenbergia*, etc.

(iii) **Diffuse :** Branches grow profusely in all directions, e.g., *Boerhaavia.*

- **Creepers :** These weak-stemmed plants grow prostrate and develop adventitious roots from their nodes. Creepers are of three kinds – runners, stolons and offsets.

(i) **Runners :** This prostrate aerial stem has a long internode and creeps horizontally. Axillary buds arise from nodes to form aerial shoots and roots. Several small (daughter) plants are thus linked by runner which may break off later. e.g., *Cynodon* (doob grass) and *Oxalis*.

(ii) **Stolons :** They are special kinds of runners which initially grow upwards like ordinary branches and then arch down to develop new daughter plants on coming in contact with the soil. e.g., Strawberry (*Fragaria vesica*), Peppermint (*Mentha piperita*), Jasminum (*Jasmine*).

(iii) **Offsets :** They are weak, elongated, horizontal branch of one internode that arises in the axil of a leaf. At the tip, it produces cluster of leaves above and tuft of roots below. The offset may break off from the parent plant and act as individual plants. They are found usually in aquatic plants and rarely is terrestrial plants. They are helpful for vegetative propagation. e.g., *Eichhornia* (water hyacinth), *Agave*, *Pistia*.

1.4 MODIFICATION OF STEM

(1) **Underground stem :** In many plants the stems remain underground. There are many advantages for the underground stems.

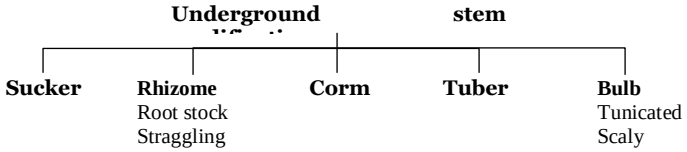
(i) They can store plenty of food material.

(ii) The underground stems are well protected from herbivorous animals.

(iii) They can live for longer time (perennation).

(iv) The underground stems can carryout vegetative propagation very easily.

The underground stems lack green colour because of their geophillous nature. They can be identified as stems because of the presence of nodes, internodes, scale leaves, buds and branches. Based on the type of growth (transverse/vertical/oblique) and the part that stores food (main stem/ branch/ leaf base), the underground stems are classified into several types :



(i) **Sucker :** This is a sub aerial branch that arises from the main stem. Initially it grows horizontally below the soil surface and later grows obliquely upward. They are shorter and stouter than the runners. e.g., *Mentha arvensis* (mint vern. Podina) and *Chrysanthemum*.

(ii) **Rhizome :** The rhizome is a thickened, underground dorsiventral stem that grows horizontally at particular depth within the soil. The rhizome is brown in colour and shows cymose branching. It can be distinguished from the modified root by the presence of nodes, internodes, terminal bud, axillary bud and scale leaves. The terminal bud develops aerial shoot that bears inflorescence. Adventitious roots develop on the ventral surface of the rhizome. The rhizomes are perennial and vegetatively propagating structures. It is of following types :

(a) **Rootstock :** They are upright or oblique with their tips reaching the soil surface. e.g., Alocasia indica and Banana.

(b) **Straggling :** They are horizontal in position and generally branched (Sympodial or Monopodial), e.g., *Nelumbo nucifera* (Lotus), *Zingiber officinale* (Ginger), *Curcuma domestica* (Turmeric), *Saccharum* etc.

(iii) **Corm :** The corm is an underground modification of main stem. It grows vertically at particularly depth in the soil. The corm stores food materials and becomes tuberous. It is non green in colour and conical, cylindrical or flattened in shape. The corm bears scale leaves at each node. In the axils of these scale leaves axillary buds arise which grow into daughter corms. The terminal bud of the corm is large. It grows into aerial shoot and bears leaves and flowers. Adventitious roots normally develop from the base or all over the body of the corm. With the help of some special adventitious roots called the contractile roots or pull roots, the corm remains constantly at a particular depth. The corm propagates vegetatively by daughter corms. e.g., *Amorphophallus*, *Colocasia* and *Crocus* (Saffron).

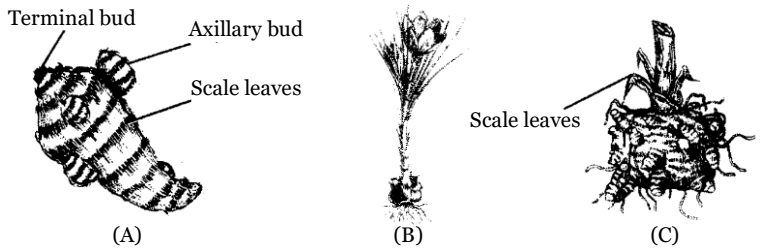


Fig : Corms : (A) *Colocasia*, (B) *Crocus* (saffron) (C) *Amorphophallus*

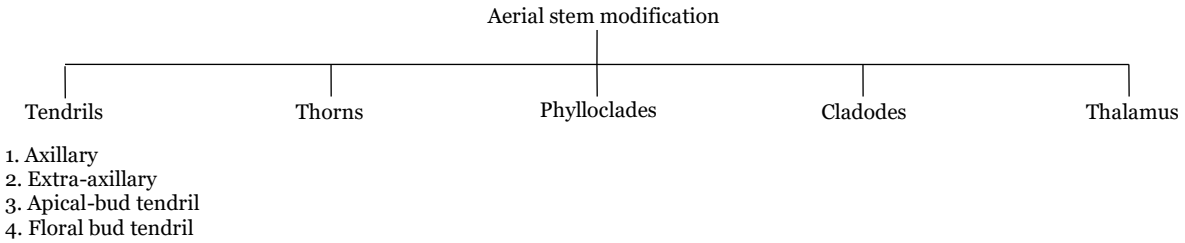
(iv) **Tuber :** Stem tuber is the tuberous tip of an underground branch. It occurs beneath the soil at any depth. The axillary branches (stolons) that are produced near the soil surface grow into the soil and their tip become swollen due to accumulation of starch and proteins e.g., *Solanum tuberosum* (potato). In potato, the stem nature is evident by the presence of 'eyes' on its brownish corky surface. Each eye is a pit like structure and represents the node. At the rim of the eye, scale leaf scar is seen. Axillary bud is situated in the pit of the eye. The stem tubers are differentiated from the tuberous roots by the presence of vegetatively propagating eyes.

(v) **Bulb :** A bulb is a specialized underground stem bears roots on it's lower side and rosette of fleshy leaf bases or fleshy scales on the upper side. In a bulb, the stem is reduced and becomes discoid. On the lower side of the disc adventitious roots develop in clusters. The upper side of the disc shows compactly arranged fleshy leaf bases or scale leaves so as to form an underground bulb. The leaf bases or scales become fleshy due to accumulation of food (carbohydrates) and water. The terminal bud grows into inflorescence or aerial shoot (scape), while some of the axillary buds develop into daughter bulbs. Bulbs are of two types, tunicated bulb and scaly bulb.

(a) **Tunicated bulb :** In tunicated bulb, the fleshy leaf bases are arranged in a concentric manner. The entire bulb is covered by peripheral dry membranous leaf bases called **tunics**, hence called the tunicated bulb. e.g., *Allium cepa* (Onion), *Narcissus* and *Tulip*. Compound tunicated bulbs as in *Allium sativum* (garlic).

(b) **Scaly or Imbricated bulb :** In scaly bulb, the fleshy scale leaves are arranged loosely overlapping one another. Such bulbs are not covered by any tunics, hence called naked bulbs or scaly bulbs. e.g., Lily.

(2) **Aerial stem :** The aerial stems are exposed to different environmental conditions. Hence they show many modifications. The vegetative and floral buds of many plants instead of growing into branches and flowers, undergo metamorphosis to form new structure.



(i) **Tendrils :** The tendrils are thin, wiry, leafless and spirally coiled branches. The terminal part of a tendril is sensitive. It holds the support by coiling round it. The tendrils help the weak stems to climb the support. In some weak stemmed plants, the axillary bud or terminal bud may modify to form tendrils which are specially called stem tendrils. Stem tendrils are following four types :

(a) Axillary : e.g., *Passiflora*.

(b) Extra-axillary : e.g., *Luffa* (vern. Ghiatori), *Cucurbita* (vern. Kaddoo), *Lagenaria* (vern. Lauki).

(c) Apical bud tendrils : e.g., Grape Vine (*Vitis vinifera*).

(d) Floral bud or Inflorescence tendrils : e.g., *Antigonon*.

(ii) **Stem thorns :** The axillary buds of some plants become arrested and get modified into stiff, sharp and pointed structures, called thorns. They are deep seated structures having vascular connections with stem. Besides reducing transpiration, they protect the plant from browsing animals. e.g., *Citrus, Duranta, Bougainvillea, Pomegranate, Flacourtia, Aegle marmelos* etc.

(iii) **Phylloclades (Cladophyll) :** The phylloclade is special modified photosynthetic stem present mostly in xerophytes. It is green, flattened or cylindrical structure which has distinct nodes and internodes. Xerophytes show many adaptations to check the rate of transpiration. Reduction of leaf size, early leaf fall, formation of scale leaves, spines, thorns, thick cuticle, presence of fewer stomata are some of the xerophytic characters. In such cases, the stems become flattened to carryout photosynthesis. These modified stems are called **phylloclades** or **cladophylls**. Usually the phylloclades retain water in the form of mucilage. e.g., *Opuntia, Casuarina, Cocoloba and Ruscus.*

In *Opuntia,* the leaves are modified into spines and the stems becomes fleshy leaf like phylloclade. In *Casuarina* the leaves are modified into scales. The phylloclade in *Ruscus* is leaf like and bear flowers. In *Cocoloba,* after the modification of leaves into scales the stem becomes ribbon like phylloclade with distinct nodes and internodes.

(iv) **Cladodes :** These are modifications of stem and branches of limited growth. It has one internode only. Each cladode is green, flat or cylindrical, leaf like structure which performs photosynthesis. In *Asparagus*, the leaves are reduced to curved spines. In *Ruscus aculeatus*, the leaf like cladode are borne in the axils of scale leaves.

(v) **Thalamus :** Thalamus of a flower is a modified stem apex. The other floral parts (sepals, petals, stamens and carpels) are born on the thalamus. It may be convex (*Ranunculus*), concave (*Lathyrus*) or flask shaped (Rosa).

1.5 Stem branching

In angiosperms, always the branches are produced by the growth axillary buds or lateral buds. This type of branching is known as lateral branching. The lateral branching is classified into two kinds racemose and cymose.

(1) **Racemose branching :** In this type of branching, the terminal (or apical) bud of the main stem grows indefinitely and the axillary buds grow out into lateral branches in acropetal succession.

This type branching is also called monopodial branching. Due to monopodial branching the shoot system of plant appears conical e.g., *Eucalyptus, Polyalthia* (Ashoka tree).

(2) **Cymose branching :** In cymose branching the terminal bud is active for a short period and becomes modified into some permanent structure like tendrils, thorns of flowers. Due to the terminal bud modification the growth of the main stem is definite. Further growth in the plant is carried by one or more axillary buds. Cymose branching may be of three types :

(i) **Uniparous or Monochasial type :** In uniparous type of branching only one lateral branch is produced at each time below the modified terminal bud. Here the successive lateral branches that are formed unite to form a stem. Such a stem is called false axis or **sympodium**. The uniparous branching is of two kinds, helicoid and scorpoid.

Fig : Types of uniparous branching
(A) Halicoid type branching in *Terminalia*
(B) Scorpioid type branching in *Carissa*

(a) **Helicoid branching :** If the successive lateral branches develop on one side it is called helicoid branching. e.g., *Saraca, Canna* and *Terminalia*.

(b) **Scorpioid branching :** If the successive lateral branches develop on either side alternately, it is called scorpioid branching, e.g., *Cissus, Gossypium* and *Carissa.*

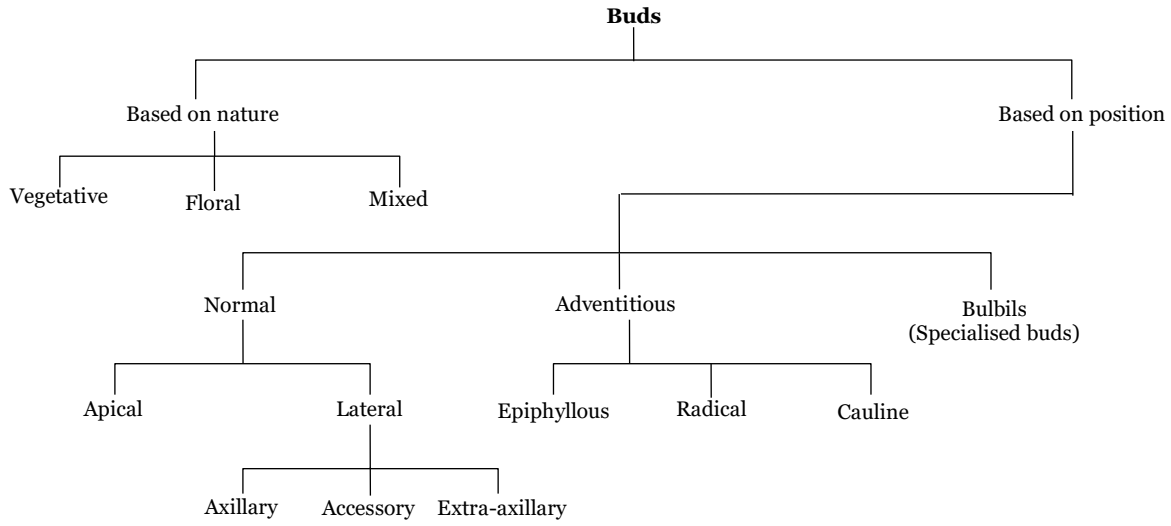
(ii) **Biparous or Dichasial type :** When the activity of terminal bud stops, further growth of plant takes place by two lateral branches, e.g., *Viscum* (Mistletoe), *Silene, Stellaria, Mirabilis jalapa* (Four O' clock), *Dianthus* (Pink), *Carissa carandas* (Karonda), etc.

(iii) **Multiparous or Polychasial type :** When the activity of terminal bud stops, further growth of plant takes place by a whorl of three or more axillary branches. The axis is said to be multipodial, e.g. *Euphorbia tirucalli, Croton, Nerium odoratum* (Oleander).

1.6 Buds

A bud is a compact underdeveloped young shoot consisting of a shoot apex, compressed axis and a number of closely overlapping primordial leaves arching over the growing apex. Sometimes a bud may occur as a mass of undifferentiated meristematic tissues not showing the leaf primordia. Buds which develop in to flower are called floral buds. In many plants buds take rest during unfavorable conditions. In mango, buds take residuring summer. So they are called summer resting buds. In *Cinnamomum*, buds take rest during winter. Such buds are described as winter resting buds. The largest vegetative bud in the plant kingdom is cabbage.

(1) **Types of buds :** The buds are classified into different kinds on the basis of their nature and position in the plants.



(i) **Nature of buds :** According to nature or structure of buds, they are following types :

(a) **Vegetative buds :** These buds grow to form only leafy shoots.

(b) **Floral buds :** These buds grow to form flowers.

(c) **Mixed buds :** They produce both vegetative and floral branches.

(ii) **Position of buds :** According to position of buds, they are following types :

(a) **Normal buds :** These buds are borne on stems either terminally or laterally. Since they are borne in normal positions, they are called normal buds :

- **Apical buds :** They are borne at the apex of the main stem or a branch. They are also called terminal buds. *Cabbage is a large apical bud.*
- **Lateral buds :** The buds, which are borne in any other place except at the apices of main stem and its branches, are called lateral buds. They are of three types :
- **Axillary buds :** They occur in the axils of leaves, e.g., Sun-flower, Rose etc.
- **Accessory buds :** Additional buds occurring in the axil of a single leaf either on the side or above the axillary bud e.g., *Cucurbita*, Brinjal, Chilly, *Bougainvillea*, etc.

❑ **Extra-axillary buds :** These buds develop on the node but outside the leaf base e.g., *Solanum nigrum*, etc.

(b) **Adventitious buds :** When a bud grows from a position other than normal, it is called adventitious bud. These may be of the following types :

❑ **Epiphyllous buds :** When the buds arise on the leaves they are called epiphyllous buds, e.g., *Bryophyllum.* These buds usually develop at the angles of the crenate margins and help in vegetative propagation.

❑ **Cauline buds :** These buds arise on the stem or branches generally at the cut end or pruned end, e.g., Rose and *Duranta*.

❑ **Radical buds :** When the buds arise on the roots, they are called radical buds, e.g., Sweet potato, Coffee, etc.

(c) **Bulbils or Specialised buds :** Modification of whole buds into swollen structures due to storage of food materials are called bulbils. When these bulbils detach from parent plant and fall on ground, they germinate into new plants and serve as means of vegetative propagation. e.g., In *Lilium bulbiferum* and *Dioscorea bulbifera,* the bulbils develop in axil of leaves; in *Agave*, floral buds of inflorescence transform into bulbils; In *Oxalis*, they develop just above the swollen roots.

1.7 THE LEAF

The leaf is a green, flat, thin, expanded lateral appendage of stem which is borne at a node and bears a bud in its axil. It is exogenous in origin and develops from the leaf primordium of shoot apex. The green colour of leaf is due to presence of the photosynthetic pigment – chlorophyll which helps plants to synthesize organic food. The green photosynthetic leaves of a plant are collectively called **foliage**. They are borne on stem in acropetal succession.

(1) **Characteristics of leaf**

(i) The leaf is a lateral dissimilar appendage of the stem.

(ii) A leaf is always borne at the node of stem.

(iii) Generally there is always an axillary bud in the axil of a leaf.

(iv) It is exogenous in origin and develops from the swollen leaf primordium of the growing apex.

(v) The growth of leaf is limited.

(vi) The leaves do not possess any apical bud or a regular growing point.

(vii) A leaf has three main parts – Leaf base, petiole and leaf lamina. In addition, it may possess two lateral outgrowths of the leaf base, called stipules.

(viii) The leaf lamina is traversed by prominent vascular strands, called veins.

(2) **Parts of a typical leaf :** The leaf consists of three parts namely, leaf base (usually provided with a pair of stipules), petiole and leaf blade or lamina.

(i) **Leaf base (Hypopodium) :** Leaf base is the lower most part of the leaf meant for attachment. It acts as a leaf cushion. In most of the plants it is indistinct. Some times leaf base shows different variations as follows :

(a) **Pulvinate leaf base :** In members of leguminosae the leaf is swollen. *Such* swollen leaf bases are called pulvinate leaf bases as seen in mango leaves. It helps in seismonastic movements (e.g., *Mimosa pudica*) and nyctinastic movements (e.g., *Enterobium, Arachis,* Bean).

(b) **Sheathing leaf base :** In grasses and many monocots, the leaf base is broad and surrounds the stem as an envelope, such a leafbase is called sheathing leaf base. e.g., *Sorghum*, Wheat and Palms. In grasses (*Sorghum*, Wheat etc.) the sheathing leaf base protects the intercalary meristem.

(c) **Modified leaf base :** The leaf bases in few plants perform accessory functions and show modifications. In *Allium cepa* (Onion), the leaf bases store food materials and become fleshy. They are arranged concentrically to form a tunicated bulb. In *Platanus* and *Robenia,* the leaf bases protect the axillary buds and grow around them to form cup like structures.

(d) **Stipule :** The stipules are the small lateral appendages present on either side of the leaf base. They protect the young leaf or leaf primordia. Leaves with stipules are called **stipulate** and those without them are called **exstipulate**. The stipules are commonly found in dicotyledons. In some grasses (Monocots) an additional outgrowth is present between leaf base and lamina. It is called **ligule**. The leaves having ligules are called ligulate. Sometimes, small stipule like outgrowths are found at the base of leaflets of a compound leaf. They are called stipules.

- **Types of stipules :** Depending upon the structure and position various kinds of stipules are recognized.
- **Free lateral stipules :** A pair of freely arranged stipules present on either side of the leaf base are called free lateral stipules, e.g., *Hibiscus* and Cotton.
- **Adnate stipules :** The two stipules that fuse with the leaf base or petiole on either side are called adnate stipules, e.g., *Arachis* and Rose.
- **Inter petiolar stipules :** Stipules present in between the petioles of opposite leaves, e.g., *Ixora* and *Hamelia*.
- **Axillary stipules :** Stipules present in the axil of a leaf are called axillary stipule. These are also called intrapetiolar stipule, e.g., *Tabernamontana* and *Gardenia*.
- **Ochraceous stipules :** Membranous tubular stipules that ensheath the axillary bud and a part of internode is called ochraceous stipule. It is formed by the union of two stipules, e.g., *Polygonum* and *Rumex.*
- **Hairy stipules :** These are hair like stipules which are dry in nature, e.g., *Anacampsora*.
- **Modification of stipule :** To carryout different functions, stipules of some plants undergo modifications. They are classified as follows :

❑ **Foliaceous :** Green, expanded, leaf like stipules are called foliaceous stipules. They carryout photosynthesis, hence called assimilatory stipules, e.g., *Pisum sativum* and *Lathyrus*.

❑ **Spinous :** In some plants the stipules are modified into hard, pointed defensive organs called spines, e.g., *Acacia arabica*, *Prosopis juliflora* and *Zizyphus*.

❑ **Convolute or Bud scales :** Scales which protect the buds are called bud scales. Sometimes they are the modified to stipules. The bud scales fall off as the buds open, e.g., *Artocarpus* and *Ficus*.

(ii) **Petiole (Mesopodium) :** A petiole or leaf stalk is a cylindrical or sub cylindrical structure of a leaf which joins the lamina to the base. It raises the lamina above the level of stem so as to provide it with sufficient light exposure. A leaf with a petiole is called **petiolate** and the one without it is called **sessile**.

(a) **Modification of petiole**

❑ **Winged petiole :** Green, flattened petioles may be called winged petioles, e.g., *Citrus* and *Dionaea*.

❑ **Tendrillar petiole :** In few plants the petioles are modified into tendrils and helps the plant in climbing. e.g., *Clematis* and *Tropaeolum.*

❑ **Leaf like petiole (Phyllode) :** A modified petiole which is flat, green and lamina like is called phyllode. It is a photosynthetic organ. e.g., *Acacia auriculae formis*.

