DAY FIVE

Morphology of Flowering Plants

Learning & Revision for the Day

- Root
- Stem
- Leaf
- Inflorescence
- Flower
- Some Important Floral Terms
- Fruit
- Seed
- Some Important Families of Flowering Plants

- **Plant morphology** deals with the study of forms and features of different plant organs, i.e. roots, stems, leaves, flowers, seeds, fruits, etc. including their development.
- **Angiosperms** (Gr. *Angion*–vessels, *sperma*–seed) are flowering, fruit bearing phanerogamic, spermatophytic and sporophytic plants. They appeared about 130 million years ago but comprise about 3,00,000 species or 50% of all plants.
- The smallest angiosperm is rootless aquatic *Wolffia* and the tallest angiosperm is *Eucalyptus* (over 100 metres).

Types of Flowering Plants

1. On the basis of shape and size, **Theophrastus** classified the plants into following types

- **Herbs** have soft stems and are small sized plants, e.g. mustard and radish.
- **Shrubs** have woody stem and are of intermediate size, bushy and perennial, e.g. China rose and *Croton*.
- **Trees** are perennial and large sized having hard woody branches.

They have many sub-types

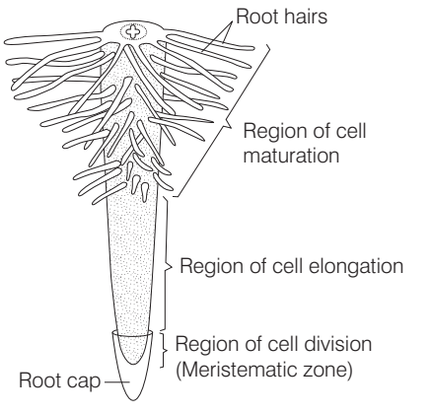
- **Culm** is unbranched, jointed with distinct nodes and hollow internodes, e.g. *Bambusa.*
- **Caudex** has unbranched trunk with crown of terminal leaves present, e.g. *Areca catechu, Cocos nucifera* and palms.
- **Excurrent** is monopodial with one main stem or trunk from base to apex. Branches are acropetal and have cone-like appearance, e.g. *Casuarina, Eucalyptus*.
- **Deliquescent** has lateral branches and large suppression of terminal bud, e.g. mango, *Dalbergia, Ficus* (banyan).

2. On the basis of lifespan, plants can be classified into following types
   - **Annuals** in which the whole life cycle (i.e. seed-plant-flower-fruit-seed) is completed within one season. Seeds are produced to tide over unfavourable period, e.g. mustard (*Brassica campestris*), wheat, sunflower, maize and pea.
   - **Biennials** in which the life cycle is completed in two seasons, i.e. vegetative and reproductive, e.g. turnip (*Brassica rapa*) and carrot (*Daucus*).
   - **Perennials** which survive for more than two years and produce flowers and fruits during specific seasons, e.g. mango, *Agave*.
3. On the basis of flowering or fruiting, plants may be
   - **Monocarpic plants** produce flower and fruit only once in their life, e.g. all annuals and biennial plants, bamboo and *Agave*.
   - **Polycarpic plants** bear flowers and fruits repeatedly after attaining maturity, e.g. mango, *Acacia*, *Eucalyptus*, etc.

Morphologically the angiospermic plant body consists of root, stem, leaves, flower, inflorescence, fruits, seeds, etc.

Root

- It is generally non-green, underground, **positively geotropic** (only main root), **positively hydrotropic** and often negatively phototropic, descending and cylindrical axis of the plant body.
- The root which develops from the radicle of the embryo is called **primary root,** which bears lateral roots is called **secondary roots**, which are further branched into **tertiary roots** and so on, e.g. many dicot plants.
- A typical root consists of a cap-like structure called **root cap** (root pockets in hydrophytes like *Lemna, Eichhornia* and *Pistia)* region, the region of meristematic activity, the region of cell elongation and the region of maturation.
- Root hairs are found in the region of maturation, which absorb water and minerals from the soil.



Regions or Zones of roots

Types of Root System

There are two different types of root system present in plants

Tap Root System

The primary roots and its branches (secondary and tertiary roots) constitute the tap root system. It is seen in dicot plants, e.g. mustard plant.

Modifications of Tap Root System

Tap roots are modified into fleshy, nodulated and pneumatophores.

- **Fleshy tap roots** Roots become swollen and fleshy for storage of food material mainly starch. The fleshy modifications in tap root can be of following types
  - **Tuberous** These roots do not have definite shape. Roots get swollen at any portion, e.g. *Mirabilis*, *Trichosanthes,* etc.
  - **Napiform** These roots become very thick at the base and tapers towards the apex, e.g. turnip, sugar beet, etc.
  - **Fusiform** These roots become thicker in middle and tapers at both the ends, e.g. radish.
  - **Conical** These roots are swollen at base and narrow at apex, e.g. carrot.
- **Pneumatophores** are present in plants of coastal habitat. These roots absorb oxygen, for respiration, e.g. *Rhizophora, Heritiera.*
- **Nodulated roots** in leguminous plants form nodule after combining with nitrogen fixing bacteria. They are meant for nitrogen-fixation, e.g. *Glycine max,* gram, pea, etc.

Adventitious Root System

Roots which are produced from any other part of the plant, except the radicle or its branches are called adventitious roots. Such part of the plant may be hypocotyl, base of the stem, nodes of stem, etc.

These roots are mainly found in monocots, e.g. grasses, cereals, sugarcane, etc.

Modification of Adventitious Root System

These roots can be modified on the basis of their function like, fleshy for food storage, mechanical support and for other vital functions.

Fleshy Adventitious Roots (For storage of food)

These are of following types

- **Tuberous roots** Swollen without any definite shape, e.g. sweet potato.
- **Fasciculated roots** Arise in bunches, e.g. *Asparagus, Dahlia.*
- **Moniliform or Beaded roots** Swells at different places, e.g. *Vitis*, etc.
- **Nodulose roots** Apical portion swells up, e.g. *Curcuma* etc.
- **Annular roots** Ring-like structure formed, e.g. *Psychotria.*

For Mechanical Support

- **Prop or Pillar roots** Hang from branches and penetrate into soil, e.g. banyan, screwpine.
- **Stilt or Brace roots** Develop from lower nodes of stem to give additional support, e.g. maize, sugarcane, etc.
- **Climbing roots** Arise from nodes and help in climbing, e.g. *Pothos, Piper betle*.