❑ **Swollen or Spongy petiole :** Sometimes the petiole becomes swollen and spongy due to the development of aerenchyma. The type of petioles encloses much air and helps the plant to float. It is a hydrophytic adaptation e.g., *Trapa bispinosa* and *Eichhornia*.

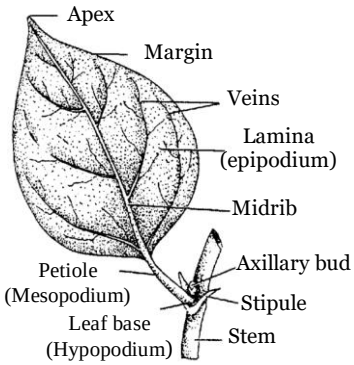


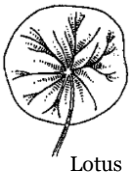
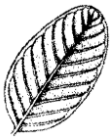
Fig : Part of a typical leaf

❑ **Spinous petiole :** In few plants, the leaf blades fall off and the petioles become hard and spinous e.g., *Quisqualis* (Rangoon creeper).

(iii) **Lamina (Epipodium) :** The green expanded portion of the leaf is called the lamina. It performs vital functions like photosynthesis and transpiration. The nature of lamina depends upon the species and age of the leaf. A leaf lamina shows variations in different aspects like shape, margin, apex, texture and venation.

(a) **Shape of lamina :** The shape of the lamina is the description of its form. It varies in different plants as follows.

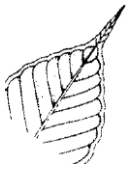
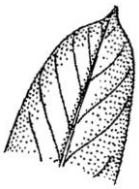
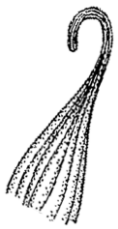
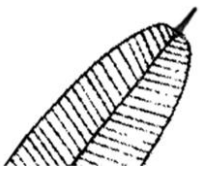
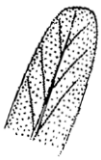
(1) **Acicular type** Needle shaped leaves.  Pinus	(2) **Linear type** Long and slightly broader le  Grass

(3) **Lanceolate type** Lance shaped leaves.  Nerium	(4) **Orbicular type** More or less circular leave  Lotus
(5) **Elliptical type** Leaves are like an ellipse.  Vinca	(6) **Ovate type** Egg shaped (oval) leaves.  Hibscus
(7) **Spathulate type** Spoon like leaves.  Euphorbia	(8) **Oblique type** Leaf lamina is with unequal l  Margosa
(9) **Oblong type** Rectangular leaves.  Banana	(10) **Reniform type** Kidney shaped leaves.  Hydrocotyle
(11) **Cordate type** Heart shaped (with a deep notch at the base) leaves.  Betel vine	(12)**Satate type** Leaves shaped like an arrow head.  Sagittaria
(13) **Hastate type** Leaves like saggitate but the two basal lobes are directed outwards.  Ipomoea	(14) **Lyrate type** Leaves shaped like a lyr  Mustard
(15) **Centric type** Hollow and cylindrical lea  Onion	(16) **Cuneate type** Wedge shaped leaves.  Pistia

(b) **Margin of lamina :** The margin of the lamina may be of different types as given.

Entire	**Serrate**	**Repand**	**Dentate**	**Crenate**	**Spiny**
Leaves with smooth margin.	Leaves have saw like margin.	Leaves have wavy margin.	Leaves have large pointed teeth like	Leaves have round teeth margin.	Leaves have spiny margin.
					
Mango	*Hibiscus*	*Polyalthia*	*Aloe*	*Bryophllum*	*Argemone*

(c) **Apex of lamina :** The apex of the leaf lamina shows variations in different plants.

(1) **Acute** The apex is narrow and pointed. e.g., Mango. 	(2) **Acuminate** The apex is draw out into a long tapering tail. e.g., *Ficus religiosa*. 
(3) **Obtuse** The apex is rounded. e.g., Banyan. 	(4) **Mucronate** Round apex wit sharp pointed tip. e.g., *Vinca*. 
(5) **Cuspidate** The apex is spinous. e.g., Date palm. 	(6) **Tendrillar** The apex form a tendril. e.g., *Gloriosa*. 
(7) **Cirrhose** The mucronate like apex ends with fine thread like structure. e.g., Banana. 	(8) **Truncate** The shape is abruptly cut across. e.g., *Paris polyphylla*. 

(9) **Retuse** The obtuse apex is slightly notched. e.g., *Pistia*. 	(10) **Emarginate** The obtuse apex is deeply notched. e.g., *Baukinia*. 

(d) **Surface of lamina :** The surface of the lamina may be of many kinds.

- **Glabrous :** Smooth and without hair. e.g,. *Mangifera indica*.
- **Glaucus :** Covered by waxy coating with white tinge. e.g., *Calotropis*.
- **Scabrous :** Rough surface. e.g., *Ficus*.
- **Viscose :** Sticky surface. e.g., *Cleome*.
- **Pubescent :** Covered with soft and wooly hair. e.g., *Tomato*.
- **Pilose :** Covered with long distinct scattered hair. e.g., *Grewia pilosa*.
- **Hispid :** Covered with long rigid hair. e.g., *Cucurbita.*
- **Spinose :** Covered with small spines. e.g., *Solanum xanthocarpum*.

(e) **Texture of lamina :** The texture of lamina also varies in different species.

- **Herbaceous :** When the lamina is thin and soft.
- **Coriaceous :** When the lamina is leathery.
- **Succulent :** When the lamina is thick, soft and juicy.
- **Hygrophytic :** When the lamina is very thin, membranous and spongy.

(3) **Types of leaves :** On the basis of shape of lamina, the leaves are classified into two types, namely, simple leaf and compound leaf.

(i) **Simple leaves :** The leaf having single undivided lamina is called the simple leaf. The simple leaf may be entire (e.g., Mango and *Hibiscus rosa sinensis*) or lobed. The lobes of a simple leaf may be entire pinnately arranged (e.g., *Brassica*) or palmately arranged (e.g., *Gossypium, Passiflora* and *Ricinus*).

(ii) **Compound leaves :** A compound leaf is one in which the lamina or the leaf blade is completely divided into many segments or units called leaflets or pinnae. When pinnae of leaflets attached in various ways to the portion of leaf axis known as the **rachis**. The compound leaves may be of two types, namely, pinnate compound leaves and palmately compound leaves.

(a) **Pinnate compound leaves :** It is the most familiar and widesperead type of compound leaf in which the rachis is elongated and bears two rows of simple or divided leaflets. The leaflets may be arranged alternately or in pairs along with the rachis. It is of following types :

- **Unipinnate compound leaf :** Here the primary rachis is unbranched and bear leaflets on either side. Unipinnate leaves are of two types :

- **Paripinnate :** The unipinnate leaf with even number of leaflets. They are borne in pairs. e.g., *Tamarindus indica* (Imli), *Cassia* etc.

- **Imparipinnate :** The unipinnate leaf with odd number of leaflets. The rachis is terminated by single unpaired leaflet. e.g., Neem, Rose, *Murraya.*

- **Bipinnate compound leaf :** In this type, the primary rachis is divided once and produce secondary and tertiary rachis. The leaflets develop on the secondary rachis. e.g., *Delonix* and *Acacia*, *Mimosa pudica*, *Albizzia*.

- **Tripinnate compound leaf :** In this type the primary rachis divides twice and produces secondary and tertiary rachii. The leaflets develops on the tertiary rachii. e.g., *Moringa* (Soanjana) and *Millingonia*.

- **Decompound leaf :** Here the primary rachis divides many times without any definite order. The lamina is dissected into many units. e.g., *Coriandrum*.

(b) **Palmate compound leaf :** In a palmately compound leaf, the leaflets are arranged at the tip of the petiole. According to the number of leaflets present at the tip of the petiole. These leaves are following types :

- **Unifoliate :** In this case, a palmately compound leaf is reduced to a single terminal leaflet. The single leaflet is articulated to the top of petiole, e.g., *Citrus* (Khatta), Lemon, etc.

- **Bifoliate :** This type of leaf has only two leaflets attached side by side at the terminal end of petiole, e.g., *Balanites roxburghii, Hardwickia binata,* etc.

- **Trifoliate :** This type of leaf has three terminal leaflets, *Aegle marmelos* (Wood apple, vern. Bael), *Oxalis corniculata, Trifollium* (Clover), etc. These leaves differ from trifoliate imparipinnate (e.g., Lablab) in having all the three leaflets attached at the tip of petiole.

- **Quadrifoliate :** This leaf has four leaflets attached to the tip of petiole. e.g., *Paris quadrifolia, Marsilea.*

- **Multifoliate :** A palmately compound leaf having five or more terminal leaflets, arranged as fingers of the palm, e.g., *Bombax malabarica, Cleome viscosa, Gynandropsis pentaphylla*, etc.

(4) **Phyllotaxy (Phyllotaxis) :** The leaves may be stem borne (cauline), branch borne (ramal) or may appear to be root borne (radical). The arrangement of leaves on the stem is called phyllotaxy (Gk. *Phyllon* = leaf; *taxis* = arrangement). It is of three types :

(i) **Alternate or Spiral :** When only one leaf is found at each node. The leaves present at successive nodes alternate with each other. The arrangement is said to be alternate or spiral. The leaves are commonly arranged spirally around the stem. Each spiral is called the genetic spiral. The angular divergence (angular distance) between any two concecutive leaves is always constant. In spiral phyllotaxy, the leaves are arranged on the stem in regular vertical row. Such rows are called orthostichies. In practice the angular divergence is determined in the following manner :

$$\text{Angular divergence} = \frac{\text{No. of circles}}{\text{Orthostichies}} \text{ of a circle i.e. } 360°$$

A phyllotaxy is written by taking the number of spirals (circles) as numerator and the number of leaves as denominator. Based on the number of orthostichies seen on the stem, the spiral phyllotaxy may be described as given under.

(a) **Distichous or 1/2 Phyllotaxy :** Where the angular divergence is 1/2 of 360° i.e., 180°. e.g., *Ravenella*.

(b) **Tristichous or 1/3 Phyllotaxy :** Where the angular divergence is 1/3 of 360° i.e., 120°. e.g., Moss, *Cyperus rotundus*.

(c) **Pentastichous or 2/5 Phyllotaxy :** Where the angular divergence is 2/5 of 360° i.e., 140°. e.g., China rose.

(d) **Octastichous or 3/8 Phyllotaxy :** Where the angular divergence is 3/8 of 360° i.e., 135°. e.g., *Carica papaya.*

In these types, if one adds up two preceeding numerators and denominators, a series is formed called **Schimper-Brown Series**.

e.g., $\frac{1}{2}, \frac{1}{3}, \frac{1+1}{2+3} = \frac{2}{5}, \frac{1+2}{3+5} = \frac{3}{8}, \frac{2+3}{5+8} = \frac{5}{13},$ and so on.

(ii) **Opposite :** When two leaves are present at node opposite to each other the type of phyllotaxy is called opposite. It is of two type :

(a) **Opposite superposed :** All the pair of leaves of a branch arise in the same plane so that only two vertical rows of leaves are formed. e.g., Jamun, Guava, etc.

(b) **Opposite decussate :** A pair of leaves at one node stands at right angle to the next upper or lower pair so that four vertical rows are formed on the stem. e.g., *Calotropis*, *Zinnia*, Tulsi, *Quisqualis*.

(iii) **Whorled :** If more than two leaves are present at a node as whorl, it is called whorled phyllotaxy. It is also called cyclic or verticellate phyllotaxy. e.g., *Nerium*, *Hydrilla* and *Alstoni scholaris*.

(iv) **Leaf mosaic :** This is a special type of arrangement of leaves. Older leaves present at the lower nodes of the stem possess longer petioles with bigger lamina and the young leaves of upper nodes bear shorter petioles with smaller lamina. The smaller young leaves occupy the space present between the bigger ones. e.g., *Begonia, Acalypha* and *Sycamore.*

(5) **Vernation :** Arrangement of leaves in bud condition is known as vernation imbricate (irregular overlapping), contorted (twisted, regular overlapping of margins), induplicate (margin bent inwardly), equitant (conduplicate in two series, one overlapping the other completely), half equitant, supervolute (convolute leaves, one rolled over other).

(6) **Heterophylly :** It is the occurrence of more than one type of leaves on the same plant. Heterophylly is of four types :

(i) **Adaptive heterophylly :** Submerged leaves are different from floating and emerged leaves of the same plant due to different adaptations. e.g., *Limnophila heterophylla*, *Sagittaria*, *Ranunculus*

aquatilis. The emerged leaves are broad and fully expanded while the submerged leaves are narrow, ribbon shaped, linear or highly dissected.

(ii) **Environmental heterophylly :** The heterophylly is due to change in environment including soil, temperature, humidity and air currents.

(iii) **Developmental heterophylly :** Young leaves are different from mature leaves, *e.g.*, *Eucalyptus.*

(iv) **Habitual heterophylly :** Leaves of different shape and incisions occur at the same time, e.g., Jack fruit tree (*Artocarpus heterophyllus*), *Ficus heterophylla*, *Hemiphragma heterophyllum*, *Broussonetia papyrifera*. In *Hemiphragma*, the main stem bears ovate and entire leaves while branches possess acicular leaves.

(7) **Modification of leaves :** Some important leaf modification are as follows :

(i) **Leaf tendrils :** In many weak stemmed plants, the leaves are modified into slender wiry and coiled structures called leaf tendrils. The tendril may be formed by entire leaf or a part of the leaf.

- Entire leaf modified into tendril, e.g., *Lathyrus aphaca* (Wild pea).
- Terminal leaflets modified into tendril, e.g., *Pisum sativum* (Pea), *Lathyrus odoratus* (Sweet pea), *Narvella*.
- Leaf tip modified into tendril, e.g., *Gloriosa.*
- Petiole modified in to tendril, e.g., *Clematis*.
- Stipule modified into tendril, e.g., *Smilax*.
- Midrib modified into tendril, e.g., *Nepenthes.*

(ii) **Spines :** A pointed structure formed by the modification of entire leaf or part of a leaf is called a spine. Different part of a leaf or entire leaf may be modified in to spines. e.g., In *Opuntia* leaves of axillary branches are modified into spines. In *Berberis* entire leaf modified into three spines. In *Phoenix* leaf tip modified into spine. In *Citrus* first leaf of axillary branch modified in to spine. In *Argimone* leaf margin modified into spines. *In Perkinsonia, Acacia* and *Zizyphus* stipules modified into spines.

(iii) **Scale leaves :** In many xerophytes, the foliage leaves are reduced to scale leaves. They are thin, membranous, dry, small, sessile, colourless structure. e.g., *Casuarina, Orobanche* and *Balanophora*.

(iv) **Phyllode :** It is a green, expanded structure formed by the modification of petiole or rachis of leaf. Many xerophytes reduce the size of their leaves to minimize water loss. Such plant develop phyllodes to carry out photosynthesis e.g., *Acacia, Melanoxylon* and *Parkinsonia*.

(v) **Storage leaves :** Leaves become fleshy due to storage of water or food materials. Such leaves are called storage leaves. They are usually found in succulent plants. In plants like *Aloe, Kalanchoe* and *Peperomia.*

(vi) **Reproductive leaves :** In some plants the vegetative propagation is carried out by the production of epiphyllous buds on leaves. Such leaves are called reproductive leaves. The epiphyllous buds when come in contact with soil develop into new plants.

(vii) **Absorbing leaves :** In some rootless, aquatic plants, the submerged leaves are modified into root like structure to absorb water and mineral salts. Such modified leaves are called absorbing leaves. e.g., *Utricularia*.

(viii) **Floral leaves :** Floral parts such as sepals, petals, stamens and carpels are modified leaves. Sepals and petals are leafly stamens are considered pollen bearing microsporophylls and carpels are ovule bearing megasporophylls.

(ix) **Cotyledons :** The mature embryo shows either one (monocotyledons) or two cotyledons, (dicotyledons). *Cuscuta* a parasite is included in dicotyledon. However it has no cotyledon and many cotyledons, as in gymnosperms. These cotyledons are considered as embryonic leaves which are the first leaves of a shoot system.

(x) **Trap leaves :** The trap leaves are also called insectivorous leaves or carnivorous leaves. Plants having trap leaves usually grow in nitrogen-deficient soils (boggy soils). They have poorly developed root system. These plants get their nitrogenous requirement by capturing the insects. To attract, capture, kill and digest the insects, the leaves are modified into trap leaves.

1.8 VENATION

The arrangement of veins in the lamina of a leaf is called **venation**. The veins are the hard structures consisting of **xylem** and **pholem**. The veins give mechanical strength and shape to the lamina. Also they are responsible for conduction of water, minerals and organic food materials. Angiosperms exhibit two types of venation.

(1) **Reticulate venation :** In this type, the lateral veins divide and redivide to form many veinlets. These veinlets are arranged in a net like fashion or reticulum. Reticulate venation is the characteristic feature of dicotyledons. But exceptionally some monocotyledons also show reticulate venation. e.g., *Smilax*, *Alocasia* and *Dioscorea.* Reticulate venation is of two types :

(i) **Unicostate or Pinnate venation :** This type of venation is characterized by the presence of a single strong midrib that extends upto the apex of lamina. The midrib produce lateral veins on either side which divide repeatedly. The ultimate branches unite to form a network. This type of venation is also called unicostate reticulate venation, because of the presence of a single prominent midrib. e.g., *Ficus* and *Mangifera*.

(ii) **Multicostate or Palmate venation :** Here more than one prominent veins start from the base of the lamina and proceed upwards. The lateral veinlets, arising from main veins, form network. Multicostate venation is of two types :

(a) **Convergent :** When the prominent veins converge towards the apex of lamina. e.g., *Zizyphus* and *Cinnamonum*.

(b) **Divergent :** When the prominent veins spread out towards the margins. e.g., Papaya, *Ricinus, Cucurbita* etc.

(2) **Parallel or Striate venation :** In this type, veins and veinlets run parallel to each other. They do not form any network or reticulum. Parallel venation is the characteristic feature of monocotyledons. Exceptionally few dicots show parallel venation, e.g., *Calophyllum* and *Eryngium*. It is of two types :

(i) **Unicostate or Pinnate venation :** The leaf lamina possesses single prominent vein which gives rise to a large number of lateral veins. All the lateral veins run parallel towards margin. e.g., Banana, Canna, *Curcuma* etc.

(ii) **Multicostate or Palmate venation :** The leaf lamina possesses several prominent veins which run parallel to each other. It is of two types :

(a) **Convergent :** The prominent veins run parallel to each other and converge at the apex. e.g., Sugarcane, Maize, Wheat, Bambooes and Grasses.

(b) **Divergent :** All the prominent veins of leaf lamina spread out towards the margin. e.g., Fan palm.

1.9 Flower

It can be defined as modified dwarf shoot which is meant for sexual reproduction. It is characteristics feature of angiosperm whease reproductive organs have been aggregated as flowers.

(1) **Parts of a typical flower :** It comprises a stalk called **pedicel** which arises in the axis of leaves called **bracts**. Upon the pedicel there may be one to many small scaly structures called **bracteoles**. The terminal part of the pedicel is the thalamus or torus. It is a modified and condensed axis of the flower. Modified leaves called floral leaves or floral parts arises from the nodes of the thalamus as successive whorls. A typical flower of an angiosperm consists of four types of floral parts namely calyx, corolla, androecium and gynoecium.

(i) **Calyx :** It is the outermost whorl composed of **sepals**.

(ii) **Corolla :** It is composed of **petals** and is the second whorl.

(iii) **Androecium :** It is the third whorl composed of **stamens**.

(iv) **Gyneocium :** It is the innermost whorl and is also called **pistil**. It shows carpels.

(2) **General description of a flower :** The flowers are termed pedicellate if they possess stalks and sessile if they lack them. The flower may be described as complete if it bears all the floral parts and incomplete, when one or more floral parts are absent. Flowers are called bisexual if they bear both androecium and gynoecium. The unisexual flowers have either androecium or gynoecium. The unisexual flowers may be male flowers or female flowers. The male flower are also called staminate flowers as they have stamens only. The female flowers have only the carpels and hence called pistillate flowers. Flowers with sterile sex organs are described as neutral flowers. According to the distribution of male, female and bisexual flowers, various pattern are recognized.

(i) **Monoecious :** Presence of male and female flowers on the same plant, e.g., *Acalypha*, *Cocos* and *Ricinus.*

(ii) **Dioecious :** Presence of male and female flowers on different plants, namely, male plants and female plants. e.g., *Cycas, Carica papaya* and *Vallisneria*.

(iii) **Polygamous :** Presence of unisexual and bisexual flowers on the same plant, e.g., *Mangifera* and *Polygonum*.

(3) **Symmetry of flower :** The number, shape, size and arrangement of floral organs in a flower determines its symmetry. On the basis of symmetry flowers can be of the following types :

(i) **Actinomorphic (Regular = Symmetrical) :** Actinomorphic flowers can be divided (passing through center) by any vertical plane in to two equal and similar halves. e.g., Mustard, Brinjal, *Catharanthus roseus.*

(ii) **Zygomorphic (Monosymmetrical) :** Zygomorphic flowers can be divide into two equal halves by only one verticle division e.g., Pea, Larkspur, *Ocimum*.

(iii) **Asymmetrical (Irregular) :** Asymmetrical flowers can not be divided into two equal halves by any vertical division. e.g., *Canna, Orchids.*

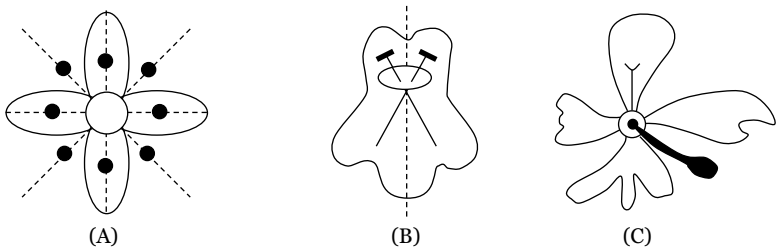


Fig : Symmetry of flowers
(A) Actinomorphic, (B) Zygomorphic, (C) Asymmetrical

(4) **Arrangement of floral organs :** On the basis of arrangement of floral organs, three types of flowers are recognized. They are :

(i) **Acyclic :** Here the thalamus is conical or convex and the floral parts are spirally arranged, e.g., water lily and *Magnolia*.

(ii) **Cyclic :** Here the floral organs are arranged in regular whorls at the nodes of the thalamus, e.g., *Hibiscus* and *Datura*.

(iii) **Hemicyclic (Spirocyclic) :** Here some floral parts (sepals and petals) are arranged in regular whorls and the remaining parts (stamens and carpels) are arranged spirally. e.g., *Annona* and *Polyalthia*.

Number of floral parts in whorl is called the **merosity**. There are two kinds of flowers based on the merosity of the flower. They are **isomerous flowers** and **anisomerous flowers**.

- If the number of sepals, petals, stamens and carpels of flower is equal, such flowers are called isomerous flowers.

Dimerous : Two floral parts in each whorl.

Trimerous : Three floral parts in each whorl.

Tetramerous : Four floral parts in each whorl.

Pentamerous : Five floral parts in each whorl.

❑ A flower with different number of floral parts in each whorl is called anisomerous flower. The sepals, petals, stamens and carpels present at different whorls of a flower vary in their numbers. These are also called heteromerous flowers.

(5) **Detailed structure of flower :** Angiospermic flowers exhibit many variations in their external morphological characters. Detailed description of a flower helps in its proper identification.

(i) **Bract :** Bract (hypsophyll) is a small leaf like structure on the peduncle which produces a flower in its axil. The floral buds are usually protected by the bracts. Flower with a bract is described as **bracteate** and the flower without a bract is known as **ebracteate**. Bracteoles are small scale like structures present on the pedicel. Bracts are modified into following structures :

(a) **Foliaceous bract :** Leaf like, expanded green bract is called the foliaceous bract, e.g., *Pisum*, *Lathyrus*, *Adathoda* and *Gynandropsis.*

(b) **Spathe :** A large modified bract which encloses spadix inflorescence totally or partially. It may be leathery or woody, e.g., *Alocasia, Cocoa*, *Musa* and *Typhonium*.

(c) **Petaloid bract :** Brightly coloured petal like bract is known as petaloid bract, e.g., *Bougainvillea*, *Poinsettia* and *Euphorbia*.

(d) **Involucre :** One or two whorls of green bracts that protect young inflorescence is called involucre, e.g., *Coriandrum, Tagetes* and *Heracleum.*

(e) **Epicalyx :** Whorl of bracteoles present below the calyx or outside the calyx, e.g., *Hibiscus rosa sinensis* and *Malvaviscus arborcus.*

(f) **Scaly bracts :** Reduced, membranous, scale like bracts seen in head inflorescence, e.g., florets in *Tridax* and *Helianthus*.

(g) **Glumes :** The bracts found on the rachilla of spikelet are called **glumes**. They may be sterile glumes or fertile glumes (lemma), e.g., *Oryza sativa*.

(ii) **Thalamus :** The terminal part of the pedicel is called thalamus or torus or receptacle. It is a condensed axis of the flower from which all floral parts arise. Depending upon the position of gynoecium on the thalamus with respect to other parts, flowers are of three kinds – hypogynous, perigynous and epigynous (See details in **Embryology Module-II**).

In many flowers, the thalamus is condensed and the internodes are not seen clearly. But there are some flowers with elongated, distinct floral internodes as mentioned below :

(a) **Anthophore :** This is the first elongated internode between the calyx and corolla, e.g., *Silene, Pennsylvania* and *Lychnis*.

(b) **Androphore :** It is the second elongated internode between corolla and androecium, e.g., *Gynandropsis*.

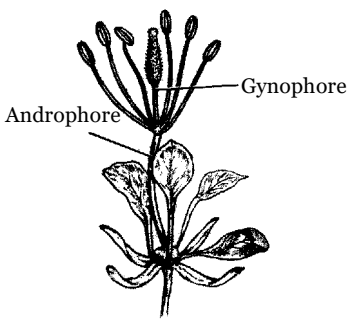


Fig : Androphore and gynophore of *Gynandropsis*

(c) **Gynophore :** It is the third elongated internode between androecium and gynoecium e.g., *Capparis* and *Gynandropsis*.

(d) **Gynandrophore :** It is an elongated stalk like part between non essential and essential organs of the flower. It is equivalent to androphore, e.g., *Passiflora*.

(e) **Carpophore :** This is a stalk like connection present between two carpels. It is formed due to expansion of the thalamus between the carpels, e.g., *Coriandrum* and *Foeniculum*.

(iii) **Perianth :** The non essential organs, calyx and corolla are together called perianth. The perianth protects the stamens and carpels. In angiospermic flowers, the perianth exists in different forms.

(a) **Achlamydeous :** Perianth is absent and the flowers appear naked. Mostly the achlamydeous flowers occur in cyathium inflorescence. e.g., *Euphorbia, Poinsettia.*

(b) **Chlamydeous :** Perianth is present and the flowers usually appear attractive. The chlamydeous flowers are of two types. They are :

- Monochlamydeous flowers are with perianth in one whorl, e.g., *Amaranthus* and *Ricinus*.
- Dichlamydeous flowers are with perianth differentiated into calyx and corolla. They are arranged in two different whorls. The dichlamydeous condition is of two types :
- **Homochlamydeous :** The two whorl or the perianth (calyx and corolla) are similar in all respects and are not identified by different colours, e.g., *Michelia*.
- **Heterochlamyoeous :** The two whorls of the perianth are dissimilar in many respects. The outer whorl consists of small, green sepals and the inner whorl with large variously coloured petals, e.g., *Datura* and *Hibisus*. The term "tepals" is used to describe the perianth lobes which appear like petals, e.g., most of the monocots.

(iv) **Calyx :** It is the outermost whorl of the flower. It consist of sepals. Usually, the sepals are small and green. They protect other floral organs when the flower is in bud condition. The calyx is described as polysepalous when the sepals are free (e.g., *Anona*, Tomato) and gamosepalous when the sepals are united (e.g., *Datura* and *Hibiscus*). If sepals are fused less than half of the length of calyx tube it is called as **partite** and if the fusion of sepals is very little, just at the base of calyx tube, it is said to be **connate**. The sepals may be deciduous or persistent. Usually the persistent calyx do not show any growth after fertilization. Such a calyx is termed as **marcescent** (e.g., *Brinjal*, Chillis). Sometimes the persistent calyx shows continuous growth even after, fertilization. This type of calyx called **acrescent** (e.g., *Physalis* and *Shorea*).

In some plants a whorl of green sepals like structure is present at the base of calyx called **epicalyx**. Epicalyx is considered a whorl of the bracteoles and mostly found in the flowers of family *Malvaceae* (*Althaea*, Cotton). The calyx may show number of modifications. They are :

(a) **Campanulate :** Bell shaped, e.g., *Althaea.*

(b) **Cupulate :** Cup like, e.g., *Gossypium.*

(c) **Urceolate :** Urn shaped, e.g., *Hyoscyamus.*

(d) **Infundibuliform :** *Funnel shaped, e.g., Atropa belladona.*

(e) **Tubular :** Calyx tube like, *e.g., Datura.*

(f) **Bilabiate :** Calyx forms two lips, *e.g., Ocimum.*

(g) **Spurred :** One or two sepals forming a beak like structure, *e.g., Larkspur*.

(h) **Pappus :** Calyx are modified into hairs *e.g., Sonchus, Tridax* (Asteraceae).

(i) **Spinous :** When calyx forms spines, e.g., *Trapa.*

(j) **Hooded :** When sepals enlarged to form a hood over the flower, e.g., *Aconitum*.

(k) **Petaloid :** Enlarged and brightly coloured sepals, e.g., *Clerodendron, Mussaenda, Sterculia, Caesalpinia* and *Saraca*.

(v) **Corolla :** It is the second whorl of the flower consisting of petals. Usually the petals are brightly coloured and scented. They attract the insects which act as agents for pollination. The corolla may be **polypetalous** (with free petals), **gamopetalous** (with united petals) or **apetalous** (without petals). The corolla may undergo modifications or possess some special appendages.

- **Sepaloid :** Green or dull coloured sepal. e.g., *Anona, Polyalthia* and *Artabotrys.*
- **Saccate :** The corolla tube may form a pouch on one side. e.g., *Antirrhinum.*
- **Spurred :** Sometimes one or two petals or the entire corolla tube grow downwards forming a spur that usually stores nectar. *e.g., Aquilegia vulgaris.*
- **Corona :** Special appendages of different kinds like scales, hairs develop from the corolla. Such appendages are called corona. e.g., *Passiflora, Oleander* and *Nerium.*

Forms of corolla : Both polypetalous and gamopetalous corolla exhibit great variation in their forms. It is following types :

(a) **Polypetalous corolla :** They are of following types :

- **Cruciform :** Four free clawed petals arranged in the form of a cross, e.g., Mustard and Radish.
- **Rosaceous :** Five free sessile petals withlobes spreading outwards, e.g., Rose, *Hibiscus*.
- **Caryophyllaceous :** Five free clawed petals with limbs at right angles to the claw, e.g., *Dianthus*.
- **Papillionaceous :** Five free unequal petal arranged in definite fashion. The posterior petal is largest and is called standard vexillum. On either side of the standard, two lateral petals unite called wings are present. The remaining two anterior petals to form a boat shaped structure called the **keel**. e.g., plants of papillionaceae.

(b) **Gamopetalous corolla :** They are of following types :

- **Tubular :** Five united petals form a cylindrical tubular structure, e.g., disc florets of Asteraceae.
- **Infundibuliform :** It is a funnel shaped corolla, e.g., *Datura*.
- **Companulate :** It is bell shaped corolla, e.g., *Thevetia*.

- **Rotate :** Short tubular corolla with spread out lobes appearing like a wheel e.g., Brinjal.
- **Hypocrateriform :** It is a salver shaped corolla. It is provided with a elongated narrow tube having lobes at the top placed at right angles, e.g., *Vinca*.
- **Ligulate :** Corolla with a short tube which is drawn out into a tongue shaped structure e.g., ray florets of Asteraceae.
- **Bilabiate :** The irregular corolla is united, in such a way that it appears two lipped. It is the characteristic corolla of labiatae, e.g., *Leucas*.

(vi) **Aestivation :** The arrangement of sepals and petals in bud condition of the flower is called "aestivation". It is may be of following types :

(a) **Open :** If the margins of perianth members in a whorl are free with wide gap between them, then the type of aestivation is called 'open', e.g., sepals of Mustard.

(b) **Valvate :** Here the edges of perianth members in a whorl are very nearly touching each other bud do not overlap, e.g., calyx and corolla in *Annona*.

(c) **Twisted :** In this type, the perianth members of a whorl show one edge outside and one edge inside. Thus they regularly overlap the neighbouring members on one side. The twisted aestivation is also called contorted or convolute aestivation, e.g., corolla of *Hibiscus*.

(d) **Imbricate :** Here in a whorl of perianth members, one is completely inside and another is completely outside. The remaining perianth members show one edge inside and the other edge outside. The imbricate aestivation is of two types, namely, descending imbricate and ascending imbricate.

- **Descending imbricate :** Here the odd petal is posterior and completely outside. The anterior pair of petals are completely inside. The remaining petals show regular overlapping in the descending manner. It is also called **vexillary aestivation**, e.g., *Tephrosia*, *Crotalaria* and *Dolichos*.

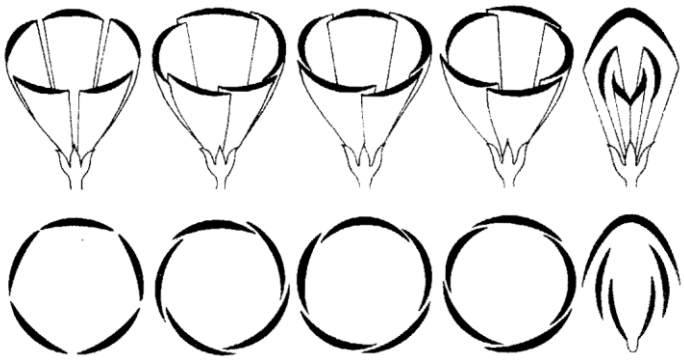


Fig : Different types of aestivation
(A) Valvate, (B) Twisted, (C) Imbricate, (D) Quincuncial (E) Vexillary

- **Ascending imbricate :** Here the odd petal is posterior and completely inside. One of the anterior petals is completely outside. The remaining petals show regular overlapping in ascending manner, e.g., *Cassia* and *Delonix*.

(e) **Quincuncial :** In this type, out of the five perianth members in a whorl two are completely outside, two are completely inside and the remaining has one edge outside and one-edge inside. This is confined to pentamerous flowers only, e.g., sepals of *Ipomoea*, *Vinca* and *Thevetia*.

(vii) **Androecium :** It is the third whorl of a flower consisting of stamens or microsporophylls. Fertile stamens produce pollen grains. **Staminodes** are the sterile stamens. Petaloid stamens are brightly coloured and appear like petals, e.g., *Canna*.

(a) **Structure of stamen :** A stamen shows a long or short stalk called the filament. The filament ends with a terminal fertile part known as the **anther**. It encloses microsporangia within which microspores or pollen grains are produced. The filament of the stamen is connected to the anther by means of a "connective". The anther may be monothecous or dithecous. The monothecous anther has only one sac. It is bilocular or bisporangiate, e.g., *Hibiscus*. The dithecous anther consists of two sacs and is tetralocular or tetrasporangiate in as *Datura*.

When the face of anther is towards centre of flower it is called **introrse** e.g., tomato when it is towards the periphery it is called **extrorse** e.g., *Ranunculus*.

(b) **Fixation :** The mode of attachment of a filament to anther by connective is called fixation. It is of following types :

- **Adnate :** Filament attached to the total length of the anther on the back. e.g., *Michelia* (Campa).

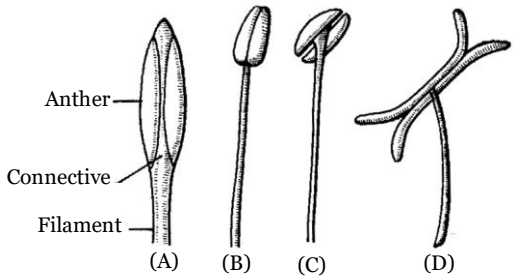


Fig : Attachment of anther to filament (A) Adnate, (B) Basifixed, (C) Dorsifixed, (D) Versatile

- **Basifixed :** Filament is attached to the base of the anther e.g., *Datura*, Mustard, Radish.
- **Dorsifixed :** Filament is attached to the anther on the dorsal side at middle portion e.g., *Passiflora*.
- **Versatile :** Filament is attached to the anther at a point so that anther can swing freely in all direction. e.g., Grasses.

(c) **Length of stamens :** Based on the relative lengths of the stamens, the conditions of androecium varies :

- **Didynamous :** When there are four stamens in a flower of which two are long and two are short, the condition is described as didynamous, e.g., *Ocimum*.
- **Tetradynamous :** Out of the six stamens that are found in a flower, four stamens are long and the two are short. This condition is called tetradynamous, e.g., *Raphanus* and *Brassica*.

The stamens are described as **inserted** when they do not extend beyond the petals or corolla tube (*Dolichos*). When the stamens extend beyond the petals or corolla tube, the stamens are known as (*Acacia*).

(d) **Insertion of stamens :** Based on the insertion of stamens, the condition of androecium varies :

- **Isostemonous :** When the stamen form a single whole and the number of stamen is the same as that of sepals and petals, the flower is isostemonous.
- **Diplostemonous :** Sometimes there are two whorls of stamens. The first whorl alternating with petals (antisepalous) and the second whorl alternating with sepals (antipetalous).
- **Obdiplostemonous :** In this condition first whorl is antipetalous and the second whorl is antisepalous.

(e) **Union of stamens :** The union of stamens takes place either among themselves (*cohesion*) or with other whorls (*adhesion*).

Cohesion of stamen : Usually three types of cohesion among stamens occur. They are :

- **Adelphy :** When the filaments of stamens are united and the anthers remain free. It is of three types :
- **Monadelphous :** All filaments unite to form a single bundle e.g., Family malvaceae (*Hibiscus*).
- **Diadelphous :** Filaments unite to form two bundles. e.g., family papilionaceae (*Pisum*, *Sesbania*, *Tephrosia*).
- **Polyadelphous :** Filaments unite to form many bundles. e.g., family rutaceae (*Citrus*, *Melaleuca*).
- **Syngenesious :** When the anther of filament are united and the filaments remain free. e.g., *Tridax*, Sunflower etc.
- **Synandrous :** Here all stamens of a flower are united completely to form a single structure. e.g., family Cucurbitaceae.

Adhesion of stamens : Stamens may unite with other floral organs like sepals, petals or gynoecium. Based on the floral organ involved in the union with stamens, the adhesion may be of the following types :

- **Epiphyllous :** Stamens unite with perianth. e.g., *Asperagus.*
- **Episepalous :** Stamens unite with sepals.
- **Epipetalous :** Stamens unite with petals. e.g., *Datura.*
- **Gynandrous :** Stamens unite with gynoecium. It is also called gynandrium or gynostegium. e.g., *Calotropis.*

(viii) **Gynoecium :** The gynoecium or pistil is the fourth essential whorl of female reproductive part of the flower and may be made up of one or more carpels (megasporophylls). A carpel has three distinct part, namely ovary, style and stigma. The lower most swollen fertile part of the carpel is the ovary. It encloses ovules. Above the ovary elongated thread like structure attached to the apex of the ovary, the style. The style end with a round, sticky stigma. A sterile pistil is known **pistillode**. The number of carpels is a gynoecium vary in different flowers. Accordingly the gynoecium may be described as follows :

(a) **Monocarpellary :** It is a ovary with a single carpel, e.g., Bean.

(b) **Bicarpellary :** It is presence of two carpels in a ovary, e.g., *Helianthus.*

(c) **Tricarpellary :** It is presence of three carpels, e.g., *Cocos.*

(d) **Tetracarpellary :** It is presence of four carpels, e.g., Cotton.

(e) **Pentacarpellary :** It is presence of five carpels, e.g., *Hibiscus*.

(f) **Multicarpellary :** It is presence of many carpels, e.g., *Annona*.

When the number of carpels in a gynoecium are two or more, they may be free or united. If they are free it is called **apocarpous** gynoecium and if they are fused it is called **syncarpous** gynoecium.

The ovary encloses one to many chambers called the locules. Usually the number of locules in a syncarpous ovary corresponds to the number of carpels. Sometimes, the number of locules may be doubled. e.g., in *Datura*, the gynoecium is bicarpellary syncarpous with four locules in the ovary. Based on the number of locules, the ovary may be described as follows :

- **Unilocular :** Ovary with one locule. e.g., *Dolichos*.
- **Bilocular :** Ovary with two locules. e.g., *Solanum.*
- **Trilocular :** Ovary with three locules. e.g., *Allium*.
- **Tetralocular :** Ovary with four locules. e.g., *Datura*.
- **Pentalocular :** Ovary with five locules. e.g., *Hibiscus*.
- **Multilocular :** Ovary with many locules. e.g., *Abutilon*.

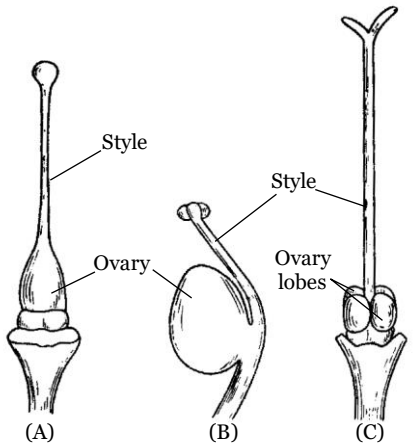


Fig : Types of styles
(A) Terminal, (B) Lateral,
(C) Gynobasic style

(ix) **Placentation :** (See the detail in 'Embryology' Module : 2)

(x) **Style :** The stalk like structure present above the ovary is called the style. The style may be long (*Datura*) or short (grasses) or absent (*Papaver*). In the family umbelliferae (apiaceae) the base of the style is swollen and forms a structure called **stylopodium**. There are three types of styles as described below :

(a) **Terminal style :** If the style arises from terminal part of the ovary, it is called terminal style, e.g., *Datura*, *Hibiscus* and *Solanum*.

(b) **Lateral style :** If the style arises from one side of the ovary, it is called lateral style, e.g., mango.

(c) **Gynobasic style :** If the style arises from the base of the ovary it is called gynobasic style, e.g., *Ocimum*, *Salvia.*

(xi) **Stigma :** The terminal receptive portion of the style is called the stigma. It receptive pollen grain during pollination. Usually the lobes of the stigma corresponds to the number of carpels. Accordingly the stigma may be unifid, bifid, trifid, tetrafid, pentafid or multifid.

- **Capitate :** Round stigma. e.g., *Hibiscus*.
- **Forked :** Divided stigma. e.g., *Tridex*.
- **Feathery :** Brush like stigma. e.g., Grasses.

(xii) **Floral formula :** It is an expression summarizing the informations given in a floral diagram. It represents the informations given in a floral diagram in the form of an equation. Following symbols are used in constructing a floral formula.

Br.	Bracteate	**C**	Corolla-free (polypetalous)
Brl.	Bracteolate	(C)	Corolla-united (gamopetalous)
Ebr.	Ebracteate	Cx	Corolla-cruciform
Bbrl.	Ebracteolate	P	Perianth
♂	Male	A	Androecium-free
♀	Female	(A)	Androecium-united
⚥	Bisexual	P ⌒ A	Epiphyllous
⊕	Actinomorphic	C ⌒ A	Epipetalous
† or **%**	Zygomorphic	G	Gynoecium-free
Ep	Epicalyx	(G)	Gynoecium-united
K	Calyx-free (polysepalous)	$\underline{G}$	Superior ovary
(K)	Calyx-united (gamosepalous)	$\overline{G}$	Inferior ovary
		G ⌒ A	Gynostagium

(xiii) **Floral diagram :** Diagram illustrating the relative position and number of parts in each of the sets of organs comprising a flower. Floral diagram is usually drawn with reference to mother axis. Following signs are used in constructing a floral diagram.