For Vital Functions

- **Buttress roots** Arise from basal part of main stem, e.g. *Ficus*.
- **Contractile roots** Underground and fleshy, help the plant in fixation, e.g. onion, corm of *Crocus,* etc.
- **Sucking or Haustorial roots** In parasitic plant, roots enter in the stem of host plant to absorb nutrition, e.g. *Cuscuta*.
- **Hygroscopic roots** Found in epiphytes, hang freely in the air and absorb moisture with the help of special sponge-like tissue called **velamen**, e.g. Orchid.
- **Floating roots** Arise from nodes, help in floating, e.g. *Jussiaea.*
- **Photosynthetic or Assimilatory roots** Have chlorophyll, e.g. *Trapa, Tinospora.*
- **Reproductive roots** Develop vegetative buds, e.g. *Trichosanthes dioica*.
- **Mycorrhizal roots** With fungal hyphae, e.g. *Pinus.*
- **Thorn roots** Serves as protective organ, e.g. *Pothos.*
- **Clinging roots** Arise from node and pierce into host plant, e.g. Orchid, *Ivy*, *etc.*
- **Foliar roots** When roots arise from leaf, e.g. *Bryophyllum*.

Functions of Root

Few general functions of roots are given below

- Anchor the plant in the ground.
- Absorb water and minerals from the soil.
- Store extra-sugars manufactured during photosynthesis.
- Transport water, minerals, sugars and hormones to and from the shoot.
- Interact with soil fungi and microorganisms that provide nutrients to the plant.

Few specialised functions of roots are as follows

- In rice, cortical root cells breakdown to form large air spaces, which are required for gaseous exchange when the soil is flooded.
- In epiphytic orchids (grow on other plants for support), the epidermis known as **velamen** covers all root but the absorptive tip of the orchid root is thick and multilayered, preventing water loss.
- Root nodules found in legumes (family–Fabaceae) and wattles (family–Mimosaceae) contain nitrogen-fixing bacteria, which convert inert nitrogen gas from the atmosphere to organic nitrogenous compounds that are then available to the host plant.
- Mycorrhizae are symbiotic association between roots of higher plants and fungi, which aid the root in absorption of nutrients, particularly phosphorus and nitrogen from the soil.

Stem

- It is the ascending part of the axis bearing branches, leaves, flowers and fruits. It develops from the plumule of embryo of a germinating seed and bears nodes and internodes. Node is the region, where auxillary buds, leaves arise and internode is the region between two nodes. Special features of stem are as follows
- In many xerophytic plants like *Opuntia,* stem becomes green, flattened or fleshy, which carries out photosynthesis. It is called **phylloclade** or **cladophyll**.
- In some plants, short, green, cylindrical (e.g. *Asparagus*) or sometimes flattened (e.g. *Ruscus*) branches, limited in growth, develop from the node of stem or branch in the axil of a leaf, which are reduced to small scales which perform the functions of photosynthesis. It is called **cladode**.
- Some stems are thin, weak and lie prostrate on soil.
- Tendril is a thread-like, green, leafless, spirally coiled structure sensitive to touch. These help in the climbing of weak stem.

Stem Modifications

On the basis of function and structural modifications, the stems can be categorised as

Underground/Subterranean Stem

This type of modification occurs generally for food storage and vegetative propagation. They are of four types

- **Bulb** It is reduced, disc-shaped stem which bears adventitious roots on the lower side and scaly leaves on the upper side, e.g. onion, garlic, etc.
- **Rhizome** It forms a horizontally running stem and bears nodes, internodes, buds and scaly leaves, which are used for vegetative propagation, e.g. ginger, turmeric, etc.
- **Corm** It is a condensed structure which grows vertically into the soil and bears scale leaves, e.g. *Colocasia*, etc.
- **Tuber** It swells up randomally and bears 'eyes', e.g. potato, etc.

Aerial/Epiterranean Stem

These are following types

- **Stem tendril** In plants with weak stem, the apical bud is modified into tendril for climbing, e.g. *Passiflora*, *Cucumber,* etc.
- **Phylloclade** In this, the stem is modified into flat, fleshy and green leaf-like structure, e.g. *Opuntia, Coccoloba, Ruscus,* etc.
- **Stem thorn** Axil of the leaf or apex of the branch is modified into pointed structure called thorn, e.g. *Citrus, Bougainvillea,* etc.
- **Cladode** It is a type of phylloclade consisting of one internode only. The stem is modified into leaf-like structure, e.g. *Asparagus*.
- **Bulbil** A multicellular structure, functions as organ of vegetative reproduction, e.g. *Oxalis, Dioscorea,* etc.

Sub-Aerial/Prostrate Stem

These stems are recognised into four types

- **Offset** This is a short horizontal branch with a bunch of leaves on the upper portion and bunch of roots on the lower portion, e.g. *Pistia*, *Eichhornia*, etc.
- **Stolon** These stem modifications initially grow upwards and then arch down to develop new daughter plants, when come in contact with soil, e.g. *Colocasia*, strawberry, etc.
- **Runner** It is a weak stem or branch that grow horizontally above the soil surface and develops adventitious roots at each nodes, e.g. *Cynodon*, *Oxalis*, *Hydrocotyle*, etc.
- **Sucker** It grows horizontally under the soil initially and later grows obliquely upwards, e.g. rose, mint, *Chrysanthamum,* etc.

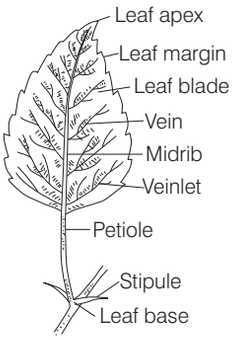
Functions of Stem

Functions of stem are given below

- The stem supports the leaves, branches, flowers, fruits and conducts water and minerals from the roots to the leaves and synthesised food from the leaves to other plant parts.
- It also bears flowers and fruits.
- It performs various secondary functions like storage, vegetative propagation and support.

Leaf

- It is a lateral, generally flattened structure borne on the stem. It develops at the node and bears a bud in its axil, which later develops into a branch.
- A typical leaf consists of three main parts, i.e. leaf base (by which leaf is attached to the stem), petiole (stalk of the leaf that connects the lamina with the stem or its branch) and lamina or leaf blade (green expanded part of the leaf with veins and veinlets). Besides these leaves in some plants have lateral appendages on either sides of leaf base, known as stipule.



A typical foliage leaf

- In some leguminous plants, the leaf base may become swollen, which is called **pulvinus.**

Venation

Distribution of vein and veinlets in the lamina of leaf is called venation. It is of following types

(i) **Reticulate venation** The veinlets are irregularly distributed to form a network, e.g. dicot plants. It is of two sub-types

(a) **Unicostate reticulate venation** Leaf has only one principal or main vein which extend from its base to apex and gives lateral branches to make a network. e.g. mango, peepal, etc.

(b) **Multicostate reticulate venation** Several veins of almost equal thickness extend from base to apex and lateral veins arise from main veins to form a network.

It is also of two sub-types

- **Convergent reticulate venation** Main veins converge towards apex, e.g. *Smilax*, *Zizyphus.*
- **Divergent reticulate venation** Main veins diverge towards margins, e.g. grape, *Luffa*.

(ii) **Parallel venation** The veins are arranged parallel to each other, e.g. monocot plants. It is of two sub-types

(a) **Unicostate parallel venation** Leaf has only one main vein and it gives rise to several lateral veins which run parallel to the margin, e.g. banana.