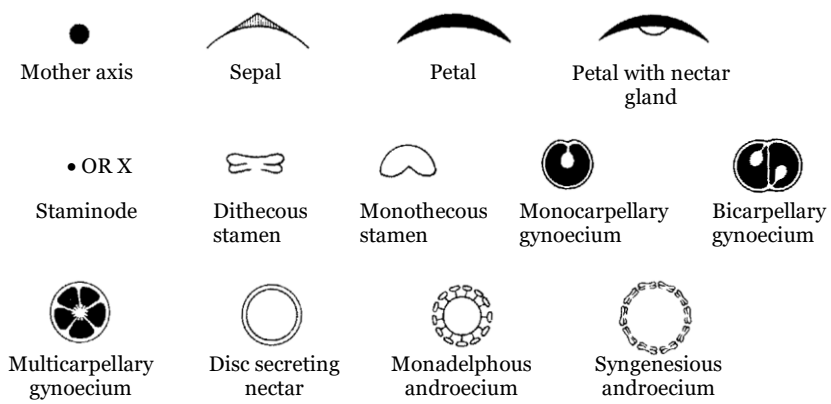


Fig : Signs used in preparation of floral diagram

TAXONOMY OF ANGIOSPERMIC PLANTS

1.10 LILIACEAE

Systematic position

Division	:	Angiospermae
Class	:	Monocotyledonae
Series	:	Coronarieae
Order	:	Liliales
Family	:	Liliaceae

Habit : Usually perennial herbs growing by means of rhizomes (e.g., *Aloe, Polygonatum*), bulbs (e.g., *Lilium, Allium*) and corms (e.g., *Colchicum*). Some herbs are annual (e.g., *Asphodelus*). Shrubs occur in *Aloe, Agave, Yucca* (Dagger plants, Adam's Needle), *Dracaena* (Dragon plant), and *Ruscus* (Butcher's Broom). They mostly grow in arid areas and are hence xerophytic (e.g., *Aloe, Yucca*). *Xanthorrhoea* of Australia is tree-like. Climbers are seen in *Smilax, Gloriosa* and species of *Asparagus.*

Root : Adventitious, fibrous or tuberous (e.g., *Asparagus*).

Stem : Erect or climbing as *Smilex*, branched or unbranched, herbaceous, phylloclade as *Ruscus*. Cladode as *Asparagus*, Bulb as *Allium cepa*.

Leaves : Radical or cauline and ramal, cauline and ramal show various types of phyllotaxy (alternate, opposite or whorled), exstipulate, stipulate in *Smilax* where the stipules are prolonged into tendrils, sessile or petiolate with sheathing leaf bases, venation parallel but reticulate in *Smilax*, leaves may be scaly, leathery, fleshy or modified into spines (e.g., *Asparagus*), leaf apex is tendrillar in *Gloriosa*. The leaves of *Phormium tenax* (New Zealand Hemp) are 3 metres long and 10 *cm* broad.

Inflorescence : Recemose, sometimes solitary (e.g., *Tulipa, Gloriosa*) or umbellate condensed cymes (umbel cyme), e.g., Onion. In several cases the inflorescence possesses a leafless peduncle called scape.

Flower : Bracteate or ebracteate, pedicellate, regular, actinomorphic, zygomorphic in a few cases (e.g., *Gilliesia*), complete or incomplete, perfect, unisexual in *Smilax* and *Ruscus*, hypogynous, generally pentacyclic, trimerous (rarely bimerous or tetramerous). Accessory floral organs undifferentiated and collectively called perianth.

Parianth : Tepals 6, in two whorls of 3 each, free or fused, sepaloid or petaloid, scarious or membranous, aestivation valvate or imbricate, distinguished into calyx and corolla in *Trillium*, inferior.

Androecium : Stamens 6 (3 in *Ruscus*, 9–12 in *Tofieldia*), free (polyandrous) or monadelphous (e.g., *Ruscus*), arranged in two whorls, antiphyllous (antitepalous), may be epiphyllous (or epitepalous), anthers fixed variously (basifixed, dorsifixed, versatile), dehiscence longitudinal or by pores, inferior.

Gynoecium : Tricarpellary, syncarpous, ovary superior, trilocular with 2-many ovules in each locules, placentation axile, rarely parietal, styles united or separate, stigma free or fused, trilobed.

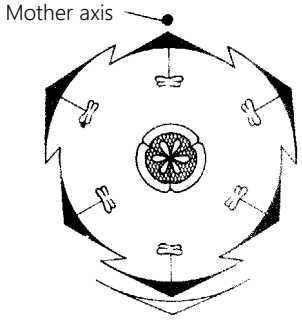


Fig : Floral diagram of liliaceae (*Allium cepa*)

Fruit : A capsule (e.g., *Asphodelus, Gloriosa*) or berry (e.g., *Asparagus*).

Seed : Endospermic and monocotyledonous.

Floral formula : ⚥ P_{3+3} or $\overbrace{(3+3)}$ A_{3+3} $G_{(\underline{3})}$

1.11 Cruciferae (Brassicaceae)

Systematic position

Division	:	Angiospermae
Class	:	Dicotyledonae
Subclass	:	Polypetalae
Series	:	Thalamiflorae
Order	:	Parietales
Family	:	Cruciferae (Brassicaceae)

Habit : Annual, biennial or perennial herbs. *Farsetia jacquemontii* is an undershrub. The plants possess pungent juice having sulphur-containing glucosides.

Root : Tap root alongwith hypocotyl is swollen in Radish (*Raphanus sativus*) and Turnip (*Brassica rapa*).

Stem : Erect, cylindrical, hairy or glabrous, herbaceous or rarely woody. It is reduced in the vegetative phase in Radish and Turnip. The stem is swollen in Kohlarabi (Knol-Kohl = Ganthgobi, *Brassica, oleracea* var. Gonglylodes). Axillary buds enlarged in Brussel's Sprouts (= Button gobhi) or *Brassica oleracea* var. *gemmifera*. *Brassica oleracea* var. *capitata* (Cabbage) has the largest terminal bud.

Leaves : Radical, cauline and ramal, alternate or sub-opposite but forming rosettes when radical, exstipulate with sheathing leaf base, sessile simple or rarely compound (e.g., *Nasturium officinale*), hairy. Bulbils occur in the leaf axils of *Dentaria bulbifera* and on the leaves of *Cardamine pratensis*.

Inflorescence : Flowers are usually arranged in racemose racemes. Occasionally they are in corymbs (candtuft).

Flower : Ebracteate or rarely bracteate (e.g., *Rorippa montana*), pedicellate, complete, perfect, regular, actinomorphic, rarely zygomorphic (e.g., *Iberis, Teesdalia*), tetramerous or bimerous, hypogynous (perigynous in *Lepidium*), cyclic, cruciform.

Calyx : Sepals 4, polysepalous, aestivation imbricate, generally arranged in two whorls, outer of antero-posterior sepals and inner of lateral sepals, lateral sepals generally saccate or pouched at the base, green or petaloid, inferior.

Corolla : Petals 4, polypetalous, arranged in one whorl and alternate with sepals, often with long claws and spread out in the form of a Greek cross. This arrangement of petals which is characteristic of the family is known as the cruciform arrangement and corolla is described as cruciform corolla, valvate aestivation. Petals reduced or absent in *Lepidium* and *Rorippa*.

Androecium : Stamens 6, (four in *Cardamine hirsuta*, two in *Coronopus didymus*, 16 in *Megacarpaea*), free (polyandrous),

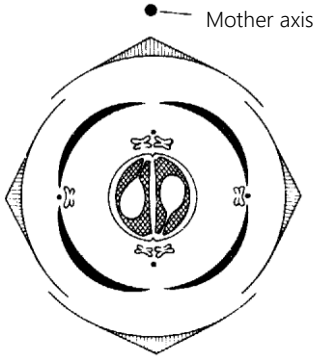


Fig : Floral diagram of cruciferae (*Brassica campestris*)

tetradynamous, arranged in two whorls, outer of two short lateral stamens while the inner whorl is made up of 4 long stamens arranged in two median pairs, anthers basifixed or dorsifixed, dehiscence longitudinal, inferior. Green nectaries are often associated with the bases of stamens.

Gynoecium : Bicarpellary (tricarpellary in species of *Lepidium*, tetracarpellary in *Tetrapoma* and *Tropidocarpum*), syncarpous, carpels placed transversely, ovary superior, placentation parietal, ovary bilocular due to the presence of a false septum called replum, style short, stigma capitate, simple or lobed.

Fruit : Siliqua of silicula, lomentaceous siliqua occurs in radish.

Seed : Non-endospermic, often oily.

Floral formula : Ebr ⊕ $K_{2+2}\ C_{\times 4}\ A_{2+4}\ G_{\underline{(2)}}$

1.12 Leguminosae

Systematic position

Division	:	Angiospermae
Class	:	Dicotyledonae
Subclass	:	Polypetalae
Series	:	Calyciflorae
Order	:	Rosales
Family	:	Leguminosae

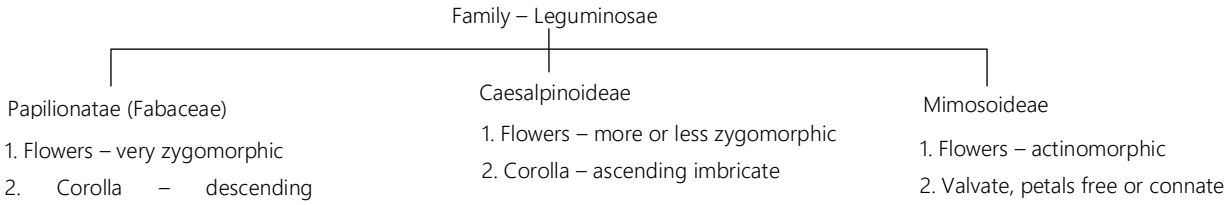
Habit : Annual or biennial, herb, shrub or tree.

Root : Tap root system.

Stem : Erect or creeping, solid or weak.

Leaf : Alternate or whorled, stipulate, petiolate, simple or usually compound, reticulate venation.

On the basis of inflorescence and flower characters, this family divided in to 3 subfamilies :



Subfamily - Papilionatae (Fabaceae)

Inflorescence : Racemose or solitory axillary.

Flower : Bracteate or ebracteate rarely bracteolate (e.g., *Arachis*), pedicellate or sessile, complete, irregular, zygomorphic, perigynous or occasionally hypogynous, pentamerous.

Calyx : Sepals 5, gamosepalous, usually companulate, lobe unequal, rarely tubular (e.g, *Cyamopsis*), odd sepal anterior, may be persistent inferior.

Corolla : Petals 5, polypetalous, papilionaceous, descending imbricate aestivation, one posterior long standered, two lateral short wings, two anterior petals jointed to each other forming keel.

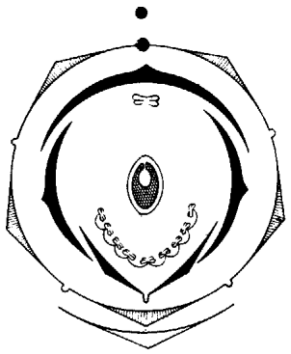


Fig : Floral diagram of subfamily papilionatae (*Pisum*

Androecium : Stamens 10, usually diadelphous (9+1 in *Lathyrus*, 5+5 in *Aeschynomene*) or monadelphous (9 in *Dalbergia*, 10 in *Arachis* and *Erythrina indica*), rarely free (e.g., *Sophora*), nectar gland often present on the inner bases of filaments, anther lobes bilocular, dorsifixed, introse.

Gynoecium : Monocarpellary, ovary superior, unilocular with marginal placentation ovary covered by staminal tube, style bent, stigma simple or capitate.

Fruit : Legume or lomentum.

Floral formula : Br ♀ $K_5\ C_{1+2+(2)}\ A_{1+(9)}\ \underline{G_1}$

Subfamily – Caesalpinoideae

Inflorescence : Raceme, umbel or a solitary flower.

Flower : Bracteate or ebracteate, pedicellate, hermaphrodite, complete, zygomorphic, hypogynous.

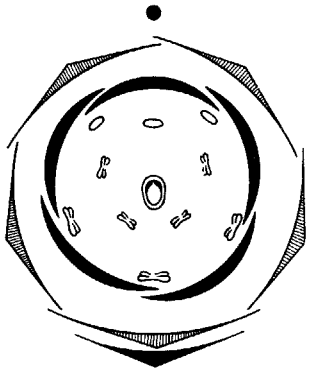


Fig : Floral diagram of subfamily caesalpinoidae (*Cassia fistula*)

Calyx : Sepals 5, polysepalous, imbricate aestivation.

Corolla : Petals 5, polypetalous, ascending imbricate aestivation.

Androecium : 10 stamens, or staminodes are found as in *Cassia*, free filaments of unequal size, anther lobes bilocular, introrse, versatile.

Gynoecium : Monocarpellary, unilocular, ovary superior, marginal placentation, stigma capitate.

Fruit : Legume.

Floral formula : ♀ $K_5\ C_5\ A_{1+2+2+2+3\,(\text{staminodes})}$ or $_{7+3\,(\text{staminodes})}\ G_1$

Subfamily – Mimosoideae

Inflorescence : Head or capitulum or spike, flowers arranged in acropetal succession.

Flower : Bracteate or ebracteate, sessile, hermaphrodite, complete actinomorphic, hypogynous, pentamerous.

Calyx : 5 sepals (4 in *Mimosa*) gamosepalous, connate at the base, valvate aestivation, rarely imbricate (e.g., *Parkia*).

Corolla : 5 petals (4 in *Mimosa*) gamopetalous or polypetalous, membranous, valvate aestivation.

Androecium : In most of the members, stamens are indefinite and polyandrous. However, there are only 4 stamens in *Mimosa pudica* and 10 each in *Prosopis* and *Dichrostachys*. Filaments are long, usually connate at the base, sometimes they are coloured and gland dotted. Anthers are dithecous and introrse.

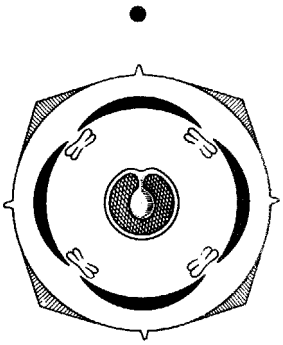


Fig : Floral diagram of subfamily mimosoidae (*Mimosa pudica*)

Gynoecium : Monocarpellary, unilocular, ovary superior, style long, cylindrical, stigma single and capitate, marginal placentation.

Fruit : Lomentum.

Floral formula : Br or Ebr ♀ $K_{(5)}\, C_{(5)}$ or $_5\, A_\infty\, G_1$

1.13 SOLANACEAE

Systematic position

Division	:	Angiospermae
Class	:	Dicotyledonae
Subclass	:	Gamopetalae
Series	:	Bicarpellatae
Order	:	Polimoniales
Family	:	Solanaceae

Habit : Mostly herbs (*Petunia, Solanum nigrum, Nicotiana, Withania*), shrubs, a few trees (*Solanum grandiflorum* or potato tree) or climbers (*Solanum jasminoides or potato vine, Solanum dulcamara*).

Root : Branched tap root.

Stem : Usually the stem is erect, solid, cylindrical and branched. Occasionally, it is spinous (*Solanum xanthocarpum, Datura stramonium, Lycium*). In potato (*Solanum tuberosum*) underground stem is modified in to tubers.

Leaves : Cauline, ramal, exstipulate petiolate or sessile, alternate, sometimes opposite, simple, entire, pinnatisect in tomato (*Lycopersicum esculentum*). Venation unicostate reticulate, variegated in *Solanum jasminoides.*

Inflorescence : Axillary or extra axillary cyme. Solitary axillary in *Physalis* and *Pentunia*. Sub-sessile umbellate cyme in *Withania somnifera*, solitary in *Datura*.

Flower : Bracteate or ebracteate, pedicillate, complete, actinomorphic, rarely zygomorphic (e.g., *Salpiglosis, schizanthus*), bisexual, rarely unisexual (e.g., *Withania coagulans*) pentamerous, hypogynous.

Calyx : Sepals 5, gamosepalous, tubular or campanulate, persistent, accrecent (enlarging in fruit, e.g., Physalis, Withania), Valvate or imbricate, green or coloured, hairy.

Corolla : Petals 5, gamopetalous, tubular or infundibuliform, valvate, twisted in *Datura,* bilabiate in *Schizanthus,* scale or hair like outgrowth may arise from the throat of the corolla tube.

Androecium : Stamens 5, rarely 4 (e.g., *Salpiglosis*) or 2 (e.g., *Schizanthus*), free, epipetalous, polyandrous alternate to petals, filament inserted deep in the corolla tube, anthers dithecous, usually basifixed or dorsifixed, introrse.

Gynoecium : Bicarpellary, syncarpous, ovary superior, carpels placed obliquely in diagonal plane, generally bilocular (2-4 locular in tomato, 4-locular in *Datura* due to false septa), placentation axile, ovules many in each locules, placentae swollen, a nectariferous disc or lobes may be present, stigma capitate or lobed.

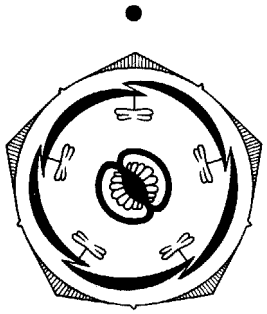


Fig : Floral formula of solanaceae (*Solanum nigrum*)

Fruit : A many seeded berry (e.g. *Tomato*) or capsule (e.g, *Datura*).

Seed : Endospermic with straight or curved embryo.

Floral formula : Br ♂ $K_{(5)}\overset{\frown}{C_{(5)}}A_{(5)}G_{\underline{(2)}}$

1.14 MALVACEAE

Systematic position

Division	:	Angiospermae
Class	:	Dicotyledonae
Subclass	:	Polypetalae
Series	:	Thalamiflorae
Order	:	Malvales
Family	:	Malvaceae

Habit : Plants are annual herbs (e.g., *Malva, Sida, Malvastrum, Urena*) shrubs (e.g., *Hibiscus rosa-sinensis, H. mutabilis*) or rarely trees (e.g., *Kydia, Bombax*).

Root : Branched tap root.

Stem : Stem is erect, aerial, herbaceous or woody, usually solid, cylindrical and branched. Herbaceous portion of the stem is covered with stellate and scaly hairs; the woody part is fibrous. Plants usually have some mucilaginous substance.

Leaves : Leaves are alternate and stipulate (stipules 2, free lateral and often Caducous). They are simple and petiolate, lamina is sometimes palmately lobed (e.g., *Gossypium*) or digitate (e.g., *Bombax*). Venation is multicostate reticulate.

Inflorescence : Usually the flowers are solitary axillary or terminal. Occasionally, they are in panicle raceme (e.g., *Kydia*).

Flowers : Flowers are bracteate, bracteolate, actinomorphic, bisexual (unisexual in *Kydia*), pentamerous and hypogynous. The number of bracteoles varies from 3 to many, they form a whorl of epicalyx below the calyx. Sometimes the epicalyx is absent (e.g., *Sida* and *Abutilon*).

Calyx : Sepals 5, gamosepalous (connate at the base but free at the tip) and show valvate aestivation. Usually epicalyx present.

Corolla : Petals 5, polypetalous (slightly fused at the base), usually adnate at the base to the staminal tube. They show twisted or imbricate aestivation.

Androecium : It has indefinite stamens. They are monadelphous. Filaments of the stamens are united to form a long staminal tube or staminal column which encloses the style. Basal part of the staminal tube is fused with the petals; thus stamens are epipetalous. Anthers are monothecous, reniform, transversely attached to the filament and extrorse. In *Bombax* stamens are polyadelphaous.

Fig : Floral diagram of malvaceae (*Hibiscus rosa sinensis*)

Gynoecium : It is 2 to many carpellary. It is bicarpellary in *Plagianthus*, tricarpellary in *Kydia*, pentacarpellary in *Hibiscus* and *Sida*, ten carpellary in *Althaea rosea* and 15 – 20 carpellary in *Abutilon indicum*. All the carpels are fused (syncarpous) to form a single ovary. Ovary is superior, multilocular with one or more ovules in each chamber. The placentation is axile.

Style is usually long and enclosed in the staminal tube. Stigmas are as many as the number of carpels or double the number of carpels.

Fruit : Fruit is a loculicidal capsule (e.g., *Gossypium*, *Hibiscus*), schizocarpic capsule (e.g., *Abutilon, Sida*) or a berry (e.g., *Malvastrum*).

Seed : Seeds are albuminous. In *Gossypium* the seeds are pubescent, i.e., covered with hairs.

Floral formula : $\mathrm{Br}\oplus \quad \mathrm{Epi}_{\alpha}\ K_{(5)}\overset{\frown}{C_5}\ A_{(\alpha)}\ \underline{G}_{(5-\alpha)}$

1.15 CUCURBITACEAE

Systematic position

Division	:	Angiospermae
Class	:	Dicotyledonae
Subclass	:	Polypetalae
Series	:	Calyciflorae
Order	:	Passiflorales
Family	:	Cucurbitaceae

Habit : These are trailing or climbing annuals or perennial herbs. They climb by means of simple or branched tendrils which are extra – axillary in position. Rarely they are shrubs (e.g., *Acanthosicyos*) or trees (e.g., *Dendrosicyos*).

Stem : Herbaceous, branched, pentangular, fistular, tendrils in axil of leaf or opposite to leaves. The morphological nature of tendril is of dispute.

Leaves : Leaves are cauline and ramal. They are alternate, exstipulate, simple, petiolate and cordate (e.g., *Cucurbita maxima*, *Coccinia grandis*) or deeply palmately lobed (e.g., *Luffa cylindrica*, *Cyclanthera pedata*). Venation is reticulate multicostate.

Inflorescence : Flowers are either solitary axillary (e.g., *Cucurbita, Coccinia*) or in cymose clusters (e.g., *Cucumis*, male flowers of *Luffa*).

Most of the members of the Cucurbitaceae are monoecious but a few are dioecious (e.g., *Coccinia cordifolia, Trichosanthes dioica*).

Flower : Flowers are bracteate or ebracteate, pedicellate, unisexual, actinomorphic, pentamerous and epigynous. *Schizopepon* is the only exception which has bisexual flowers.

Male flower

Calyx : Sepals 5, gamosepalous, quincuncial aestivation.

Corolla : Petals 5, gamopetalous, campanulate or rotate, imbricate or valvate aestivation.

Androecium : Stamens 5, polyandrous as in *Fevillea*, or (2)+(2)+1 as in *Momordica*, anthers twisted, alternate to petals, sometimes epipetalous, dehiscence longitudinal.