(b) **Multicostate parallel venation** Leaf lamina possess several veins which run parallel to each other, e.g. grass and palm. It is also of two sub-types

- **Convergent parallel venation** Main veins converge towards apex, e.g. maize.
- **Divergent parallel venation** Main veins diverge towards margins, e.g. fan palm (*Livistona*).

Types of Leaves

(i) On the basis of incision of lamina, the leaves are of two types

(a) **Simple leaves** In this, there is a single lamina, which is usually entire, e.g. mango, guava, *Cucurbita*, etc.

(b) **Compound leaves** In this type of leaf, the incision of lamina, reach up to midrib or petiole, e.g. rose, neem, lemon, etc. These are of two types

- Pinnately compound leaves as in neem.
- Palmately compound leaves as in strawberry.

(ii) On the basis of origin and function, leaves are of the following types:

(a) **Cotyledonary leaves** Present in the from of cotyledons with seed, e.g. *Ricinus*, *Geranium*, etc.

(b) **Prophylls** These are thin, flattened leaf-like structure, e.g. *Agave americana*, etc.

(c) **Bract leaves** The leaves become coloured like flower, e.g. *Euphorbia*, *Bougainvillea*, etc.

(d) **Floral leaves** These leaves acts as the part of flowers, as petal and sepal, e.g. most angiosperms.

(e) **Scaly leaves** These are mostly colourless or dull leaves, e.g. ginger, etc.

(f) **Foliage leaves** These are green, photosynthetic leaves, e.g. almost all plants.

Phyllotaxy

It is the pattern of arrangement of leaves on the stem or branch. This is usually of three types

1. **In alternate** type of phyllotaxy, a single leaf arises at each node in alternate manner, e.g. *Mangifera indica* (mango), *Hibiscus rosa-sinensis* (China rose), *Brassica campestris* (mustard), *Nicotiana tabacum* (tobacco).
2. **In opposite** type of phyllotaxy, each node gives rise to two leaves lying opposite to each other, e.g. *Calotropis*, guava.

   Opposite phyllotaxy may be

   (a) **Opposite superimposed** (i.e. position of two leaves of each node resembles with the leaves of upper node), e.g. *Eugenia*, *Quisqualis*, *Ixora,* etc.

   (b) **Opposite decussate**, (i.e. leaves of a node are at right angles to the leaves of next node), e.g. *Calotropis procera*, *Ocimum,* etc.

   It should be noted that in guava (*Psidium guajava*), both types of arrangements are found.
3. **In whorled** phyllotaxy, more than two leaves arise at a node and form a whorl, e.g. *Alstonia, Nerium, Vangueria,* etc.

Leaf Modifications

Leaves are often modified to perform functions other than photosynthesis.

Some Modifications of Leaves

Modification	Form/Function	Example
Tendril	Green, thread-like, thigmotropic, do not have scale leaves, unbranched, climbing/support the weak stem.	—
(a) Whole leaf tendril	Tendrils from whole leaf whose function is taken over by foliaceous stipules.	Wild pea (*Lathyrus aphaca*)
(b) Leaflet tendril	Only upper leaflets modified to form tendril.	*Pisum sativum* and *Bignonia venusta*
(c) Stipular tendril	Modification of stipules.	*Smilax*
(d) Petiolar	Petiole modified to form tendril.	*Clematis* and *Nepenthes*
(e) Leaf apex tendril	Thigmotropic leaf apex is drawn out to form tendril.	*Gloriosa*
Spine	Whole leaf or parts of leaves modified into spines (protective, prevent excessive transpiration).	*Opuntia* (whole leaf), *Yucca* (leaf apices) *Argemone* (margin) and *Acacia* (stipules)
Succulent	Leaves become fleshy and thickened to retain water in hot and arid climate.	*Aloe* and *Bryophyllum*

Modification	Form/Function	Example
Insect catching leaves	Catch insects and absorb their nitrogen to fulfil plant's nitrogen requirement and for storage function.	
(a) Pitcher (Lamina forms the pitcher)	Leaves are modified into pitchers to catch and digest the insects.	*Nepenthes* and *Sarracenia*
(b) Bladder	Leaf segments form bladder which acts as trap for insects.	*Utricularia*
Other modifications of leaves		
Phyllode	Flat, petiole green and photosynthetic.	*Acacia* and *Parkinsonia*
Hooks	Terminal leaflet's claw-like.	*Bignonia* and *Asparagus*
Reproductive	Adventitious buds.	*Bryophyllum* and *Salvinia*
Leaf roots	Roots emerge from one out of three leaves.	*Ranunculus* and *Alisma plantago*
Heterophylly	More than one type of leaf on same plant.	*Casuarina* (occurs on rhizome, corms, phylloclade and cladode)
Leaf scales	Sessile, thin and membranous.	

Functions of Leaf

Leaves in plants performs several functions as given below

- Leaf carry out photosynthesis and possess stomata for the gaseous exchange and transpiration.
- The leaves protect terminal and axillary buds.
- Vascular bundles present in veins and petiole carry out the function of conduction.
- Modified leaf structures perform various functions like storage, support and vegetative reproduction (*Bryophyllum*).

Inflorescence

The arrangement of flowers on the floral axis is termed as **inflorescence**. The axis of inflorescence is called **peduncle**. These are of basically four main types

1. Racemose Inflorescence

- It is one in which the main axis continues to grow and the flowers are borne laterally in an **acropetal succession** (the older flowers are found towards the base and younger ones at the apex) or **centripetal** (older towards periphery and younger towards centre), e.g. radish and *Delphinium*.
- They are further classified as raceme (mustard), panicle (gulmohur), corymb (candytuft), spike (bottle brush), spikelet (wheat), catkin (mulberry), spadix (palm), umbel (coriander), capitulum (sunflower) and capitate (*Acacia*).

2. Cymose or Determinate or Definite Inflorescence

- It includes uniparous or monochasial cyme and biparous or dichasial cyme.
- In uniparous or monochasial cyme, the main axis ends into a flower and produces only one lateral branch at a time ending into flower.
- It can be either scorpioid monochasial, e.g. *Ranunculus, Tecoma* or helicoid monochasial, e.g. *Drosera*, *Begonia*.
- In biparous or dichasial cyme, two flowers arise from the same point and again central flower is most mature with two lateral shoots, e.g. *Ixora* and *Mussaenda*.
- Polychasial (*Dianthus*) and cymose head (*Anthocephalus*) are also types of cymose inflorescence.

Racemose and cymose inflorescence differ in several characters. These differences are given below

Differences between Racemose and Cymose Inflorescence

Character	Racemose	Cymose
• **Peduncle**	It does not end in a single flower instead grows continuously.	It ends up into a single flower.
• **Number of flowers**	Indefinite or indeterminate number of flowers are formed.	A definite or determinate number of flowers are formed.
• **Position of flowers on peduncle**	Flowers are arise laterally in all sides on the peduncle.	Flowers actually arise terminally in one side only.
• **Bract**	The bracteate flowers are borned in the axile of the bracts.	In uniparous cyme, the bracts when exist, are formed on the side opposite the origin of flowers.
• **Arrangement of flowers**	The flowers are arranged in an acropetal manner.	The flowers are arranged in a basipetal manner.
• **Grouping of flowers**	It is of less common occurrence.	It is of more common occurrence.