Gynoecium : Absent.

Female flower

Calyx : Similar to male flower.

Corolla : Similar to male flower.

Androecium : Absent but sometimes 2, 3, 5 staminodes present.

Gynoecium : Tricarpellary, syncarpous, unilocular, ovary inferior, numerous ovules, parietal placentation but looks as axile placentation, style is simple, stigma 3.

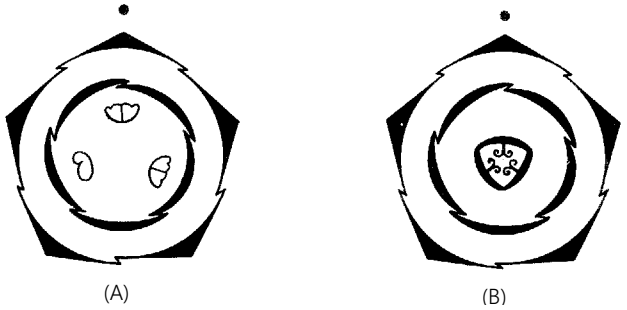


Fig : Floral diagram of cucurbitaceae (*Cucurbita maxima* / Kaddu)
(A) Floral diagram of male flower (B) Floral diagram of female flower

Fruit : Pepo (variation of berry).

Seeds : Exalbuminous.

Male flower : *Br* or *Ebr* ♂ $K_{(5)}\,C_{(5)}\,A_{(2)+(2)+1}\,G_0$

Female flower : *Br* or *Ebr* ♀ $K_{(5)}\,C_{(5)}\,A_0\,\overline{G_{(3)}}$

1.16 Compositae (Asteraceae)

Systematic position

Division	:	Angiospermae
Class	:	Dicotyledonae
Subclass	:	Gamopetalae
Series	:	Inferae
Order	:	Asterales
Family	:	Compositae (Asteraceae)
		(Largest family among the angiosperms)

Habit : Most of the plants are annual herbs (e.g., *Chrysanthemum, Lactuca, Calendula, Helianthus, Tagetes*). A few are shrubs (e.g., *Artemisia, Pluchea lanceolata*) or rarely trees (e.g., *Vernonia arborea, Wilkesia, Leucomeris*). *Milkamia cordata* is a twiner.

Root : Usually there is a tap root, but in *Dahlia* and *Taraxacum officinale* fasciculated roots are present.

Stem : Stem is usually herbaceous, erect, branched, solid, fibrous and sometimes with milky latex. In Jerusalem artichoke (*Helianthus tuberosus*) the stem is underground and tuberous. In *Baccharis*, it is winged like a leaf.

Leaves : Leaves are mostly alternate and occasionally opposite (e.g., *Helianthus*) or whorled (e.g., *Eupatorium, Zinnia verticillata*). They are exstipulate, petiolate, simple, pinnately or palmately lobed or compound (e.g., *Dahlia*, *Cosmos*). Venation is reticulate.

Inflorescence : Inflorescence is capitulum or head with an involucre of bracts at its base. The number of flowers in each inflorescence varies from 1000 (in large flowers of *Helianthus*) to 1 (in *Echinops*). Peduncle flat on which florets are attached.

Flower : Epigynous, usually pentamerous with reduction in certain whorls, hermaphrodite or unisexual complete or incomplete, tubular (actinomorphic) or ligulate (zygomorphic), bracteate or ebracteate.

(1) **Ray florets :** Towards periphery of head, sessile bracteate, pistillate or neutral, zygomorphic, ligulate, epigynous.

Calyx : Absent or hairy pappus or scaly, persistant.

Corolla : Petals 5, gamopetalous, ligulate, strap shaped.

Androecium : Absent.

Gynoecium : Bicarpellary, syncarpous, ovary inferior, unilocular, one ovule in each locule, basal placentation, style simple narrow, stigma branched.

(2) **Disc florets :** In the centre of head, bracteate, bisexual, actinomorphic, tubular, pentamerous, epigynous.

Calyx : Absent or pappus.

Corolla : Petals 5, gamopetalous, tubular.

Androecium : 2 stamens, epipetalous, syngenesious, dithecous, bilobed, introrse, filament free.

Gynoecium : Bicarpellary, syncarpous, ovary inferior, unilocular, single ovule in the locule, basal placentation, style single, short, stigma bifid.

(3) **Neutral florets :** Androecium and gynoecium both are absent. Remaining structures are similar to ray floret and disc florets.

Fruit : Cypsella.

Seed : Exalbuminous.

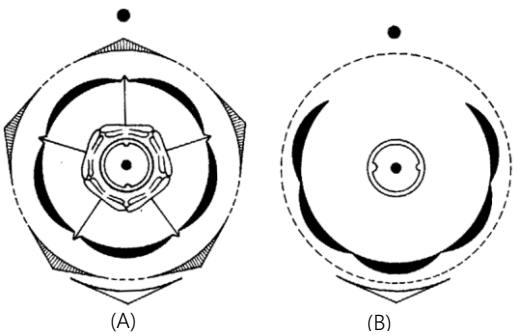


Fig : Floral diagram of compositae (*Helianthus annuus*)

Floral formula :

Ray florets : $Br.\%\ \oplus\ K_0\ or\ P\ C_{(5)}\ A_0\ \overline{G_{(2)}}$

Disc florets : $Br.\%\ or \oplus \underset{+}{\male}\ K_0\ or\ P\ C_{(5)}\quad A_{(3)}\ \overline{G_{(2)}}$

Neutral florets : $\%\ \text{or} \oplus \text{K}_0\ \overset{\frown}{C_{(5)}}\ A_0\ G_0$

***

ASSIGNMENT

ROOT

Basic Level

1. Water is absorbed by
(a) Root hairs (b) Root cap (c) Root (d) Root apex

2. Black pepper is a
(a) Tree (b) Climber (c) Shrub (d) Herb

3. Pneumatophores occur in plants of
(a) Sandy soil (b) Saline marshy soil (c) Marshy soil (d) Water

4. Roots developing from plant parts other than radicle are
(a) Epiphyllous (b) Epicaulous (c) Adventitious (d) Fibrous

5. Roots are feebly developed in
(a) Hydrophytes (b) Mesophytes (c) Xerophytes (d) Halophytes

6. Nodulated roots occur in
(a) Pea (b) Wheat (c) Mustard (d) Rice

7. Root cap takes part in
(a) Formation of new cells (b) Absorption of water and minerals
(c) Protection of root meristem (d) Storage of food

8. Conical fleshy roots occur in
(a) Sweet potato (b) *Dahlia* (c) *Asparagus* (d) Carrot

9. Napiform roots are recorded from
(a) Radish (b) Carrot (c) Beet (d) Sweet potato

10. Fusiform roots are found in
(a) *Solanum tuberosum* (b) *Calocasia* (c) *Daucus carota* (d) *Raphanus sativus*

11. Primary root and its branches constitute
(a) Adventitious root system (b) Tap root system
(c) Fibrous roots (d) Seminal roots

12. Stilt roots are reported from
(a) *Pandanus* (b) Radish (c) Mango-ginger (d) *Bryophyllum*

13. Assimilatory (Photosynthetic) roots a characteristic of
(a) *Trapa* and *Tinospora* (b) *Taeniophyllum* and *Podostemon*
(c) Both correct (d) None of these

14. A plant called plantless root is
(a) *Arceuthobium* (b) *Podostemon* (c) *Rafflesia* and *Sapria* (d)All of these

15. Root bears
(a) Nodes only (b) Internodes only
(c) Both nodes and internodes (d) None of these

16. Root pockets act as balancers and found in
(a) Hydrophytes (b) Free floating hydrophytes
(c)Fixed floating hydrophytes (d) Submerged hydrophytes

17. The root that never does primary function is
(a) Nodulated root of gram (b)Conical roots of carrot
(c) Buttress roots of *Ficus* (d)Stilt root of maize

18. Monocot plants are characterised by the presence of
(a) Tap roots (b) Fibrous roots (c) Annulated roots (d) Stilt roots

19. Nodulated roots bearing family is
(a) Mimosoideae (b) Caesalpinoideae (c) Papilionatae (d) Solanaceae

20. Clinging and epiphytic roots are found in
(a) Orchid (b) *Tinospora / Trapa*
(c) *Rhizophora / Pandanus* (d) *Pothos / Podostemon*

21. Bacteria found in root nodules of legumes are
(a) *Nitrobacter* (b) *Nitrosomonas* (c) *Rhizobium* (d) *Azotobacter*

22. In *Pandanus* (Screw pine) stilt roots arise from
(a) Basal nodes (b) Upper surface of oblique stem
(c) Lower side of oblique stem (d)Anywhere

23. In *Ipomoea batatas*/Sweet potato the food is stored in
(a) Root tuber (b) Stem tuber (c) Bud (d) Leaves

24. In maize, the fibrous roots develop from
(a) Lower nodes (b) Upper nodes (c) Upper internodes (d) None of the above

25. Prolongation of radicle gives rise to
(a) Fibrous root system (b) Primary root (c) Stilt root (d) Pillar root

26. Edible part of Sweet potato is
(a) Stem tuber (b) Unripe fruit (c) Adventitious root tuber (d)Rhizome

27. Leguminous plants possess
(a) Napiform roots (b) Nodulated roots (c) Tuberous roots (d) Fusiform roots

28. Roots are used in vegetative propagation in
(a) Potato (b) Sweet potato (c) Ginger (d) Onion

29. Which modification of root does not store food
(a) Tuberous (b) Napiform (c) Conical (d) Stilt

30. Epiphytic roots occur in
(a) *Rhizophora* (b) *Trapa* (c) *Vanda* (d) *Asparagus*

31. Climbing roots are present in
(a) *Loranthus* (b) *Curcuma amada* (c) Rose (d) *Piper betle*

32. Sweet potato is modification of
(a) Leaf (b) Root (c) Stem (d) Flowering axis

33. Which is not a product of root
(a) Sugarbeat (b) Carrot (c) Radish (d) Potato

34. Aerial absorptive roots occur in
(a) Epiphytes (b) Mesophytes (c) Hydrophytes (d) Xerophytes

35. Balancing roots occur in
(a) *Hydrilla* (b) *Vallisneria* (c) *Lemna* (d) Lotus

36. Climbing roots occur in
(a) *Vanilla* (b) *Vanda* (c) *Pongamia* (d) *Taeniophyllum*

37. A rootless angiosperm is
(a) *Cuscuta* (b) *Balanosphora* (c) *Utricularia* (d) All of these

38. Choose the correct statement about haustorial (Parasitic) roots of *Cuscuta*
(a) These roots develop contact with xylem of host
(b) These develop contact with xylem and phloem of host
(c) These develop contact with phloem of host to get food
(d) These develop contact with pericycle and lateral roots of host

39. Respiratory roots are found in
(a) *Sonneratia* and *Heritiera* (b) *Trapa*
(c) Rhizophores (d) *Eichhornia*

40. A modification of the following is a sucking structure
(a) Pneumatophores (b) Climbing roots (c) Assimilatory roots (d) Haustorial roots

41. In orchids which of the following types of roots are found
(a) Tuberous roots (b) Assimilatory roots (c) Respiratory roots (d) Pneumatophores

42. Epiphyllous roots in *Begonia* and *Bryophyllum* are
(a) Green roots (b) Modified leaves
(c) Roots bearing stem (d) Roots arising from leaves

43. Pneumatophores are characteristics of family
(a) Loranthaceae (b) Hydrocharitaceae (c) Rhizophoraceae (d) Orchidaceae

44. Adventitious roots of *Pistia* are helpful in
(a) Vegetative reproduction (b) Storing the food material
(c) Photosynthesis (d) Balancing the plant

45. There is maximum growth in root
(a) In the dark (b) In the light
(c) At the root apex (d) Just behind the root apex

46. Prop roots of Banyan tree are meant for
(a) Respiration (b) Absorption of water from soil
(c) Retention of water in soil (d) Providing support to big tree

47. Roots have thorny branches in
(a) *Vanilla* (b) *Asparagus* (c) *Acanthorhiza* (d) *Pothos*

48. Root cap is absent in
(a) Hydrophytes (b) Lithophytes (c) Xerophytes (d) Mesophytes

49. Sucking roots occur in
(a) *Ficus* (b) *Vanda* (c) *Carrot* (d) Mistletoe

50. Which is not a stem modification
(a) Ginger (b) Mango-ginger (c) Potato (d) Garlic

51. Food is stored in one of the following
(a) Respiratory root (b) Fibrous root (c) Fasciculated root (d) Nodulated root

52. White spongy floating roots occur in
(a) *Trapa* (b) *Nymphaea* (c) *Eichhornia* (d) *Jussiaea*

53. Prop or pillar roots are
(a) Fasciculated roots (b) Tap roots (c) Adventitious roots (d) Secondary roots

54. Photosynthetic roots are recorded from
(a) *Jussiaea* (b) *Rhizophora* (c) *Bryophyllum* (d) *Tinospora*

55. Root pocket occurs in
(a) Maize (b) *Pandanus* (c) *Banyan* (d) Water Hyacinth

56. Pneumatophores occur in
(a) *Vanda* (b) *Avicennia* (c) Banyan (d) *Mirabilis*

57. Nodulated roots make the plant rich in
(a) Food (b) Proteins (c) Carbohydrates (d) Fats

58. Roots of which plant are used for treating blood pressure
(a) *Aconite* (b) *Rauwolfia* (c) *Sarasparilla* (d) *Vinca*

59. In Turnip, 2/3 part of swollen area is derived from
(a) Hypophysis (b) Hypocotyl (c) Epicotyl (d) Radicle

60. A root hair is
(a) Always unicellular (b) May be unicellular or multicellular
(c) Unicellular but branched (d) Multicellular and branched

61. A tap root is always
(a) +vely geotropic and +vely hydrotropic (b) +vely phototropic and +vely hydrotropic
(c) –vely geotropic and +vely hydrotropic (d) –vely hydrotropic and –vely geotropic

62. Palm like fleshy adventitious roots are the feature of
(a) *Dahlia* (b) *Asparagus* (c) *Curcuma* (d) *Orchis*

63. Roots help in clinging and climbing in
(a) *Pothos* and *Tecoma* (b) *Hedera* (Ivy) and *Piper* (Betel)
(c) Black pepper (d) All of these

64. Stilt roots which grow obliquely from basal nodes of culm stem and acting as brace are found in
(a) Sorghum (b) Maize (c) Sugarcane (d) All of these

65. In roots, branches (Secondary roots) are
(a) Stellar in origin (b) Cortical in origin
(c) Stellar and endogenous (d) Cortical and exogenous

66. In *Pandanus* (Screw Pine) root cap is
(a) Simple, multicellular (b)Multiple, multicellular
(c) Absent (d)Replaced by root pocket

67. Root cap is largest in
(a) Banyan (b) *Pandanus* (c) *Jussiaea* (d) Maize

68. Which one is a fleshy root
(a) *Ficus benghalensis* and *Solanum tuberosum* (b) *Raphanus sativus* and *Daucus carota*
(c) *Colocasia* and *Allium* (d) *Chrysanthemum* and *Musa*

69. Roots are absent in
(a) *Myriophyllum* (b) *Ceratophyllum*
(c) *Utricularia* and *Wolffia* (d) All of these

70. In which, fleshy tap root, hypocotyl does not form root
(a) Conical of carrot (b) Fusiform of radish (c) Napiform of radish (d) All of these

71. Thick unbranched roots found in corms and rhizomes of some plants are
(a) Reproductive (b) Contractile (c) Root thorns (d) Stilt roots

72. Haustoria are
(a) Epiphytic roots (b) Hygroscopic roots (c) Reproductive roots (d) Parasitic roots

73. Root is distinguishable from stem in
(a) Having a root cap (b) Having root hairs
(c) Absence of nodes and internodes (d) All of these

74. A root that never develops from radicle is
(a) Fibrous roots of grasses (b) Stilt roots of maize
(c) Sucking roots of *Cuscuta* (d) All of these

75. A deep feeder root system shows
(a) Racemose tap root system (b) Cymose tap root system
(c) Adventitious root system (d) None of these

76. Seminal roots are found in
(a) Dicots (b) Monocots (c) Gymnosperms (d) All of these

77. A root cap is absent in the root of
(a) Hanging prop root of Banyan (b) Stilt root of *Pandanus*
(c) Epiphytic roots (d) Seminal roots

78. Velamen takes part in
(a) Absorption of moisture from air (b) Absorption of water from soil
(c) Exchange of gases (d) Transpiration

79. Adventitious roots are adventitious in their
(a) Function (b) Position (c) Place of origin (d) Internal structure

80. In *Dahlia*, the roots are

(a) Fibrous (b) Stilt

(c) Moniliform (d) Fasciculated tuberous

81. Pneumatophores are useful in

(a) Respiration (b) Transpiration (c) Guttation (d) Protein synthesis

82. Pneumatophores or breathing roots occur in

(a) Hydrophytes (b) Epiphytes (c) Xerophytes (d) Mangrove plants

83. Root hairs develop from

(a) Region of maturation (b)Zone of elongation

(c) Meristematic region (d)Region of mature cells

84. Haustoria or sucking roots occur in

(a) Betel (b) Orchids (c) *Cuscuta* (d) *Tinospora*

85. Relation between bacteria and legume having nodulated roots is that of

(a) Host-parasitism (b) Commensalism (c) Symbiosis (d) Epiphytism

86. Buttress roots are

(a) Aerial (b) Underground (c) Aquatic (d) Horizontal

87. Velamen is present in

(a) Tuberous roots (b) Epiphytic roots of orchids

(c) Breathing roots (d) Parasitic roots

88. Underground food is stored in

(a) Solanaceae and Leguminosae (b)Liliaceae and Cruciferae

(c) Cruciferae and Solanaceae (d) Solanaceae and Malvaceae

89. Reproductive roots taking part in reproduction are found in

(a) *Dalbergia* (Shisham) (b)*Dahlia*

(c) Sweet Potato (*Ipomoea*) (d) All of these

90. Which of the following pairs are correctly matched

(1) Assimilatory roots — Photosynthesis

(2) Fasciculated roots — Food storage

(3) Stilt root — Mechanical support

(4) Sucking root — Absorption of moisture from the air

Select the correct answer –

(a) 2, 3 and 4 (b) 1, 2 and 4 (c) 1, 3 and 4 (d) 1, 2 and 3

Advance Level

91. *Rhizobium* lives symbiotically with root nodules and fixes atmospheric nitrogen. It gives nitrogenous compound to host and inturn takes food from host. This food taken by bacterium is

(a) Fats (b) Proteins (c) Carbohydrates (d) Any of these

92. Epiphytes like *Vanda* develop special layer of absorptive tissue velamen consiting of 4 or 5 layers of long polygonal cells. Velamen is formed by

(a) Absorbing roots (b) Stem (c) Clinging roots (d) Hanging roots

93. The factors which initiate development of respiratory roots in *Avicenia* and other mangrooves are
(a) Soil is physiologically dry (b) Saline marshes
(c) Poor oxygen supply (d) All of these

94. Lateral roots arise from primordia developed by division of
(a) Pericycle cells in between two protoxylem points
(b)Pericycle cells opposite protoxylem points
(c) Endodermis cells in between two protoxylem points
(d)Endodermis opposite protoxylem points

95. The layer which separates velamen (A spongy tissue in epiphytic roots of some orchids for absorption of atmospheric moisture) from cortex is called
(a) Epidermis (b) Epiblema (c) Exodermis (d) Endodermis

96. Buttress or plank roots in *Bombax* and *Ficus* are metamorphosed tap roots for support. They arise from
(a) Base of tap root (b) Base of adventitious roots
(c) Base of tap root and trunk both (d) Base of trunk

97. Regions of root from base to root tip are
(a) Maturation zone — Cell division zone — Elongation zone
(b) Maturation zone — Elongation zone — Cell division zone
(c) Cell division zone — Elongation zone — Maturation zone
(d) Elongation zone — Cell division zone — Maturation zone

98. A plant with epidermis specialised to absorb moisture from air is
(a) *Avicennia* (b) *Vanda* (c) *Rhizophora* (d) *Jussiaea*

99. Hygroscopic roots occur in
(a) *Vanda* (b) *Rhizophora* (c) *Bryophyllum* (d) All the above

100. A root is adventitious when it is
(a) Swollen (b) Growing in marshy places
(c) Formed from plumule (d) Modified for storage

101. Soil binding roots are found in
(a) Sugarcanes (b) Maize (c) Grasses (d) Dicots

102. Which type of root is found in mirabilis jalapa
(a) Respiratory (b) Tuberous (c) Reproductive (d) Fasciculated

103. A fleshy root tapering at both ends is
(a) Fusiform (b) Conical (c) Napiform (d) Tuberous

104. A fibrous root system is better adapted than tap root system for
(a) Storage of food (b) Anchorage of plant to soil
(c) Absorption of water and minerals (d) Transport of water and organic food

STEM

Basic Level

105. In *Amorphophallus* and *Colocasia* (Ariods) an extremely enlarged underground vertical stem meant for vegetative reproduction and storage is
(a) Tuber (b) Corm (c) Bulb (d) Rhizome

106. Vegetative reproduction occurs by bulbil in
(a) *Agave* (b) *Colocasia* (c) *Zingiber* (d) *Vallisneria*

107. Primary function of stem is to
(a) Bear and hold out leaves (b) Absorb water and minerals
(c) Fixation of plant (d) Help in vegetative propagation

108. Plants of tropics bear
(a) Winter buds (b) Summer buds (c) Naked buds (d) Adventitious buds

109. Accessory buds occur at
(a) Stem tip (b) Branch tip (c) Leaf axil (d) Side of axillary bud

110. Which is not a stem modification
(a) Rhizome of Ginger (b) Corm of *Colocasia* (c) Pitcher of *Nepenthes* (d) Tuber of Potato

111. Potato is multiplied vegetatively with the help of
(a) Corm (b) Rhizome (c) Tuber (d) Phyllode

112. Potato tuber is an underground stem because it bears
(a) Buds on the nodes (b) Abundant food reserve (c) Adventitious roots (d) No chlorophyll

113. Potato tuber is modified /Edible part of potato is
(a) Stem (b) Bulb (c) Stolon (d) Root

114. Cladodes are common among
(a) Liliaceae/*Asparagus* and *Ruscus* (b) *Opuntia* and *Casurina*
(c) Cactus (d) *Euphorbia*