Character	Racemose	Cymose
• **Flowering period**	Flowers open at short intervals.	Flowers open at long intervals and the total flowering period is much larger.
• **Pollination**	A single visit by a pollinator can pollinate a large number of flowers.	A pollinator cannot pollinate many flowers in one visit though flowers are grouped more frequently.
• **Flowers arrangement in a group**	In a floral group, flowers are arranged in a centripetal manner, i.e. younger flowers occupy central position, while older flowers towards the periphery.	In a group of flowers, the flowers are arranged in a centrifugal manner, which is opposite situation to centripetal.
• **Fruit protection by flowers**	Newly formed fruits are not protected by flowers because these fruits are formed towards the periphery of grouping of flowers.	Newly formed fruits are protected by new flowers, because fruits formed towards the centre of grouping of flowers.

3. Mixed Inflorescence

It has combination of cymose and racemose characters, e.g. cymose, umber, thyrsus.

4. Special Type of Inflorescence

It can be of following types

(i) **Cyathium inflorescence** is the characteristic feature of *Euphorbia* in which single female flower present in centre is surrounded by a number of male flowers inside a cup-shaped **involucre** which consists of whorl of bracts.

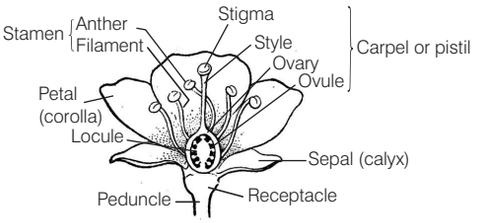
(ii) **Hypanthodium inflorescence** is the characteristic feature of family–Moraceae, e.g. fig, peepal, etc., in which cup-shaped cavity with an apical opening or **ostiole** is formed by a fleshy receptacle, guarded by inwardly projecting hair and bear flowers on the inner wall of the cavity.

The female flowers are present at the base and male flowers at the opening.

(iii) **Verticillaster inflorescence** is the characteristic feature of tulsi (*Ocimum*) which belongs to family–Lamiaceae or Labiatae. Here, flowers are arranged in two opposite cymose groups on each node.

Flower

A flower is a modified, condensed shoot of limited growth to carry out the function of reproduction in angiosperms. Calyx, corolla, androecium and gynoecium represent four whorls of the flower, these floral parts can be seen as follow



A flower showing detailed structure

Floral Symmetry

The shape, size and arrangement of floral appendages around floral axis is called floral symmetry. A flower can be asymmetric, i.e. it cannot be divided into two equal halves through any vertical plane, e.g. *Canna*. The symmetrical flowers contain floral symmetries of following types

(i) **Actinomorphic** Flower can be divided into two equal halves by many vertical sections, e.g. mustard, chilli, etc.

(ii) **Zygomorphic** Flower can be divided into two equal halves by only one vertical section, e.g. pea, bean, *Cassia*, gulmohar, etc.

Position of Floral Parts on Thalamus

According to the position of floral parts on thalamus, the flowers are categorised as

(i) **Hypogynous** Ovary is situated at the top while stamens, petals and sepals are borne successively below. Such flowers are called hypogynous and ovary is said to be superior, e.g. mustard, China rose, brinjal, etc.

(ii) **Perigynous** Ovary is situated in the centre and other parts of the flower are located on the rim of the thalamus, almost at the same level. Ovary is half superior and half inferior, e.g. rose, plum, peach, etc.

(iii) **Epigynous** Ovary is completely surrounded and fused with thalamus. The other floral parts are borne at the top of the ovary. Such flowers are called epigynous and ovary is said to be inferior, e.g. cucumber, guava, etc.

Number of Floral Parts

Occurrence of same number of parts in different flower is called isomer and that of different number of parts in each whorl is termed heteromerous. An isomerous flower may be

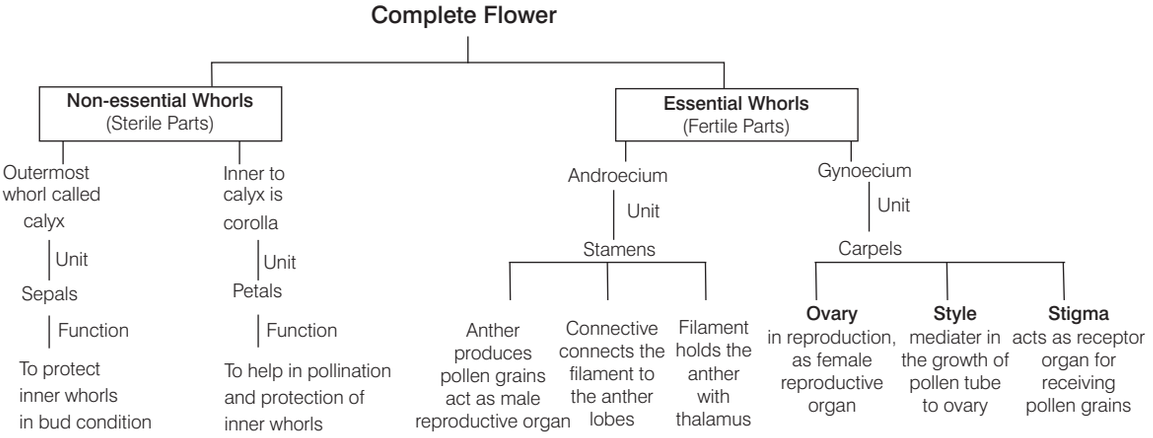
(i) **Dimerous** Floral parts in multiple of 2

(ii) **Trimerous** Floral parts in multiple of 3

(iii) **Tetramerous** Floral parts in multiple of 4

(iv) **Pentamerous** Floral parts in multiple of 5

- The structure of a complete flower is illustrated in the flow chart below



The parts of flowers are as follows

Calyx (Sepal)

The outermost whorl of floral leaves and the individual segment is called sepal. Mostly they are green in colour, but sometimes coloured-like petals, i.e. petaloid.

(i) Sepals free from each other – Polysepalous

(ii) Sepals fused with each other – Gamosepalous

Modifications of Sepals

Sepals undergoes following modifications

- **Pappus** Hair-like modified sepals particularly for the dispersal of fruits, e.g. sunflower, *Tagetes*, *Tridax*, etc.
- **Spinous** Spine-like, e.g. *Trapa*.
- **Tubular** Tube-like, e.g. *Datura*.
- **Spurred** A tubular outgrowth called spur, arise at the base of one of the sepals, e.g. *Delphinium* (larkspur).
- **Campanulate** Ball-shaped, e.g. China rose.
- **Leaf** One sepal becomes leaf-like, e.g. *Mussaenda*.
- **Hooded** One sepal becomes hood-like, e.g. *Aconitum*.
- **Cupulate** Cup-like, e.g. *Gossypium*.
- **Bilabiate** Like two lips of mouth, e.g. *Salvia*, *Ocimum*.
- **Infundibuliform** Funnel-shaped, e.g. *Atropa*.
- **Ureolate** Urn-like, e.g. *Silene*.

Corolla (Petals)

It is composed of petals. Petals are usually brightly coloured to attract insects for pollination. Like calyx, corolla may also be gamopetalous (petals united) or polypetalous (petals free).

The shape and colour of corolla may vary greatly in shape. Corolla may be tubular, bell-shaped, funnel-shaped.

AESTIVATION

Arrangement of floral parts in a floral bud with respect to the other members of the same whorl is known as aestivation. It may be of following types:

- **Valvate** When sepals or petals lie very close to each other, without overlapping, e.g. mustard, *Calotropis*.
- **Twisted** When one margin of the sepal or petal overlaps the margin of next and other margin is overlapped by the third one, e.g. China rose, lady's finger, cotton.

Types of aestivation in corolla : (i) Valvate (ii) Twisted (iii) Imbricate (iv) Ouincuncial (v) Vexillary

- **Imbricate** When both margins of one of the petals are covered by others two petals and both margins of another one covers other, rest are arranged in twisted manner, e.g. *Cassia, Caesalpinia,* gulmohur.
- **Quincuncial** When two petals are inner, two are outer and one is partly outer and partly inner, e.g. *Ranunculus*.
- **Vexillary** The posterior one is the largest and almost covers the two lateral petals and the latter inturn nearly overlap the two anterior petals, e.g. pea (Papilionaceae).

Androecium

- This is third and male whorl called androecium They are collection of stamens in a flower. Each stamen has two parts, a long filament and a knob-like terminal anther.
- The two lobed anther called dithecous anther, e.g. pea. The anther with one lobe is called monothecous anther, e.g. member of Malvaceae.
- When stamens are free from each other the condition is called polyandrous, e.g. mustard.
- A sterile stamen is called staminode.

Fixation of Anthers

- **Basifixed** Filament attached to base of anthers, e.g. *Brassica*.
- **Adnate** Filament continued from base to apex of anthers, e.g. *Michelia*.
- **Dorsifixed** Filament attached to dorsal side of anther, e.g. passion flower.
- **Versatile** Filament attached lightly at its back, so that it can swing freely, e.g. wheat and grasses.

Dehiscence of Anthers

Dehiscence is spontaneous natural bursting of plant organs like sporangium, anther or fruit at maturity. It is of following types

- **Longitudinal** Slits appear length wise.
  - **Extrorse** Anther dehiscing towards periphery of flower, e.g. Leguminosae.
  - **Introrse** Anther dehiscing towards centre of the flower, e.g. Papaveraceae.
  - **Latrorse** Dehiscence occurs lateral to anther, e.g. *Croton sparsiflorus*.
- **Transverse** Slits appear breadthwise in anther, e.g. *Malva*.
- **Valvular** Anther walls break and lifted at places like valves, e.g. barberry.
- **Porous** Anther lobes dehisce by apical or basal pores, e.g. *Solanum*.

Length of Stamens

- **Didynamous** In this type arrangement, out of four stamens, two are long and two are short, the condition is didynamous, e.g. *Ocimum*.
- **Tetradynamous** Here, out of six stamens, two outer are short and four inner are long, the condition is tetradynamous, e.g. plants of family–Brassicaceae.

Position of Stamens

When the stamens are shorter then corolla tube, they are **inserted** and when the stamens are longer than the corolla tube and are protruding outwards they are called **exserted**.

Cohesion of Stamens

Fusion of stamen among themselves is called cohesion. According to the pattern of stamens which are joined together, the flowers are termed as

- **Monadelphous** Stamens may be united by means of their filaments in one bundle with free anthers, e.g. cotton, China rose.
- **Diadelphous** When the filaments are united into two bundles and the anthers remain free, e.g. pea, gram.
- **Polyadelphous** When the filaments are united into more than two bundles but anthers are free, e.g. castor, lemon.
- **Syngenesious** When anthers are united but the filament are free, e.g. sunflower.
- **Synandrous** When anthers as well as filaments of stamens are united through out their whole length, e.g. members of Cucurbitaceae and *Colocasia*.

Adhesion of Stamens

It can be described as

- **Epipetalous** When stamens are attached to petals, e.g. *Datura,* sunflower.
- **Epiphyllous** When stamens are attached to perianth (tepal), e.g. onion, garlic.
- **Episepalous** When stamens are attached to sepals, e.g. *Quisqualis indica.*
- **Gynandrous** Stamens are partially or wholly attached to gynoecium, e.g. *Calotropis.*

Gynoecium

- It is the innermost and female whorl composed of one or more carpels which is further divided into a basal ovule containing part called ovary, a middle elongated part called style and a pollen receiving terminal structure called stigma.
- The gynoecium may be monocarpellary (one carpel) or polycarpellary (many carpels).

Cohesion of Carpels

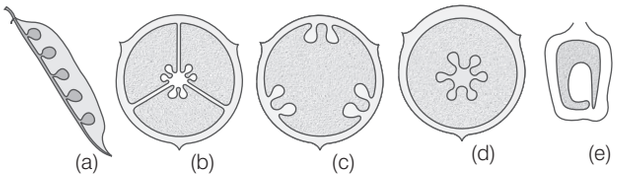
- **Apocarpous** Gynoecium comprises of two or more carpels which are free, e.g. *Ranunculus.*
- **Syncarpous** Gynoecium comprises of two or more carpels which are fused, e.g. *Hibiscus.*

Placentation

The arrangement of ovules within the ovary is known as placentation. The placenta is a tissue, which develops along the inner wall of the ovary. The ovules remain attached to the ovary by placental tissue. The placentation can be of different types

- **Marginal** It is the most primitive type of placentation in which the placenta forms a ridge along the ventral suture of the ovary and the ovules are borne on this ridge forming two rows is called marginal placentation, the ovary is multilocular with numerous carpels, e.g. pea.
- **Axile** When the placenta is axial and the ovules are attached to it in a multilocular ovary, the placentation is called axile, e.g. China rose, tomato and lemon.
- **Parietal** When the ovules develop on the inner peripheral part of the ovary it is called parietal placentation. Ovary is one chambered but it becomes two-chambered due to formation of the false septum, e.g. mustard and *Argemone*.
- **Free-central** When the ovules are borne on central axis and septa are absent, the placentation is called free-central, e.g. *Dianthus* and primrose.

- **Basal** In this type, the placenta develops at the base of ovary and a single ovule is attached to it as in sunflower, marigold. The placenta develops directly on the thalamus.