115. In hook climber *Artabotrys*, the hooks are modified
(a) Petioles (b) Axillary shoots (c) Leaves (d) Inflorescence axis

116. In *Opuntia*, the function of phyotosynthesis is carried out by
(a) Cladode (b) Phylloclade (c) Phyllode (d) Bulb

117. An underground specialised shoot with reduced disc like stem covered by fleshy leaves is
(a) Bulb (b) Bulbil (c) Rhizome (d) Rhizophore

118. In *Opuntia*, each areole represents
(a) A node (b) An internode (c) An apical bud (d) An accessary bud

119. Bulb of *Allium cepa* (Onion) is
(a) Underground modified bud (b) Underground shoot
(c) Both correct (d) Underground stem

120. The bulb of Garlic is
(a) Nontunicated (b) Tunicated layered (c) Compound tunicated (d) Simple tunicated

121. New Banana plants develop from
(a) Rhizome (b) Sucker (c) Stolon (d) Seed

122. Buds typically occur at
(a) Leaf bases (b) Leaf axils
(c) Tips of stems and roots (d) Tips of branches and leaf bases

123. A disc like reduced stem is found in
(a) Ginger (b) Canna (c) Onion (d) *Crocus*

124. In *Agave* (Century plant), garlic and kalanchoe, bulbils are modified
(a) Axillary buds (b) Floral buds (c) Adventitous buds (d) Thorns

125. Largest bud is of
(a) Cabbage (b) Cauliflower (c) Agave (d) Onion

126. Function of stem is
(a) To produce branches and leaves (b) Storage of food
(c) Conduction of water and minerals (d) All of these

127. The aerial stem in banana is
(a) Corm (b) False stem (Pseudostem)
(c)True herbaceous stem (d) Rhizome

128. Stolon is
(a) Horizontal underground runner (b) Arched runner
(c) Both (a) and (b) (d) Both wrong

129. Runner is
(a) Diageotropic (b) Geotropic (c) Plagiotropic (d) None of these

130. Which underground stem helps in storage of food, perennation and reproduction
(a) *Dryopteris* (b) *Gladiolus* (c) *Narcissus* (d) All of these

131. Examples of twiner (Stem climber) is
(a) *Convolvulus* and *Ipomoea* (b) *Lablab* (Beans) and *Cuscuta*
(c) *Asparagus* and *Phaseolus* (d) All of these

132. Thorns differ from prickles in having
(a) Vascular supply (b) Endogenous origin (c) Bark (d) All of these

133. *Mentha* (Mint) has one of the following
(a) Sucker (b) Offset (c) Stolon (d) Rhizome

134. Thorns, spines and prickles are
(a) Organs of defence (b) Organs of offence
(c) Organs of clinging (d) Specialised for gaseous exchange

135. Offset occurs in
(a) Strawberry (b) *Colocasia* (c) *Pistia* (d) *Chrysanthemum*

136. Corm is characterised by
(a) Adventitious roots (b) Axillary buds (c) Circular nodes (d) Perennial nature

137. Stem is modified into thorns in
(a) *Citrus* (b) *Asparagus* (c) *Opuntia* (d) *Solanum surattense*

138. Potatoes develop on
(a) Lateral roots (b) Stolons (c) Primary root (d) Rhizomes

139. Ginger is a stem which can be differentiated from root because it
(a) Grows parallel to ground (b) Stores food
(c) Lacks chlorophyll (d) Has nodes and internodes

140. Epiphyllous buds develop from
(a) Leaf surface (b) Leaf axil (c) Leaf base (d) Stipule

141. Brussel's Sprouts are
(a) Undeveloped inflorescence (b) Floral buds
(c) Vegetative buds (d) Fruits

142. Which is not a rhizome
(a) *Colocasia* (b) Lotus (c) Ginger (d) Turmeric

143. In *Passiflora*, the tendrils are modified
(a) Axillary buds (b) Upper leaflets (c) Whole leaves (d) Stipules

144. In *Luffa* the tendrils are modified
(a) Extra-axillary branches (b)Stipules
(c) Axillary branches (d) Petioles

145. Stem takes part in storage and perennation in
(a) Wheat (b) Groundnut (c) Radish (d) Ginger

146. Axillary buds develop
(a) Exogenously from epidermis (b) Exogenously from inner layer of cortex
(c) Endogenously from inner layer of cortex (d) Endogenously from pericycle

147. *Citrus* thorn is actually modification of
(a) Stem (b) Branch (c) Leaf (d) Stipule

148. The buds which arise at places other than leaf axils are called
(a) Accessory buds (b) Latent buds (c) Adventitious buds (d) Floral buds

149. In which of the following the stem is modified into tendril
(a) *Ruscus* (b) *Cocoloba* (c) *Cucurbita* (d) *Asparagus*

150. In humid climate, presence of spines in shrubs is
(a) To reduce transpiration (b) To defend against mammal herbivory
(c) To defend against wood cutters (d) To check seed predation by birds

151. A lateral bud arising on the lateral sides of axillary bud is called
(a) Adventitious bud (b) Collateral bud (c) Extra axillary bud (d) Superposed bud

152. Stolon is found in

(a) *Colocasia* (b) *Jasmine* (c) Strawberry (d) All of these

153. Phylloclade of *Opuntia* is stem because

(a) It bears flowers and leaves (b) It arises in the axil of leaf

(c) Only (b) is correct (d) Both (a) and (b) are correct

154. Assertion : Ginger has a prostrate-growing rhizome

Reason : Shoot growth is not effected by gravity

(a) If both Assertion and Reason are true and the reason is the correct explanation of the assertion

(b) If both Assertion and Reason are true but the reason is not the correct explanation of the assertion

(c) If Assertion is true statement but Reason is false

(d) If both Assertion and Reason are false

155. The weak stemmed plants which can climb with the help of thorns, spines, prickles are

(a) Scramblers (b) Stolons (c) Straggling (d) Lianas

156. Potato and sweet potato

(a) Have edible parts which are homologous organs

(b) Have edible parts which are analogous organs

(c) Have been introduced in India from the same place

(d) Are two species of the same genus

157. Rhizomes can be differentiated from roots is

(a) Having scale leaves with axillary buds (b) Being thinner

(c) Being thicker (d) Being darker

158. In Onion, the swollen underground structure is

(a) Root (b) Rhizome (c) Bulb (d) Tuber

159. Corm is

(a) Underground shoot (b) Underground root

(c) Horizontal stem (d) Underground vertical stem

160. Phylloclade is a modification of

(a) Leaf (b) Root (c) Flower (d) Stem

161. Stem is enlarged in

(a) Rhizome (b) Corm (c) Bulb (d) Tuber

162. Aroids store food in

(a) Inflorescence (b) Enlarged root (c) Leaf bases (d) Swollen stem

163. Ginger plant has an underground stem which is

(a) Rhizome (b) Bulb (c) Tuber (d) Corm

164. The bulb stores food in

(a) Enlarged roots (b) Swollen leaf bases (c) Swollen stem (d) Inflorescence

165. Prickles of Rose are
(a) Modified leaves (b) Modified stipules
(c) Exogenous in origin (d) Endogenous in origin

166. Thorn of *Bongainvillea* is modified
(a) Stem (b) Leaf (c) Floral bud (d) Root

167. Bulb is modified
(a) Leaf (b) Shoot (c) Root (d) Flower

168. Potato is (underground) stem because it
(a) Possesses axillary buds (Eyes) (b) Lacks chlorophyll
(c) Does not bear roots (d) Contains reserve food

169. Thorn is a stem structure because it
(a) Develops from trunk (b) Develops from axillary bud
(c) Grows from external surface (d) Is pointed

170. Floral bud tendril is found in
(a) *Antigonon* (b) *Smilax* (c) Rose (d) *Bryophyllum*

171. Buds occurring on the nodes outside the leaf bases are
(a) Axillary (b) Extra-axillary (c) Terminal (d) Cauline

172. Smallest cladode is reported in
(a) *Lemna* (b) *Azolla* (c) *Wolffia* (d) *Parkinsonia*

173. Stem thorns help in
(a) Climbing (b) Protection from grazing animals
(c) Reduction in rate of transpiration (d) All of these

174. Rhizomes are mostly
(a) Sympodial (b) Diageotropic (c) Horizontal (d) All of these

175. Rhizome of *Crocus* (Saffron) is
(a) Rhizome (b) Corm (c) Root (d) Bulb

176. The thorn of *Alhagi* is stem modification because it bears
(a) Axillary position (b) Flowers (c) Exogenous origin (d) All of these

177. Sucker which is subaerial stem modification for vegetative propagation is seen in
(a) *Pistia* (b) *Jussiaea* (c) *Chrysanthemum* (d) *Hydrilla*

178. In onion leaves food is stored in the form of
(a) Sugar (b) Starch (c) Protein (d) Malic acid

179. One of single internodal branches are found in
(a) *Asparagus* (b) *Euphorbia* (c) *Lilium* (d) *Casuarina*

180. Bulbil is a modification of
(a) Underground stem (b) Bases of leaves (c) Buds (d) Radicle

181. Phylloclade is found in
(a) *Chrysanthemum* (b) *Asparagus* (c) *Ruscus* (d) *Opuntia*

182. Thorns with leaves and flowers are found in
(a) *Bougainvillea* (b) *Carissa* (c) *Duranta* (d) *Artabotrys*

183. Thick underground stem growing parallel to soil surface is
(a) Stolon (b) Rhizome (c) Sucker (d) Offset

184. Underground stem is rhizome in plant
(a) *Allium* (b) *Scilla* (c) *Lilium* (d) *Gloriosa*

185. Green leaf-like one internode long stem branches are called
(a) Phylloclades (b) Phyllodes (c) Bulbils (d) Cladodes

186. Stem tendrils occur in
(a) *Smilax* (b) *Gloriosa* (c) *Vitis* (d) *Lathyrus*

187. Which of the following is not related to corm
(a) Tunic (b) Lateral buds (c) Nodes (d) Scale leaves

188. Eye of potato is
(a) Apical bud (b) Axillary bud (c) Accessory bud (d) Adventitious bud

189. A stem with distinct solid nodes and hollow internodes is
(a) Sobole (b) Culm (c) Scape (d) Intercalary stem

Advance Level

190. The sensitive thread-like structures found in climbers which can coil around a support are
(a) Twiners (b) Tendrils (c) Trailers (d) Scramblers

191. A runner of water with one thick internode, found in aquatic rosette plants like *Eichhorina* (Water hyacinth) is called
(a) Stolon (b) Offset (c) Both correct (d) Both wrong

192. Horizontal branched rhizome is called straggling rhizome. It can be monopodial or sympodial. Monopodial rhizome is found in
(a) Lotus (*Nelumbo*) (b) *Saccharum* (Moonj)
(c) Allium sativum (d) Both (a) and (b) correct

193. In Rose, buds are found on stem at places other than nodes. These buds are known as
(a) Foliar (b) Cauline (c) Accessory (d) Radicle

194. A nongreen stem branch that grows obliquely or sometimes grows horizontally inside the soil and then comes out of the soil as a branch is called
(a) Stolon (b) Sucker (c) Offset (d) Rhizome

195. In Duranta, axillary buds and in Carrisa the apical bud is modified into stem thorns, what is correct for Ulex ? It has
(a) Leaf tendrils and stem spines (b) Leaf spines
(c) Stem thorns (d) Both stem thorns as well as leaf spines

196. In Garlic (*Allium sativum*) each fleshy scale represents a bud called bulbletor clove. It is a bud because

(a) It is borne on stem (b) It arises in the axil of tunicated leaf

(c) It has a growing point and immature leaves (d) All of these

197. A weak creeping stem, rooting at nodes and bear a series of plants of successive vegetative generations is called

(a) Trailer (b) Runner (c) Stolon (d) Offset

198. Tip of twiner is sensitive and coils around support itself. This coiling is called

(a) Nutation (b) Vernation (c) Epinasty (d) Circination

199. In potato tubers, reserve food is starch. It is stachyose in *Stachys* (Chinese artichoke) tubers. It Jerusalem artichoke (*Helianthus tuberosus*), the reserve food is in the form of fan shaped crystals composed of

(a) Starch (b) Insulin (c) Callose (d) Inulin

200. The coloured part in *Poinsettia* (*Euphorbia*) is

(a) Perianth (b) Petal (c) Leaf (d) Bract

201. Free lateral stipules occur in

(a) Mango / *Mangifera* (b) Maize / *Zea*

(c) Rice / *Oryza* (d) China Rose / *Hibiscus*

202. A leaf is identified from

(a) Flat green lamina (b) Presence of leaf blade and petiole

(c) Presence of axillary bud (d) Occurrence of chlorophyll

203. Leaves fall off from branches in winter due to

(a) Formation of abscission layer (b) Shortening of day length

(c) Fall in temperature (d) All the above

204. Finely dissected leaves occur in

(a) Free floating plants (b) Rooted floating leaved plants

(c) Submerged plants (d) Emerged plants

205. In Tamarind (Imli) the pinnate leaf is

(a) Tripinnate (b) Bipinnate (c) Paripinnate (d) Imparipinnate

206. Presence of sheathing leaf base and ligule are characteristic of

(a) Cycas leaf (b) Fern leaf (c) Banana leaf (d) Grass leaf

207. Approximate diameter of *Victoria* leaf is

(a) 1*m* (b) 1.3*m* (c) 2*m* (d) 3*m*

208. A dicotyledenous plant showing parallel venation is

(a) *Dioscorea* (b) *Smilax* (c) *Calophyllum* (d) *Hibiscus*

209. Bipinnate leaves are characteristic of

(a) Cruciferae (b) Solanaceae (c) Papilionoideae (d) Mimosoideae

210. In *Lathyrus aphaca*, the leaves are modified into

(a) Spine (b) Tendril (c) Scale (d) Stem-like structure

211. Swollen lower end of leaf stalk is
(a) Petiole (b) Pulvinus (c) Thalamus (d) Disc

212. In sweet pea, the tendrils are modified
(a) Stem branches (b) Leaflets (c) Leaves (d) Stipules

213. Bud scales of *Ficus* are modified
(a) Leaves (b) Stipules (c) Stem (d) Prickles

214. Imparipinnate leaf is the one where
(a) Leaflets are borne in pairs (b) Leaflets are small
(c) Leaflets are large (d) Rachis is terminated by an odd leaflet

215. Storage leaves occur in
(a) *Allium* (b) *Zizyphus* (c) *Triticum* (d) *Trapa*

216. A simple leaf is present in
(a) Peepal (b) *Mimosa* (c) Neem (d) All of these

217. Presence of ochreate stipules is a characteristic feature of the family
(a) Liliaceae (b) Solanaceae (c) Polygonaceae (d) Moraceae

218. Phyllotaxis is
(a) Mode of leaf arrangement on stem (b) Types of roots
(c) Arrangement of sepals and petals in a flower (d) Type of ovary

219. Tendrillar stipules occur in
(a) *Dolichos lablab* (b) *Acacia* (c) *Smilax* (d) Mango

220. In Gloriosa (Glory lily) the tendril is formed from
(a) Stipule (b) Leaf apex (c) Axillary bud (d) Leaf

221. Adnate stipules occur in
(a) China Rose (b) *Gardenia* (c) Rose (d) Cotton

222. Onion stores food in
(a) Underground stem (b) Fleshy scales (c) Root (d) Shoot

223. Main function of leaf is
(a) Manufacture of food (b) Nerve impulse conduction
(c) Increasing grandeur (d) Exchange of gases

224. A monocot can be distinguished from a dicot by
(a) Phyllotaxy (b) Aestivation (c) Venation (d) Vernation

225. Petiole is modified into tendril in
(a) *Passiflora* (b) *Gloriosa* (c) *Pisum* (d) *Clematis*

226. Swollen spongy petiole is present in
(a) *Hydrilla* (b) *Eichhornia* (c) *Ruppia* (d) *Pistia*

227. Which part of leaf shows venation
(a) Vagina (b) Mesopodium (c) Epipodium (d) Leaflet

228. Leaflets are called Pinnules in

(a) Twice pinnately compound leaf (b)Once pinnately compound leaf

(c) Thrice pinnately compound leaf (d)Decompound leaf

229. When leaves bear flower or inflorescence in their axil, they are called

(a) Cotyledonary leaves (Scutellum) (b)Bract leaves (Hypsophylls)

(c) Scale leaves (Cataphylls) (d)Floral leaves (Sporophylls)

230. 1/3 spiral phyllotaxy (called Tristichous) means

(a) 3 rows of alternate rows (b)In one circle, there are 3 leaves

(c) The angular divergence between 2 leaves is 120° (d)All of these

231. Axillary bud and stipules are absent in

(a) Simple leaves (b) Leaflets (c) Cauline leaves (d) Ramal leaves

232. Phythode of *Acacia auriculiformis* is a leaf modification because

(a) It does not arise in the axil of a leaf (b)It bears a bud in its axil

(c) It is vertical in position and reduces transpiration (d)All of these

233. When incision in a leaf is more than half way towards the midrib it is called

(a) Pinnatisect (b) Pinnatipartite (c) Pinnatifid (d) Palmatipartite

234. When the apex is pointed, hard and sharp like a spine as in Date Palm, it is called

(a) Emarginate (b) Cuspidate (c) Retuse (d) Mucronate

235. Quadrifoliate palmate compound leaf is found in

(a) *Trigonella* (b) *Trifolium* (c) *Marsillea* (d) *Bombax*

236. A mature angiosperm that bears only one leaf is

(a) *Welwitschia* (b) *Monophyllea* (c) *Rafflesia* (d) *Betula*

237. Tongue like out growth in the leaf of grasses is

(a) Stipule (b) Plumule (c) Ligule (d) Scutellum

238. Belt's corpuscles and leghaemoglobin is found in plants belonging to

(a) Papilionatae and calsalpinoideae respectively

(b) Caesalpinoideae and Mimosoideae respectively

(c) Mimosoideae and Papilionatae respectively (d) Papilionatae alone

239. Main photosynthetic organs of *Lathyrus sativus* plant are

(a) Leaves (b) Leaflets (c) Stipules (d) Phyllodes

240. Time interval between the appearance of two successive leaves or pairs of leaves is termed

(a) Hypsophyll (b) Plastochron (c) Cataphylls (d) Brachyblast

241. Leaf of marigold is

(a) Simple (b) Pinnately compound (c) Bipinnately compound (d)Decompound

242. Petiole is winged in

(a) Citrus (b) Pea leaf (c) *Dionea leaf* (d) Both (a) and (c)

243. Heterophylly has

(a) Morphological significance (b) Adaptive significance

(c) Anatomical significance (d) None of these

244. Leaves of which plant are economically important

(a) Coffee (b) Tea (c)*Ocimum* (d) Palms

245. In *Ficus* (Rubber plant) the young leaves are protected by reddish structures called bud scales. These are

(a) Stipules (b) Scales (c) Bracts (d) Bracteols

246. Leaf is

(a) Exogenous lateral outgrowth (b) Endogenous lateral outgrowth

(c) Superficial dorsal outgrowth (d) Vascular lateral growth

247. Vegina (Hypopodium = leaf base) is pulvinus in

(a) Grasses (b) All legumes

(c) Some legumes (d) Legumes and grasses

248. When petiole bears leaflets at its tip, it is a

(a) Simple leaf (b) Pinnate compound leaf

(c)Palmate compound leaf (d) Isobilateral leaf

249. Rachis is present in

(a) Pinnate compound leaf (b)Palmate compound leaf

(c) Both correct (d) Both wrong

250. The phyllotaxy in which two leaves arise from a bud at each node is

(a) Whorled (b) Alternate (c) Opposite (d) None of these

251. In Moringa (Drum stick), the leaves are

(a) Decompound (b) Unipinnate (c) Tripinnate (d) Palmate

252. Arrangement of floral leaves in a floral bud is called

(a) Vernation (b) Prefoliation (c) Aestivation (d) Ptyxis

253. Divergent multicostate reticulate venation is found in leaves of

(a) *Castor* (b) *Luffa* (c) Cotton (d) All of these

254. Unifoliate compound leaf is found in

(a) Mango (b) *Citrus* (c) *Asparagus* (d) Pea

255. The leaf of *Mimosa pudica* is

(a) Simple (b) Bifoliate (c) Bipinnate (d) Trifoliate

256. Unicostate venation is called as

(a) Palmate (b) Pinnate (c) Reticulate (d) Parallel

257. A phyllotaxy with two or more leaves present on the same node is

(a) Opposite (b) Verticillate (c) Whorled (d) Cyclic

258. Anisophylly is

(a) Different types of leaves on the same plant (b) Unequal sized opposite leaves

(c) Presence of lobed and entire leaves

(d) Leaves with unequal sized basal and terminal leaflets

259. In spiral phyllotaxy, the number of leaves at each node is

(a) One (b) Two (c)Many (d) Three

260. Phyllode is an adaptation to
(a) Heterophylly environment (b)Halophytic environment
(c) Mesophytic environment (d)Xerophytic environment

261. A unifoliate compound leaf can be differentiated from simple leaf in having
(a) Joint (b) Stalk
(c) Unicostate reticulate venation (d) Multicostate reticulate venation

262. In *Calotropis* the phyllotaxy is
(a) Alternate (b) Verticellate
(c) Opposite and superposed (d) Opposite and decussate

263. Which one is Schimper-Brown series
(a) $1/2,\ 1,\ 1,\ 1\frac{1}{2},\ 3,\ 4,\ 5\frac{1}{2}$ (b) 1, 1, 2, 3, 5, 8, 13
(c) 1/2, 1/3, 2/5, 3/8, 5/13, 8/21 (d) Both (b) and (c)

264. Phyllopodium is
(a) Whole leaf (b) Base of leaf
(c) Axis of leaf (d) Leaf made of mesopodium and epipodium

265. Rachis is modified into a leafy structure called
(a) Phyllode (b) Ochrea (c) Phylloclade (d) Phyllome

266. Where will you get spiny stipules for protection against grazing animals
(a) *Zizyphus* (b) *Acacia* (c) *Capparis* (d) All of these

267. In 3/8 alternate phyllotaxy (Called ostastichous)
(a) There are 8 leaves in 3 circles (b) 3 leaves in 8 circles
(c) There are 3 rows of leaves
(d) There are 8 rows of leaves on three sided stem