Types of placentation (a) Marginal (b) Axile (c) Parietal (d) Free-central (e) Basal

Some Important Floral Terms

The important floral terms for the description of a flower are given below

- **Asymmetric flower** cannot be divided into two equal halves by any vertical plane passing through the centre, e.g. *Canna.*
- **Bisexual**, hermaphrodite or monoecious flower contains both male and female reproductive organs, e.g. China rose, mustard, *Papaver,* pea, cotton, *Datura*, etc.
- **Unisexual** or dioecious flower has only one essential floral whorl, either androecium (staminate) or gynoecium (pistillate) e.g. *Morus alba,* papaya and *Cucurbita.*
- **Complete** flower is when it contains all floral whorls, i.e. calyx, corolla, androecium and gynoecium, e.g. *Solanum*, mustard.
- **Incomplete flower** is when either of the four whorls is absent, e.g. *Cucurbita.*
- **Regular flower** has same size, shape, colour and arrangement of various floral whorls/ organs.
- **Irregular flower** is when any flower of a plant shows dissimilarity in any of it's part or trait.
- **Cyclic flower** occurs when the floral parts of a flower are arranged in a whorl, e.g. *Solanum*.
- **Acyclic flower** occurs when the floral parts of a flower are arranged spirally and not in whorls, e.g. *Ranunculus, Opuntia* and *Nymphaea.*
- **Achlamydous flowers** are those in which the accessory floral whorls (calyx and corolla) are absent, e.g. *Piper* sp. (Piperaceae).
- **Monochlamydous flowers** contain only one accessory whorl (either calyx or corolla) or perianth (a collective term given to a group of undifferentiated calyx and corolla), e.g. *Polygonum* (Polygonaceae), onion (Liliaceae).
- **Dichlamydous condition** is observed when both the accessory whorls (calyx and corolla) are present, e.g. in most of the flowers.
- **Heteromerous flowers** are when different parts of different floral whorls have different basic number of its multiple.
- **Bract** is a small leaf-like structure whose axil bears a pedicel (flower stalk).
- **Bracteate flower** contains bract, e.g. *Justicia adhatoda.*
- **Ebracteate flowers** are those without bracts, e.g. *Solanum.*

Fruit

- The fruit is a mature or ripened ovary, developed after fertilisation. If a fruit is formed without fertilisation of the ovary, it is called **parthenocarpic fruit**.
- The fruit consists of a wall or **pericarp** and seeds. The pericarp may be dry or fleshy. When pericarp is thick and fleshy, it is differentiated into the outer epicarp, the middle mesocarp and an inner endocarp.
- In mango and coconut, the fruit is known as **drupe**. They develop from monocarpellary superior ovaries and are one seeded. In mango, the pericarp is well-differentiated into an outer thin epicarp, middle fleshy mesocarp and an inner stony hard endocarp.
- In coconut, the mesocarp is fibrous.
- If a fruit develops from the ovary, it is known as the true fruit. But sometimes some other floral parts participate in the formation of fruit, such fruits are known as **false fruits**, e.g. thalamus in apple is modified to form fruit.

Types of True Fruits and their Floral Origin

Type of Fruit	Floral Origin	Examples
(i) Simple	Single ovary of one flower	Pea, bean Larkspin, *Calotropis*, *Brassica*, *Capsella Gossypium*, *Datura*, *Papaver*, *Argemone Trapa*, wheat, rice, maize, groundnut, mango, peach, coconut, almond, walnut, cucumber, muskmelon.
(ii) Aggregate	Many ovaries of one flower	Etaerio of follicles, e.g., *Michelia* and *Catharanthus*. Etaerio of berries, e.g., *Polyalthia*, *Anona* and *Squamosa*. Etaerio of achenes, e.g., *Naravelia* and *Clematis*. Etaerio of drupes, e.g., *Rubus idaeus*.
(iii) Multiple	Many ovaries of many flowers	Sorosis, e.g, *Artocarpus integrifolia*, *Ananas sativus* and *Morus indica*. Syconus, e.g. *Ficus carica*.

Seed

- The fertilised ovules develop into the seeds. A seed contains seed coat which encloses the embryo.
- The embryo is made up of a radicle, an embryonal axis and one (wheat, maize) or two cotyledons (gram and pea).

- It has two layers, i.e. the outer testa and the inner tegmen.
- The hilum is a scar on the seed coat above which is a small pore called the **micropyle**.
- In dicot seeds, the embryo consists of an embryonal axis and two cotyledons. The cotyledons are often fleshy and full of reserve food.
- In some seeds, such as castor, the endosperm is formed as a result of **double fertilisation**. It is a food storing tissue.
- In plants such as bean, gram and pea, the endosperm is not present in mature seeds, such seeds are called **non-endospermous**.
- In monocots, seeds are endospermic but several like orchids are non-endospermic.
- In the seeds of cereals such as maize, the seed coat is membranous and generally fused with the fruit wall. The endosperm is bulky and stores food.
- The outer covering of endosperm separates the monocot embryo by a proteinous layer called **aleurone layer**.
- The embryo of monocot consists of one large and shield-shaped cotyledon known as **scutellum** and a short axis with a plumule and a radicle.
- The plumule and radicle are enclosed in sheaths, which are called **coleoptile** and **coleorhiza**, respectively.

Floral Formula and Floral Diagram

They are used in describing various parts of plants (roots, stems, leaves inflorescence and flower parts). Following symbols are used in constructing a floral formula.

Br	–	Bracteate	$\overline{G}$	–	Inferior ovary
Ebr	–	Ebracteate	♂	–	Male
K	–	Calyx	♀	–	Female
C	–	Corolla	⚥	–	Bisexual
P	–	Perianth	⊕	–	Actinomorphic symmetry of flower
A	–	Androecium	%	–	Zygomorphic symmetry of flower
G	–	Gynoecium			
$\underline{G}$	–	Superior ovary			

Some Important Families of Flowering Plants

1. Fabaceae

- Family–Fabaceae was earlier called Papilionoideae, a subfamily of family–Leguminosae.
- **Vegetative characters** The plants are trees, shrubs, root with root nodules, stem erect or climber, leaves alternate, pinnately compound or simple, pulvinated leaf base and venation is reticulate.
- **Flower characters** Inflorescence is racemose, flower is bisexual, sepals five, gamosepalous, petals five, polypetalous, androecium having 10 stamens, gynoecium monocarpellary, ovary superior, fruit legume and seed non-endospermic.
- **Floral formula** Br % ⚥ $K_{(5)}C_{1+2(2)}A_{(9)+1}\underline{G}_1$
- **Members** Plants of this family include pulses (gram, sem, moong, etc.), dye (*Indigofera*), fibres (hemp), fodder (*Sesbania, Trifolium*), ornamentals, medicine (muliathi), etc.

2. Solanaceae

- **Vegetative characters** Mostly herbs, shrubs and rarely small trees. Stem is herbaceous, hairy or glabrous, underground in potato. Leaves are alternate, simple, venation is reticulate.
- **Flower characters** Inflorescence is solitary, axillary or cymose, flower is bisexual, sepals five, united, petals five, androecium stamen five, gynoecium bicarpellary, ovary superior with many ovules. Fruits are berry or capsule. Seeds are many and endospermous.
- **Floral formula** ⊕ ⚥ $K_{(5)}\overset{\frown}{C_{(5)}A}_{(5)}\underline{G}_{(2)}$
- **Members** Plants of this family include vegetables (tomato, brinjal and potato), spice (chilli), medicine (*Belladonna* and aswagandha), fumigatory (tobacco) and ornamentals (*Petunia*).

Solanaceae is a large family, commonly known as the potato family.

3. Liliaceae

- **Vegetative characters** This family is a characteristic representative of monocot plants. These are perennial herbs, with underground bulbs/corms and rhizomes. Leaves are mostly basal, alternate with parallel venation.
- **Flower characters** Inflorescence is solitary/cymose, flower is bisexual, perianth tepal six (3 + 3), stamen six, gynoecium syncarpous, ovary superior with many ovules. Fruit is capsule and seeds are endospermous.
- **Floral formula** → Br⊕ ⚥ $P_{(3+3)}A_{(3+3)}\underline{G}_{(3)}$
- **Members** Plants of this family are good ornamentals (tulip, *Gloriosa*), source of medicines (*Aloe*), vegetables (*Asparagus*) and colchicine.

DAY PRACTICE SESSION 1

FOUNDATION QUESTIONS EXERCISE

1 Which of the following constitutes the descending part of the plant axis?
(a) Branches (b) Leaves (c) Stem (d) Root

2 Roots developed from parts of the plant other than radicle are called
(a) tap roots (b) fibrous roots
(c) adventitious roots (d) All of these

3 Sweet potato is a modified ➝ NEET 2018
(a) tap root (b) adventitious root
(c) stem (d) rhizome

4 The root swollen in the middle and tapering gradually towards both the ends, is called
(a) napiform (b) fusiform
(c) moniliform (d) tuberous

5 Pneumatophores occur in ➝ NEET 2018
(a) carnivorous plants (b) free-floating hydrophytes
(c) halophytes (d) submerged hydrophytes

6 Root cap has no role in absorption of water, because it has
(a) cells arranged loosely
(b) no cells containing chloroplast
(c) no root hair
(d) no direct connection with the vascular system

7 Which of the following is not correct?
(a) In maize, roots arise from the base of stem
(b) In *Bryophyllum* roots arise from leaf
(c) Carrot (*Daucus carota*) have napiform root
(d) Mangroves (e.g. *Rhizophora*) have respiratory roots (pneumatophores)

8 Which of the following is a flowering plant with nodules containing filamentous nitrogen-fixing microorganism?
(a) *Casuarina equisetifolia* (b) *Crotalaria juncea*
(c) *Cycas revoluta* (d) *Cicer arietinum*

9 Stem tendril is not present in
(a) passion flower (*Passiflora*)
(b) grapevine (*Vitis*)
(c) groundnut (*Arachis hypogaea*)
(d) lemon (*Citrus*)

10 Stems modified into flat green organs performing the functions of leaves are known as ➝ NEET 2018
(a) phyllodes (b) phylloclades
(c) scales (d) cladodes

11 Which of the following is not a phylloclade?
(a) *Opuntia* (b) *Euphorbia*
(c) *Ruscus* (d) *Asparagus*

12 Which of the following is not a stem modification ? ➝ NEET 2016
(a) Thorns of *Citrus*
(b) Tendrils of cucumber
(c) Flattened structures of *Opuntia*
(d) Pitcher of *Nepenthes*

13 Which of the following is a group of rhizomes?
(a) *Allium cepa*, *Canna*, *Zingiber*
(b) *Canna*, *Zingiber*, *Curcuma*
(c) *Allium sativum*, *Ammomum*, *Curcuma*
(d) *Cynodon*, *Canna*, *Allium cepa*

14 Study the following and choose the incorrect statements.
I. Bulb of *Allium cepa* is a modified stem.
II. Cloves of *Allium sativum* are fleshy scale leaves.
III. Corm of *Colocasia* is a modified root.
IV. Tendril in *Vitis vinifera* is a modified axillary bud.

Codes
(a) I and II (b) II and IV
(c) II and III (d) I and IV

15 Tripinnate leaves occur in
(a) *Acacia* (b) *Oxalis*
(c) *Moringa* (d) *Gynandropsis*

16 The modification of petiole into leaf-like structure is called
(a) phylloclade, e.g. *Opuntia*
(b) cladode, e.g. *Asparagus*
(c) phyllode, e.g. Australian *Acacia*
(d) leaf tendril, e.g. *Pisum sativum*

17 A small aquatic herb in which a portion of leaf forms a tiny sac or bladder which traps water insects is
(a) *Dionaea* (b) *Utricularia*
(c) *Drosera* (d) *Sarracenia*

18 Which of the following is not correctly matched?
(a) Alternate phyllotaxy — *Mangifera indica*
(b) Whorled phyllotaxy — *Psidium guajava*
(c) Opposite superimposed phyllotaxy — *Eugenia*
(d) Opposite decussate — *Calotropis procera*

19 The incorrect statement is
(a) In *Nepenthes*, the lamina forms a pitcher-like structure
(b) *Utricularia* leaves modify to form bladder-like structure
(c) *Drosera* leaves are reproductive in nature
(d) *Bryophyllum* leaves help in vegetative propagation

20 Edible part of cauliflower is
(a) bud (b) inflorescence
(c) flower (d) fruit

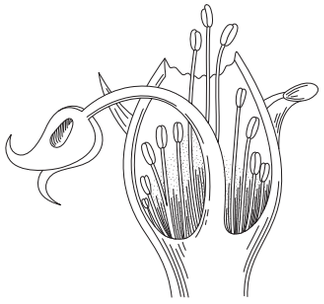
21 A man without any knowledge of Botany thinks that it is a flower but actually it is an inflorescence.
(a) Pea (b) Sunflower (c) Rose (d) China rose

22 In an inflorescence, where flowers are borne laterally in an acropetal succession, the position of the youngest floral bud shall be
(a) proximal (b) distal (c) intercalary (d) anywhere

23 When a large number of sessile flowers grow from a suppressed rachis giving rise to a globose structure, the inflorescence is called
(a) capitulum (b) umbel (c) catkin (d) turmeric

24 Cymose inflorescence is present in
(a) *Solanum* (b) *Sesbania* (c) *Trifolium* (d) *Brassica*

25 The below inflorescence is a/an



(a) cyathium (b) dichasial (c) umbel (d) panicle

26 When petals are free from each other as in mustard, the condition is known as
(a) gamopetalous (b) pistalloid
(c) polypetalous (d) caducous

27 When the margins of sepals or petals overlaps one another without any particular direction, the condition is termed as
(a) vexillary (b) imbricate
(c) twisted (d) valvate

28 Bisexual flowers, e.g. *Datura* are also called
(a) dioecious (b) monoecious (c) bicarpellary (d) dithecous

29 The term polyadelphous is related to ➔ NEET-II 2016
(a) gynoecium (b) androecium
(c) corolla (d) calyx

30 Ovules arise from the central axis in which type of placentation ?
(a) Basal (b) Axile (c) Parietal (d) Marginal

31 The aestivation in family–Papilionaceae is
(a) vexillary (b) valvate (c) twisted (d) quincuncial

32 In onion, the flowers are divisible into two or more equal halves by any radial plane. Such flowers are called
(a) actinomorphic (b) zygomorphic
(c) asymmetric (d) vexillary