268. In 1/2 distichous phyllotaxy
(a) 2nd leaf lies on 1st leaf at 180° angle (b) 3rd leaf on 1st leaf at 180° angle
(c) 1st leaf lies exactly below 2nd leaf at 120° angle (d) None of these

269. A plant in which whole leaf is changed into a pitcher but is not an insectivorous is
(a) *Nepenthes* (b) *Darlingtonia* (c) *Sarracenia* (d) *Dischidia*

270. Phyllodes are common among
(a) Malvaceae (b) Papilionatae (c) Mimosoideae (d) Solanaceae

271. When leaves fall individually at different times it is called
(a) Caducous (b) Deciduous (c) Persistent (d) Abscission

272. Interpetiolar stipules occur in
(a) *Zizyphus* (b) *Ixora* (c) *Mangifera* (d) *Polygonum*

273. A unipinnate compound leaf can be differentiated from a branch having simple leaves by
(a) Presence of terminal bud in compound leaf (b) Absence of veins in the leaflets
(c) Presence of buds in the axils of leaflets (d) Presence of buds in the axils of leaves

274. Presence of leaves of more than one shape is common in amphibious plants (Helophytes) like *Limnophila*. This is called

(a) Heterozygosity (b) Heterosis (c) Heterophylly (d) Phyllotaxy

275. The arrangement and folding of each lamina without any relationship with other leaves in bud, is called

(a) Ptyxis (b) Vernation (c) Aestivation (d) Phyllotaxy

276. On the margins of leaves of a plant called *Bryophyllum* tiny plants grow complete with roots. These tiny plants fall of and continue to grow. This is a form of

(a) Hermophroditism (b) Vegetative reproduction

(c)Sexual reproduction (d) Reproduction by fission

277. In Banana, true stem is underground. The stem like structure outside soil is formed by

(a) Peduncle (b) Petiole of leaves

(c) Leaf bases (d) Overlapping of leaves

278. Leaves arising from an underground stem like bulb are called radical leaves. The leaves arise on nodes of stem branches are called

(a) Cauline (b) Ramal (c) Caducous (d) Deciduous

279. In *Pinguicula* (butterwort), leaves are large and fleshy and bear 2 types of glands. These are

(a) Stalked mucilage glands and sessile digestive glands

(b) Sessile mucilage and stalked digestive glands

(c) Unicellular mucilage and multicellular digestive glands

(d) Both mucilage and digestive glands are alike

280. The old bladders in *Utricularia* are useless as they contain used debris of insects. The insects are digested inside leaf bladders where digestive glands secrete digestive juice. These glands are

(a) One celled (b) Two celled (c) Three celled (d) Four celled

281. In *Acacia* species, the first few leaves are pinnately compound. Then there are leaves with flattened petiole and fewer pinnae. The leaves of adult plant has parallel veined flattened petiole and no pinnae. It shows that

(a) Leaves of adult plant are reduced to phyllodes while those of the seedling are unreduced

(b) The parallel-veined green structures of the adult plant are phylloclades

(c) The plant shows developmental heterophylly, compound in seedling and simple in adult plant

(d) The leaves of adult plant are unreduced while they are reduced in the seedling stage

282. In some plants like Cotton, *Eucalyptus* leaves change their shape. This helps to know the

(a) Physical conditions of the plant (b)Physiological maturity of plant

(c) Adaptability of plant (d)Data insufficient to predict

283. Leaves are changed into spines in xerophytic structures called

(a) Phyllode (b) Cladode (c) Phylloclade (d) All of these

284. Pinnately parallel venation is found in

(a) *Canna* (b) *Grass* (c) *Zizyphus* (d) Castor

285. Ochreate stipules occur in leafy vegetable
(a) *Amaranthus* (b) *Mentha* (c) *Platanus* (d) *Rumex*

286. Spiral phyllotaxy in which sixth leaf lies above the first one after completing two circles is
(a) Distichous (b) Tristichous (c) Pentastichous (d) Octastichous

287. Match the columns

(i) Acicular	(1) Grass
(ii) Linear	(2) Nerium
(iii) Lanceolate	(3) Banana
(iv) Oblong	(4) Pine

(a) (i) 4 (ii) 1 (iii) 2 (iv) 3 (b) (i) 4 (ii) 1 (iii) 3 (iv) 2
(c) (i) 4 (ii) 2 (iii) 3 (iv) 1 (d) (i) 4 (ii) 3 (iii) 2 (iv) 1

288. Leaves develop from
(a) Nodes (b) Internodes (c) Epidermis (d) Endodermis

289. Phyllode is found in
(a) *Clematis* (b) *Gloriosa* (c) *Acacia* (d) *Dischidia*

290. Parallel venation occurs in
(a) Monocots (b) Dicots (c) All angiosperms (d) Ferns

291. *Bombax* leaf is
(a) Tripinnate (b) Unipinnate (c) Multifoliate (d) Quadrifoliate
(e) Trifoliate

292. Name the plant having reticulate venation
(a) *Musa* (b) *Mangifera* (c) *Oryza* (d) *Canna*

293. In *Nepenthes* the pitcher is modified
(a) Whole leaf (b) Leaf apex (c) Lamina (d) Petiole

FLOWER

Basic Level

294. A placenta formed directly from thalamus and bearing a single ovule inside the ovary is
(a) Superficial (b) Parietal (c) Free central (d) Basal

295. Flower is intersexual in
(a) Date palm (b) *Cucurbita* (c) *Papaya* (d) *Hibiscus*

296. Thalamus is
(a) Base of flower (b) Base of ovary
(c) Modification of pollen (d) Modification of petal

297. Synandrous condition is fusion of
(a) Filaments only (b) Both filaments and anthers
(c) Anthers only (d) Petals

298. A characteristic of angiosperms is
(a) Flower (b) Root (c) Seed (d) All of these

299. Floral formula represents
(a) Position of flower (b) Symmetry of a flower
(c) Functions of a flower (d) Diagrammatic notation of floral characters

300. Placentation in legumes is
(a) Basal (b) Marginal (c) Axile (d) Free central

301. Ligulate/strap-shaped corolla occurs in sunflower in
(a) Disc florets (b) Immature florets
(c) Ray florets (d) Both ray and disc florets

302. A single basal ovule is present in
(a) Compositae (b) Malvaceae (c) Solanaceae (d) Cruciferae

303. Beauty of *Bougainvillea* flower is due to
(a) Corolla (b) Calyx (c) Bracts (d) Androecium

304. Petals possess claw in
(a) Solanaceae (b) Liliaceae (c) Malvaceae (d) Cruciferae

305. Flower is complete when it has
(a) Calyx, corolla, androecium and gynoecium (b) Calyx and corolla
(c) Androecium and gynoecium (d) Corolla, androecium and gynoecium

306. Epicalyx is
(a) A whorl of bracts (b) A whorl of bracteoles
(c) Involucre (d) Additional whorl of calyx

307. Tetradynamous condition is related to
(a) Androecium (b) Inflorescence (c) Perianth (d) Gynoecium

308. In monadelphous condition, stamens have
(a) Filaments of all united in one group but anthers are free
(b) Filaments united in groups but all anthers are free
(c) Anthers are fused but filaments are free (d) Both anthers and filaments are fused

309. Stamens attached to petals are
(a) Antipetalous (b) Epipetalous (c) Epiphyllous (d) Episepalous

310. Arrangement of sepals and petals with respect to each other is
(a) Venation (b) Vernation (c) Aestivation (d) Phyllotaxy

311. Pappus is characteristic of family
(a) Asteraceae/Compositae (b) Papaveraceae
(c) Papilionaceae/Fabaceae (d) Malvaceae

312. An apocarpous flower is found in
(a) *Caesalpinnia* (b) *Ranunculus* (c) *Brassica* (d) *Datura*

313. Axis developing between androecium and gynoecium is
(a) Anthophore (b) Androphore (c) Gynophore (d) Gynandrophore

314. A plant with both male and female flowers borne over it is
(a) Monoecious (b) Dioecious (c) Unisexual (d) Bisexual

315. Polyadelphous condition is related to
(a) Calyx (b) Androecium (c) Corolla (d) Gynoecium

316. Aestivation in which members of a whorl lie close but do not overlap
(a) Vexillary (b) Valvate (c) Imbricate (d) Twisted

317. Papilionaceous flower with large vexillum covering two wings and the wings covering the keel has corolla aestivation of
(a) Descending imbricate (b) Ascending imbricate (c)Twisted (d) Valvate

318. Flowers are monochlamydeous in
(a) Malvaceae (b) Fabaceae (c) Liliaceae (d) Polygonaceae

319. Ligulate corolla found in compositae is
(a) Wheel-shaped (b) Strap-shaped (c) Masked (d) Two-lipped

320. Butterfly shaped flower with one stranded, two wing-like and two keeled petal belong to
(a) Compositae (b) Rubiaceae (c) Malvaceae (d) Papilionaceae

321. National flower of India is
(a) Lotus (b) *Rosa* (c) *Carica* (d) *Colocasia*

322. Most important part in the life cycle of a plant is
(a) Leaf (b) Root (c) Flower (d) All of these

323. The most suitable flower for study of floral parts is
(a) Rose (b) Sunflower (c) Mustard (d) Cucumber

324. In Maize, the flowers are
(a) Absent (b) Unisexual but on different plants
(c) Bisexual (d) Unisexual but on the same plant

325. In *Mimosa pudica* the placentation is
(a) Basal (b) Marginal (c) Parietal (d) Axile

326. Diadelphous stamens occur in
(a) Gramineae (b) Cucurbitaceae (c) Papilionatae (d) Malvaceae

327. Persistant calyx is characteristics of
(a) *Allium*/Liliaceae (b) *Hibiscus*/Malvaceae
(c) *Dalbergia*/Papilionatae (d) *Solanum*/Solanaceae

328. Which of the family possess perianth of six coloured tepals
(a) Mimosoideae (b) Solanaceae (c) Liliaceae (d) Malvaceae

329. Odd sepal is enlarged and leaf-like in
(a) Rose (b) *Smilax* (c) *Mussaenda* (d) *Bougainvillea*

330. Sometimes sepals are modified into hairy structures which are useful in dispersal of seeds. These are called
(a) Tepals (b) Epik (c) Pappus (d) Trichome

331. Glumes are modified
(a) Petals (b) Bracts (Dry and scaly bracts)
(c) Gynoecium (d) Androecium

332. Vexillum, alea and keel are
(a) Androecium (b) Gynoecium (c) Corolla (d) Calyx

333. Pappus is modification of
(a) Bracts (b) Bracteoles (c) Corolla (d) Calyx

334. Cruciform corolla is found in
(a) Pea (b) China Rose (c) Radish (d) Sunflower

335. A longitudinal or vertical section of the flower indicates
(a) Type of pollination (b) Arrangement of members in a whorl
(c) Number of floral parts in whorls
(d) Manner of insertion of parts in different whorls

336. Two minute scales or lodicules occur in
(a) *Citrus medica* (b) *Triticum aestivum*
(c) *Helianthus annus* (d) *Gossypium herbaceum*

337. Inferior ovary occurs in
(a) Cruciferae (b) Compositae (c) Malvaceae (d) Ranunculaceae

338. Monadelphous androecium occurs in
(a) Pea (b) *Hibiscus* (c) *Brassica* (d) *Helianthus*

339. Which of the following is not a flower
(a) Passion flower (b) Sunflower (c) Rose (d) May flower

340. Arrangement of floral members which are partily spiral and partily in whorl is
(a) Cyclic (b) Acyclic (c) Hemicyclic (d) Pentacyclic

341. Flower of *Hibiscus* is
(a) Actinomorphic and epigynous (b) Actinomorphic and hypogynous
(c) Zygomorphic and hypogynous (d) Zygomorphic and epigynous

342. Hair present on the cob of corn are
(a) Seed hairs (b) Modified hairs of bracts
(c)Styles (d) Stigmas and styles

343. Versatile anther is attached to filament
(a) At top firmly (b) At base firmly
(c) Throughout length (d) About middle of connective allowing free movement

344. Placentation in a syncarpous unilocular ovary where ovules occur on sutures is
(a) Apical placentation (b) Parietal placentation
(c) Marginal placentation (d) Superficial placentation

345. An ovule is equivalent to
(a) Microsporophyll (b) Megasporophyll (c) Megasporangium (d) Microsporangium

346. Transversely placed syncarpous ovary occurs in
(a) Compositae (b) Cruciferae (c) Malvaceae (d) Cucurbitaceae

347. Opening of flowers in the cymose inflorescence is
(a) Acropetal (b) Centrifugal (c) Basipetal (d) Centripetal

348. Choose the product that is derived from style and stigma
(a) Saffron (b) *Fenugreek* (c) *Asafoetida* (d) *Psyllium*

349. Featnery (hairy) style is persistant in
(a) *Solanum* (b) *Clematis* (c) *Helianthus* (d) *Hibiscus*

350. Ray florets of sunflower (Compositae) are
(a) Bisexual (b) Unisexual (c) Asexual (d) None of these

351. Tricarpellary axile placentation is characteristic of
(a) Solanaceae (b) Malvaceae (c) Liliaceae (d) Cruciferae

352. Ovary is called inferior in
(a) Hypogynous condition (b)Epigynous condition
(c)Perigynous condition (d) None of these

353. Marginal placentation is found in
(a) Solanaceae (b) Cruciferae
(c) Fabaceae/Leguminosae (d) Asteraceae/Compositae

354. Part of pistil which receives pollen is
(a) Ovary (b) Style (c) Stigma (d) Ovule

355. Versatile anthers occur in
(a) *Helianthus annus* (b) *Oryza sativa* (c) *Solanum tuberosum* (d) *Hibiscus esculentus*

356. Aestivation of corolla in Pea is
(a) Contorted (b) Valvate (c) Imbricate (d) Vexillary

357. Gynobasic style is found in
(a) Labiatae (b) Liliaceae (c) Gramineae (d) Compositae

358. Monocarpellary pistil with unilocular ovary and marginal placentation are found in
(a) Compositae (b) Leguminosae (c) Cruciferae (d) Solanaceae

359. The perianth is the term used when
(a) Androecium and gynoecium are similar (b) Androecium and calyx are similar
(c) Corolla and gynoecium are similar (d) Calyx and corolla are similar

360. A flower is actinomorphic when it is divisible into two
(a) Halves having equal number of sepals and petals
(b) Similar halves by a vertical division in any plane
(c) Similar halves by a vertical division in one plane only
(d) Halves having similar parts by a transverse division

361. A flower is zygomorphic when
(a) Any transverse section divides it into two equal halves
(b) Only one transverse section divides it into two equal halves
(c) Every vertical section passing through its centre divides it into two equal halves
(d) Only one vertical section passing through its centre divides it into two equal halves

362. Flower is a modified shoot as
(a) Thalamus may elongate to show internodes (b) There is aggregation into inflorescence
(c) It bears essential organs (d) It may have epicalyx

363. Which is correct about flower ? It is modified
(a) Root (b) Shoot (c) Leaf (d) Inflorescence

364. Which is present in monocot flowers
(a) Sepals (b) Petals (c) Tepals (d) None of these

365. Smallest flower belongs to
(a) *Rosa indica* (b) *Wolffia microscopica*
(c) *Ranunculus scleratus* (d) *Colocasia antiquorum*

366. Largest flower is that of
(a) Sunflower (b) *Rafflesia* (c) *Nelumbo* (d) *Drosera*

367. Polyadelphous anthers are present in
(a) Sunflower (b) Lemon (c) Lady's finger (d) Peanut

368. Basifixed monothecous anthers (OR) anthers with two microsporangia is characteristics of
(a) Leguminosae/Pea (b) Malvaceae/Cotton (c) Solanaceae/Tomato (d) Liliaceae/Onion

369. Tetradynamous condition is characteristics of
(a) *Liliaceae/Allium/Asphodelus* (b) Cruciferae/Mustard/Iberis
(c) Malvaceae/*Althea/Hibiscus* (d) Solanaceae/*Nicotiana/Petunia*

370. Flowers of Liliaceae, Malvaceae and Solanaceae are
(a) Hypogynous (b) Perigynous (c) Epigynous (d) Amphigynous

371. Staminodes occur in family
(a) Papilionatae/*Arachis* (b)Malvaceae/*Hibiscus*
(c) Caesalpinoideae/*Cassia* (d) Cruciferae/*Iberis*

372. Zygomorphy in *Cassia* flower is due to
(a) Calyx (b) Corolla (c) Staminodes (d) Placentation

373. Flowers and stamens of compositae are
(a) Hypogynous and inferior (b) Epigynous and superior
(c) Hypogynous and superior (d) Epigynous and inferior

374. Compound apocarpous gynoecium is found in
(a) Lily (b) Hollyhock (c) Lotus/*Ranunculus* (d) Pumpkin

375. The primitive type of stamens are found in the flowers family
(a) Liliaceae (b) Malvaceae
(c) Gramineae/Poaceae (d) Degeneriaceae/Magnoliaceae

376. Cruciferae differ from Malvaceae in the presence of
(a) Multicarpellary unilocular ovary and siliqua fruit
(b)Multicarpellary multilocular ovary and capsule fruit
(c) Monocarpellary, multilocular ovary with capsule fruit
(d) Multicarpellary unilocular ovary and cypsella fruit

377. Which of the family does not possess axile placentation
(a) Solanaceae (b) Malvaceae
(c) Leguminosae/Cruciferae (d) Liliaceae

378. Perigynous condition is common among
(a) Liliaceae (b) Solanaceae (c) Leguminosae (d) Malvaceae

379. Stylopodium is present in
(a) Mustard (b) *Petunia* (c) Coriander (d) Pea

380. When stamens are superior the flower is
(a) Hypogynous (b) Perigynous (c) Epigynous (d) Hypogeous

381. Oblique septum and swollen placenta is characteristic feature of
(a) *Gloriosa superba* (b) *Capsicum frutescence* (c) *Althea rosea* (d) *Dalbergia sissoo*

382. In which of the following family the stamens are concealed into keel that is cleistostemonous
(a) Mimosoideae (b) Caesalpinoideae (c) Papilionatae (d) Leguminosae

383. When stamens are adnate (fused) to perianth it is termed
(a) Episepalous (b) Epipetalous (c) Epiphyllous (d) Polyphyllous

384. Gynostegium (Fusion of anthers with stigma) and pollinia are present in family
(a) Apocynaceae (b) Asclepiadaceae
(c) Convolvulaceae (d) Solanaceae/Cucurbitaceae

385. Which of the character does not become apparent in floral formula
(a) Placentation and aestivation (b)Number of floral parts
(c) Whorls of floral parts (d)Position of ovary

386. The typical floral formula of Papilionaceae is
(a) $\oplus$ ♀ $K_{(5)}\ C_{(5)}\ A_5\ \underline{G_2}$ (b) $\oplus$ ⚤ $K_{(5-4)}\ C_{(5-4)}\ A\ \underline{G_5}$
(c) % $K_5\ C_{1-2+(2)}\ A_{1+(9)}\ \underline{G_1}$ (d) % ♀ $K_{(5)}\ C_5\ A_{10}\ \underline{G_1}$

387. Floral formula of Caesalpinoideae is
(a) + ♀ $K_5\ C_{(5)}\ A_{1+(9)}\ \underline{G_1}$ (b)+ ♀ $K_{(5)}\ C_{(5)}\ A_5\ G_1$
(c) % ♀ $K_5\ C_{(5)}\ A_{10}\ G_1$ (d)Br + ♀ $K_5\ C_5\ A_{5+5}\ \underline{G_1}$

388. Floral formula of mustard (or) Cruciferae is
(a) $\oplus$ ♀ $K_{(5)}\ C_{(5)}\ A_5\ \underline{G_{(2)}}$ (b) Ebr ⚥ $K_{2+2}\ C_4\ A_{2+4}\ \underline{G_{(2)}}$
(c) $\oplus$ ♀ $K_5\ C_5\ A_{(5)}\ \underline{G_{(2)}}$ (d) $\oplus$ ♀ $K_5\ C_5\ A_5\ \underline{G_{(2)}}$

389. The division of Leguminosae into its sub families is based upon (or) the Leguminosae is distinguished on the basis of
(a) K and C (b) K and A (c) C and A (d) A and G

390. Ascending imbricate corolla is found in
(a) *Pisum*/Papilionatae (b) *Tamarindus*/Caesalpinoidae
(c) *Mimosa*/Mimosoidae (d) *Datura*/Solanaceae

391. Two spines in *Trapa* fruit ('Singhara' fruit) are modifications of
(a) Seed coat (b) Pericarp (c) Sepals (d) Bracts

392. Parachute like pappus is found in
(a) Liliaceae/Cotton (b) Gramineae/Paddy
(c) Compositae/Marigold (d) Solanaceae/Calotropis

393. In Gossypium the type of cohesion is
(a) Monoadelphous (b) Diadelphous (c) Polyadelphous (d) Monothecous

394. Which of the following family is characterized by 6-dicylic diplestemonous stamens
(a) Mimosoideae (b) Solanaceae (c) Malvaceae (d) Liliaceae

395. Obdiplostemonous condition is that in which the stamens are in two whorls and
(a) Outer whorl is fused to inner whorl (b) Outer whorl is opposite to petals
(c) Inner whorl is opposite to petals
(d) Both inner as well as outer whorls are opposite to petals

396. The side of a flower facing the mother axis is called
(a) Anterior side (b) Posterior side (c) Dorsal side (d) Ventral side

397. When the anthers mature earlier than the stigma of ones own flower, the condition is known as
(a) Herkogamy (b) Protandry (c) Heterostyly (d) Heterogamy

398. Anthophore is an internode between
(a) Two opposite leaves in spiral phyllotaxy (b) Calyx and corolla
(c) Corolla and androecium (d) Androecium and gynoecium

399. In *Hibiscus rosa-sinensis* there is an additional floral whorl known as
(a) Calyx (b) Involucre (c) Epicalyx (d) Obdiplostemonous layer

400. Study of flowers is
(a) Anthology (b) Pomology (c) Floriculture (d) Spermology

401. Maturation of male and female sex organs at different time in a flower is called
(a) Apogamy (b) Polygamy (c) Dichogamy (d) Herkogamy

402. A true gynophore is present in
(a) *Capparis* and *Cleome* (b)*Euphorbia* and *Capparis*
(c) *Passiflora and Cleome* (d) All of these

403. Most primitive placenta is superficial. Which one is most advanced
(a) Basal (b) Parietal (c) Axile (d) Marginal

404. *Thymus* possesses two types of plants, female flowered and hermaphrodite flowered. The condition is called

(a) Trioecious (b) Polygamous (c) Gynomonecious (d) Gynodioecious

405. In syngynia the flowers are

(a) Epigynous (b) Fused to form a disc

(c) Fused by gynaecia only (d) Both (a) and (b)

406. The term Anthesis is used for

(a) Cluster of anthers (b) Opening of flowers (c) Dehiscence of anthers (d)Falling of flowers

407. Largest flower of India is

(a) *Wolfia* (b) *Victoria* (c) *Rafflesia* (d) *Sapria*

408. In which of the following androgynophore is present

(a) *Brassica* (b) *Helianthus* (c) *Nelumbium* (d) *Gynandropsis*

409. The whorl of bracts present below the infloresence of *Helianthus* is

(a) Bract (b) Involucel (c) Involucre (d) Stipule

410. Leafy or vegetative bract is characteristics of the flower of

(a) Cruciferae (b) Malvaceae (c) Liliaceae (d) Papilionatae

411. Inflorescence of *Tagetes* bears

(a) Male flowers only (b) Staminate and pistillate flowers

(c) Bisexual and male flowers (d) Perfect and pistillate flowers

412. Placenta of a flower is a tissue that

(a) Forms pollen grains (b) Attaches stamens with corolla/sepals/tepals

(c) Bears ovules (d) Bears corona

413. Corolla with four diagonally arranged petals is

(a) Vexillary (b) Cruciform (c) Gamopetalous (d) Caryophyllaceous

414. When two stamens are short and two are long, they are

(a) Tetradynamous (b) Didynamous

(c) Long and short stamens (d) Varied stamens

415. $A_{1+(9)}$ stands for

(a) Adelphous (b) Synantherous (c) Diadelphous (d) None of these

416. Pollinia are sac like structures

(a) Which secrete yellow substance called pollenkit material

(b) In which pollen grains are present in mass

(c) In which anther lobes are present (d) Which are found in megasporangia

417. Androecium having dissimilar stamens is

(a) Unequal (b) Heterostemonous (c) Diplostemonous (d) Obdiplostemonous

418. When the anthers do not possess pollen grains at all, these are known as

(a) Staminodes (b) Basifixed anthers (c) Antheroids (d) Petalloid

419. In which of the following superficial placentation is seen

(a) *Calotropis* (b) *Nymphaea* (c) *Argemone* (d) *Cosmos*

420. A gamopetalous funnel like corolla is called
(a) Campanulate (b) Bilabiate (c) Infundibuliform (d) Caryophyllaceous

Advance Level

421. Gynobasic style is that which arises from the base of the thalamus. It is found in
(a) *Salvia* (b) *Petunia* (c) *Brassica* (d) Pea

422. When both sexes are absent from a flower or are non-functional, the flower is said to be
(a) Neutral (b) Incomplete (c) Unisexual (d) Intersexual

423. If the thalamus projects into the ovary and the carpels remain attached to it. It is known as
(a) Carpophore (b) Thalamophore (c) Anthophore (d) Androphore

424. When the placentae bearing ovules develop from the central axis of ovary having one placenta in each chamber, the placentation is called
(a) Axile (b) Basal (c) Parietal (d) Marginal

425. When the filaments are attached to the carpels throughout their whole length or by their anthers only, the condition is called
(a) Epigynous (b) Gynandrous (c) Epiphyllous (d) None of these

426. Bicarpellary syncarpous gynoecium, parietal placentation, tetradynamous stamens and siliqua fruit are characteristic features of family
(a) Cucurbitaceae (b) Cruciferae (c) Compositae (d) Solanaceae

427. Bilocular oblique ovary with numerous shining ovule on swollen axile placenta is the characteristics of
(a) Cruciferae (b) Solanaceae (c) Liliaceae (d) Malvaceae

428. Persistent calyx forms a dry bladder like structure enclosing edible berry in
(a) *Physalis* (b) *Nicotiana* (c) *Capsicum* (d) *Solanum*

429. When the filaments are united into a number of bundles but the anthers are free the stamens are said to be
(a) Monoadelphous (b) Diadelphous (c) Polyadelphous (d) Syngenesious

430. Placentation, in which ovules develop on axial column, not connected with ovary wall is called
(a) Axile (b) Parietal (c) Free-central (d) Marginal

431. In many cultivated ornamental flowers, number of petal whorls is higher than the one in wild type. Extra petals are generally modified
(a) Sepals (b) Petals (c) Stamens (d) Pistils

432. When two of the sepals or petals are outer, two are inner and one is partly outer partly inner, this condition is known as
(a) Imbricate aestivation (b) Quincuntial aestivation
(c) Twisted aestivation (d) Valvate aestivation

433. In a multilocular ovary there are numerous carpels, the placentae develop all around the inner surface of the partition wall. Such a placentation is said to be
(a) Basal (b) Superficial (c) Parietal (d) Free central

434. The correct floral formula of Liliaceae is

(a) $\oplus \male\!\!\!\!\female$ $P_{3+3}\ A_6\ \underline{G_{(3)}}$ (b) $\oplus \male\!\!\!\!\female$ $P_{3+3}\ A_{3+3}\ \underline{G_{(3)}}$ (c) † $\male\!\!\!\!\female$ $P_{3+3}\ A_{3+3}\ \underline{G_{(3)}}$ (d) † $\male\!\!\!\!\female$ $P_{3+3}\ A_{3+3}\ \underline{G_{(6)}}$

435. The two families dominate in having maximum useful plants

(a) Fabaceae and Poaceae (b)Liliaceae and Solanaceae

(c) Malvaceae and Brassicaceae (d)Liliaceae and Poaceae

436. Which of the following is regarded as equivalent to perianth

(a) Glume (b) Lodicule (c) Superior palea (d) Inferior palea

437. Pepo fruit is found in

(a) Cruciferae (b) Cucurbitaceae (c) Liliaceae (d) Solanaceae

438. The systematic position of Cucurbitaceae according to Bentham and Hooker's system

(a) Thalamiflorae, Parietales (b) Inferae, Asterales

(c) Calyciflorae, Rosales (d) Calyciflorae, Passiflorales

439. Touch me not belongs to

(a) Liliaceae (b) Solanaceae (c) Mimosoideae (d) Malvaceae

440. Which of the following families is characterised by the presence of perianth

(a) Malvaceae (b) Liliaceae (c) Cruciferae (d) Solanaceae

441. The botanical name of Satawar is

(a) *Smilax* (b) *Asparagus* (c) *Yucca* (d) *Lilium*

442. *Dalbergia* belongs to

(a) Liliaceae (b) Malvaceae (c) Leguminosae (d) Solanaceae

443. Indian telegraph plant (*Desmodium gyrans*) belongs to

(a) Malvaceae (b) Leguminosae (c) Solanaceae (d) Liliaceae

444. Which of the following is phylogenetically most advanced of the dicotyledonous families

(a) Acanthaceae (b) Scrophulariaceae (c) Compositae (d) Umbelliferae

445. The condition of stamens in Cruciferae family is correctly expressed as

(a) A_6 (b) A_{2+4} (c) A_{4+2} (d) All of these

446. The androecium of Malvaceae is

(a) Didynamous (b) Tetradynamous (c) Diadelphous (d) Monadelphous

447. Rutaceae differs from Malvaceae in having

(a) Simple leaves (b) Polypetalous corolla

(c) Syncarpous, superior ovary (d) Obdiplostemonous stamens

448. Which statement is wrong for compositae

(a) 5-lobed stamens (b) Syngenesious stamens (c) Basal ovule (d) Ligulate ray florets

449. The floral formula for Malvaceae is

(a) $\oplus \overset{\circ}{+}$ $\text{Epi}_{(3-7)}\ \overset{\frown}{\text{K}}_{(5)}\ \text{C}_{(5)}\ \text{A}_{(\infty)}\ \underline{G_{(5)}}$

(b) $\oplus \overset{\circ}{+}$ $\text{Epi}_{(3-7)}\ \overset{\frown}{\text{K}}_{(5)}\ \text{C}_{5}\ \text{A}_{5}\ \underline{G_{(5)}}$

(c) $\oplus \overset{\circ}{+}$ $\text{Epi}_{(3\text{-}7)}\ \overset{\frown}{\text{K}}_{(5)}\ \text{C}_{5}\ \text{A}_{(\infty)}\ \underline{G_{(5)}}$

(d) $\oplus \overset{\circ}{+}$ $\text{Epi}_{(3\text{-}7)}\ \overset{\frown}{\text{K}}_{(5)}\ \text{C}_{(5)}\ \text{A}_{(\infty)}\ \underline{G_{(3-\infty)}}$

450. Red Gram is

(a) *Phaseolus aureus* (b) *Cicer arietinum* (c) *Cajanus cajan* (d) *Phaseolus mungo*

451. $\oplus \breve{\varphi}$ $\text{K}_{2+2}\ \text{C}\times_4\ \text{A}_{2+4}\ \underline{G_{(2)}}$ is floral formula of

(a) *Allium cepa* (b) *Solanum nigrum* (c) *Helianthus annuus* (d) *Brassica nigra*

452. Botanical name of Radish is

(a) *Brassica nigra* (b) *Brassica oleracea* (c) *Raphanus sativus* (d) None of these

453. Millets belong to

(a) Fabaceae (b) Poaceae (c) Liliaceae (d) Asteraceae

454. Commissural stigma (Along carpellary cohesion plane) occurs in family

(a) Solanaceae (b) Liliaceae (c) Cruciferae (d) Fabaceae

455. A monocot showing reticulate venation is

(a) *Bombusa* (b) *Smilax* (c) *Callophyllum* (d) *Ginkgo*

456. Name the plant from seeds of which oil is obtained

(a) *Cicer arietinum* (b) *Saccharum officinarum*

(c) *Saccharum munja* (d) *Arachis hypogea*

457. Chief features of family Brassicaceae/Cruciferae is presence of

(a) Latex (b) Pectin (c) Alkaloids (d) Myrosin enzyme

458. *Carthamus tinctorium* belongs to family

(a) Asteraceae (b) Solanaceae (c) Malvaceae (d) Fabaceae

459. Botanical name of Cauliflower is

(a) *Brassica oleracea* var. *capitata* (b) *Brassica campesteris*

(c) *Brassica oleracea* var. *botrytis* (d) *Brassica oleracea* var. *gemmifera*

460. Plants are always herbs in

(a) Fabaceae (b) Solanaceae (c) Brassicaceae (d) None of these

461. A family belongs to inferae of gamopetalae

(a) Fabaceae (b) Liliaceae (c) Asteraceae (d) Brassicaceae

462. A family delimited by type of inflorescence is

(a) Fabaceae (b) Asteraceae (c) Solanaceae (d) Liliaceae

463. Axile placentation occurs in

(a) Asteraceae and Fabaceae (b) Brassicaeae and Solanaceae

(c) Solanaceae and Liliaceae (d) Brassicaceae and Solanaceae

464. A diagnostic trait for identification of fabaceous flower is

(a) Tetradynamous androecium (b) Inferior ovary

(c) Cruciform corolla (d) Vexillary aestivation

465. Indian Mustard or Rai is

(a) *Brassica juncea* (b) *Brassica nigra*

(c) *Brassica rapa* (d) *Brassica campesteris*

466. Botanical name of Finger Millet is

(a) *Sorghum vulgare* (b) *Eleusine coracana*

(c) *Amaranthus viridis* (d) *Pennisetum typhoides*

467. Flower of Fabaceae is

(a) Complete, zygomorphic, pentamerous (b) Complete, actinomorphic, trimerous

(c) Incomplete, zygomorphic, trimerous (d) Incomplete, actinomorphic, pentamerous

468. Ovary having basal placentation is

(a) Monocarpellary bilocular (b) Bicarpellary, syncarpous and unilocular

(c) Multicarpellary, syncarpous and unilocular (d) Syncarpous with two or more carpels

469. Most important character of *Brassica campesteris* is

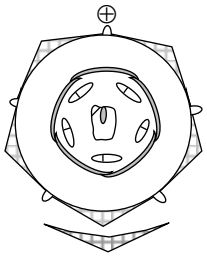
(a) False septum (b) Parietal placentation

(c) Ebracteate (d) Imbricate aestivation

470. In fabaceae, one of the following immediately encloses the essential organs

(a) Anterior petals (b) Posterior petal (c) Lateral petals (d) Sepals

471. Choose the correct description depicted by floral diagram



(a) United valvate sepals, free twisted petals, free stamens, unilocular ovary with marginal placenta

(b) United valvate sepale, free imbricate petals, free stamens, unilocular ovary with axile placenta

(c) United valvate sepals, free imbricate petals, epipetalous stamens, unilocular ovary with marginal placenta

(d) United valvate sepals, free imbricate petals, free stamens, unilocular ovary with marginal placentation

472. Compositae is also known as

(a) Fabaceae (b) Asteraceae (c) Liliaceae (d) Poaceae

473. Four sepals arranged in two whorls is characteristic of family

(a) Solanaceae (b) Fabaceae (c) Brassicaceae (d) Liliaceae

474. Name the family having (9)+1 arrangement of stamens

(a) Solanaceae (b) Asteraceae (c) Liliaceae (d) Fabaceae

475. Largest family of flowering plants is

(a) Fabaceae (b) Liliaceae (c) Poaceae (d) Asteraceae

476. Fruit dispersal in Asteraceae is usually by

(a) Mechanical means (b) Wind (c) Water (d) Animals

477. Family Fabaceae belongs to series

(a) Inferae (b) Thalamiflorae (c) Calyciflorae (d) Disciflorae

478. Familiar examples of family Liliaceae are

(a) *Allium cepa*, *Aloe vera* and *Tamarindus indica*

(b) *Saraca india*, *Allium cepa* and *Aloe vera*

(c) *Allium sativum*, *Allium cepa* and *Aloe vera*

(d) *Tamarindus indica*, *Allium cepa* and *Allium sativum*

479. Russian Millet, *Digitaria*, is grown in

(a) Bihar (b) Karnataka (c) Rajasthan (d) Meghalaya

480. Which one is odd

(a) *Allium cepa* (b) *Helianthus annuus* (c) *Brassica juncea* (d) *Arachis hypogea*

481. Scientific name of Sunflower is

(a) *Brassica compesteris* (b)*Pisum sativum*

(c) *Helianthus annuus* (d) *Gossypium herbaceum*

482. *Colchicum autumnale* is a member of

(a) Brassicaceae (b) Liliaceae (c) Poaceae (d) Fabaceae

483. A weed belonging to family Asteraceae which has spread in all parts of India is

(a) *Nicotiana* (b) *Oryza* (c) *Parthenium* (d) *Hordeum*

484. Epipetalous and syngenesious stamens occur in

(a) Solanaceae (b) Brassicaceae (c) Fabaceae (d) Asteraceae

485. *Iberis*, a winter annual, is popularly called

(a) Candytuft (b) Shepherd's Purse (c) Wall flower (d) Pansy

486. Carbohydrate rich food is got from

(a) Brassicaceae (b) Poaceae (c) Fabaceae (d) Asteraceae

487. *Raphanus* belongs to

(a) Asteraceae (b) Brassicaceae (c) Solanaceae (d) Liliaceae

488. A crop plant which can grow well even in nitrogen deficient soil is

(a) *Helianthus annuus* (b) *Gossypium herbaceum*

(c)*Brassica campesteris* (d) *Cajanus cajans*

489. Bicarpellary, syncarpous, unilocular ovary with basal placentation occurs in

(a) Liliaceae (b) Solanaceae (c) Asteraceae (d) Fabaceae

490. Pulses are obtained from

(a) Fabaceae (b) Asteraceae (c) Poaceae (d) Solanaceae

491. *Lycopersicum esculentum* is the name of

(a) Tomato (b) Potato (c) Cabbage (d) Brinjal

492. Which is false about Asteraceae

(a) Cypsela fruit (b) Syngenesious androecium

(c) Head inflorescence (d) Hypogynous inflorescence

493. Which of the following is correct with reference to flowers of family solanaceae

(a) Pentamerous, actinomorphic, unisexual, hypogynous

(b) Pentamerous, zygomorphic, bisexual, epigynous

(c) Pentamerous, bisexual, actinomorphic, hypogynous

(d) Trimerous, actinomorphic, bisexual, hypogynous

494. Mark the correct statement for Gramineae

(a) The carpel has two styles (b)Spikelets are always in pairs

(c) Palea is the bracteole (d) Awn is an appendage of the palea

495. The typical formula for Gramineae is

(a) $\oplus \quad P_2\ A_3$ or $_6\underline{G}_{(2)}$ (b) $\oplus \quad P_2\ A_3$ or $_6\underline{G}_{(1)\text{or}(3)}$

(c) $\oplus\ \varnothing\ P_3\ A_2\ \underline{G}\ \underline{1}$ (d) $\oplus\ \varnothing\ P_{0\text{ or }2}\ A_{3\text{ or }6}\ \underline{G}\ 1$

496. In Gramineae, the perianth is represented by small scaly Iodicules which are generally

(a) Two (b) Three (c) Four (d) Five

497. In family Gramineae, the inflorescence is

(a) Capitulum (b) Verticellaster (c) Hypanthodium (d) Spike of spikelet

498. Potato belongs to the family

(a) Solanaceae (b) Compositae (c) Gramineae (d) Cruciferae

499. *Lycopersicun esculentum* belongs to

(a) Malvaceae (b) Cruciferae (c) Solanaceae (d) None of the above

500. The carpels of *Solanum* flower are obliquely placed because

(a) Posterior and anterior carpels turn by 180°

(b) Posterior and anterior carpels move to the left

(c) Posterior carpels turn to right are anterior to the left

(d) Posterior carpels turn to left and anterior to the right

501. Datura belongs to

(a) Compositae (b) Labiatae (c) Malvaceae (d) Solanaceae

502. Potato, tomato, brinjal, mustard and cauliflowers belong to how many genera

(a) Five (b) Four (c) Three (d) Two

***

ANSWER

ASSIGNMENT (BASIC AND ADVANCE LEVEL)

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
a	b	b	c	a	a	c	d	c	d	b	a	c	d	d	b	d	b	c	a
21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40
c	c	a	a	b	c	b	b	d	c	d	b	d	a	c	a	d	b	a	d
41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60
b	d	c	d	d	d	c	a	d	b	c	d	c	d	d	b	b	b	b	a
61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80
a	d	d	d	c	b	b	b	d	a	b	d	d	d	a	b	c	a	c	d
81	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96	97	98	99	100
a	d	a	c	c	d	b	c	d	d	c	d	d	a	c	c	b	b	a	c
101	102	103	104	105	106	107	108	109	110	111	112	113	114	115	116	117	118	119	120
c	b	a	c	b	a	a	c	d	c	c	a	a	a	d	b	a	a	c	c
121	122	123	124	125	126	127	128	129	130	131	132	133	134	135	136	137	138	139	140
a	d	c	b	a	d	b	c	a	d	d	d	a	a	c	c	a	b	d	a
141	142	143	144	145	146	147	148	149	150	151	152	153	154	155	156	157	158	159	160
c	a	a	a	d	b	a	c	c	b	b	d	d	b	a	b	a	c	d	d
161	162	163	164	165	166	167	168	169	170	171	172	173	174	175	176	177	178	179	180
b	d	a	b	c	a	b	a	b	a	b	a	d	d	b	d	c	a	a	c
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d	c	a	c	c	d	b	c	d	b	b	b	b	d	a	a	c	a	c	b
221	222	223	224	225	226	227	228	229	230	231	232	233	234	235	236	237	238	239	240
c	b	a	c	d	b	c	a	b	d	b	d	b	b	c	b	c	c	c	b
241	242	243	244	245	246	247	248	249	250	251	252	253	254	255	256	257	258	259	260
a	d	b	b	a	a	c	c	a	c	c	a	d	b	c	b	c	b	a	d
261	262	263	264	265	266	267	268	269	270	271	272	273	274	275	276	277	278	279	280
a	d	c	c	a	d	a	b	d	c	c	b	d	c	a	b	c	b	a	d
281	282	283	284	285	286	287	288	289	290	291	292	293	294	295	296	297	298	299	300
a	b	a	a	d	c	a	a	c	a	c	b	c	d	d	a	b	a	d	b

301	302	303	304	305	306	307	308	309	310	311	312	313	314	315	316	317	318	319	320
c	a	c	d	a	b	a	a	b	c	a	b	c	a	b	b	a	d	b	d
321	322	323	324	325	326	327	328	329	330	331	332	333	334	335	336	337	338	339	340
a	c	c	d	b	c	d	c	c	c	b	c	d	c	d	b	b	b	d	c
341	342	343	344	345	346	347	348	349	350	351	352	353	354	355	356	357	358	359	360
b	d	d	b	c	b	b	a	b	b	c	b	c	c	b	d	a	b	d	b
361	362	363	364	365	366	367	368	369	370	371	372	373	374	375	376	377	378	379	380
d	a	b	c	b	b	b	b	b	a	c	c	b	c	d	a	c	c	c	c
381	382	383	384	385	386	387	388	389	390	391	392	393	394	395	396	397	398	399	400
a	c	b	b	a	c	d	b	c	b	c	c	a	d	b	b	b	b	c	a
401	402	403	404	405	406	407	408	409	410	411	412	413	414	415	416	417	418	419	420
c	a	a	d	c	b	d	d	c	b	d	c	b	b	c	b	b	a	b	c
421	422	423	424	425	426	427	428	429	430	431	432	433	434	435	436	437	438	439	440
a	a	a	a	b	b	b	a	c	c	c	b	b	b	a	b	b	d	c	b
441	442	443	444	445	446	447	448	449	450	451	452	453	454	455	456	457	458	459	460
b	c	b	c	b	d	d	a	c	c	d	c	b	c	b	d	d	a	a	c
461	462	463	464	465	466	467	468	469	470	471	472	473	474	475	476	477	478	479	480
c	b	c	d	a	b	a	b	b	a	d	b	c	d	d	b	c	c	d	a
481	482	483	484	485	486	487	488	489	490	491	492	493	494	495	496	497	498	499	500
c	b	c	d	a	b	b	d	c	a	a	d	c	c	d	a	d	a	c	c
501	502
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d	c

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