33 While constructing floral formula, % sign denotes
(a) bicarpellary (b) actinomorphic
(c) perianth (d) zygomorphic

34 The technical term used for the androecium of flowers of family–Malvaceae in which the filaments are fused while anthers are free is
(a) monadelphous (b) diadelphous
(c) polyandrous (d) polyadelphous

35 Stamens are united throughout their whole length in
(a) rose (b) sunflower
(c) China rose (d) *Cucurbita*

36 Didynamous stamens are found in
(a) *Salvia* (b) mustard (c) pea (d) tomato

37 Replum is present in the ovary of flower of
(a) sunflower (b) pea (c) lemon (d) mustard

38 Long filamentous threads protruding at the end of the young cob of maize are
(a) styles (b) ovaries (c) hairs (d) anthers

39 Among China rose, mustard, brinjal, potato, guava, cucumber, onion and tulip, how many plants have superior ovary?
(a) Five (b) Six (c) Three (d) Four

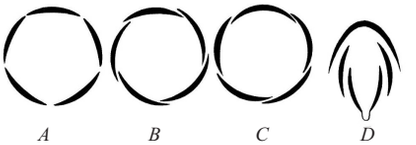
40 Among bitter gourd, mustard, brinjal, pumpkin, China rose, lupin, cucumber, sunnhemp, gram, guava, bean, chilli, plum, *Petunia*, tomato, rose, *Withania*, potato, onion, *Aloe* and tulip, how many plants have hypogynous flower ? ➔ NEET 2013
(a) Six (b) Ten (c) Fifteen (d) Eighteen

41 The ovary is half inferior in flowers of
(a) cucumber (b) cotton (c) guava (d) peach

42 What type of placentation is seen in sweet pea?
(a) Basal (b) Axile
(c) Free-central (d) Marginal

43 Placentation in mustard and *Argemone* is
(a) parietal (b) free-central
(c) marginal (d) axile

44 The following diagrams represent the types of aestivation in corolla. Identify the correct combination of labelling.



(a) *A* – Valvate, *B* – Twisted, *C* – Vexillary, *D* – Imbricate
(b) *A* – Valvate, *B* – Vexillary, *C* – Twisted, *D* – Imbricate
(c) *A* – Vexillary, *B* – Imbricate, *C* – Twisted, *D* – Valvate
(d) *A* – Valvate, *B* – Twisted, *C* – Imbricate, *D* – Vexillary

45 The standard petal of a papilionaceous corolla is also called
(a) pappus (b) vexillum (c) corona (d) carina

46 Keel is the characteristic feature in the corolla of
(a) *Allium* (b) *Indigofera*
(c) sunflower (d) cotton

47 In brinjal, the flowers are
(a) actinomorphic, hypogynous with valvate aestivation
(b) actinomorphic, hypogynous with twisted aestivation
(c) zygomorphic, hypogynous with imbricate aestivation
(d) zygomorphic, epigynous with imbricate aestivation

48 In epigynous flower,
(a) ovary is superior
(b) calyx, corolla and androecium are all superior
(c) calyx, corolla and androecium are all inferior
(d) only accessory whorls are inferior

49 Which part of coconut is economically important in producing fibre?
(a) Seed coat (b) Mesocarp (c) Epicarp (d) Pericarp

50 Fruit of mango is
(a) drupe (b) berry (c) legume (d) caryopsis

51 The fruit which develops from inflorescence is called
(a) achene (b) berry
(c) etaerio (d) composite fruit

52 Which of the following represents the edible part of the fruit of litchi ?
(a) Pericarp (b) Mesocarp (c) Juicy aril (d) Endocarp

53 Geocarpic fruits are produced by
(a) carrot (b) onion (c) groundnut (d) watermelon

54 Edible part of banana is
(a) epicarp
(b) mesocarp and less developed endocarp
(c) endocarp and less developed mesocarp
(d) epicarp and mesocarp

55 Which plant will lose its economic value if its fruits are produced by induced parthenocarpy?
(a) Grape (b) Pomegranate
(c) Banana (d) Orange

56 Pineapple (*Ananas*) fruit develops from
(a) a unilocular polycarpellary flower
(b) a multipistillate syncarpous flower
(c) a cluster of compactly borne flowers on a common axis
(d) a multilocular monocarpellary flower

57 In *Citrus* fruits (orange, lemon, etc), a special type of berry called hesperidium is present. The edible part of *Citrus* fruit is
(a) unicellular juicy hair which arise from endocarp
(b) epicarp
(c) mesocarp
(d) None of the above

58 Embryo of sunflower has
(a) one cotyledon (b) two cotyledons
(c) many cotyledons (d) no cotyledon

59 Non-endospermic seed is produced in
(a) maize (b) castor (c) wheat (d) pea

60 In monocots, the single cotyledon of embryo is represented by
(a) scutellum (b) prophyll (c) coleoptile (d) coleorhiza

61 Cotyledons and testa are edible parts of
(a) groundnut and pomegranate (b) walnut and tamarind
(c) French bean and coconut (d) cashew nut and litchi

62 Seed coat is membranous and fused with the fruit wall in
(a) maize (b) pea (c) gram (d) All of these

63 An example of a seed with endosperm, perisperm and caruncle is
(a) cotton (b) coffee (c) lily (d) castor

64 Which one of the following statements is correct?
(a) The seed in grasses is not endospermic
(b) Mango is a parthenocarpic fruit
(c) A proteinaceous aleurone layer is present in maize grain
(d) A sterile pistil is called a staminode

65 Perisperm differs from endosperm in
(a) being a haploid tissue
(b) having no reserve food
(c) being a diploid tissue
(d) its formation by fusion of secondary nucleus with several sperms

66 The floral formula $\oplus\,\male\female K_{2+2}\ C_4 A_{2+4}\ \underline{G}_{(2)}$ represents
(a) *Solanum nigrum* (b) *Hibiscus rosa-sinensis*
(c) *Citrus aurantum* (d) *Brassica campestris*

67 Floral formula of tomato / tobacco is
(a) $\oplus\,\male\female K_{4-5}\,A_{10}\,\underline{G}_{(2)}$ (b) $\oplus\,\male\female K_{2+2}C_4K_{2+4}\,G_1$
(c) $\oplus\,\male\female P_2A_3G_1$ (d) $\mathrm{Br}\oplus\,\male\female K_{(5)}C_{(5)}A_5\,\underline{G}_{(2)}$

68 From the options given below, find out the correct floral formula for a flower having the following characters namely actinomorphic, bisexual, five united sepals, five united petals, stamens five and epipetalous, bicarpellary, syncarpous with superior overy
(a) $\oplus\,\male\female K_{(5)}C_{(5)}\underline{A_5}\,\underline{\underline{G}}_{(2)}$ (b) $\oplus\,\male\female K_{(5)}\overline{\overline{C_{(5)}}}\,A_5\,\underline{\underline{G}}_{(2)}$
(c) $\oplus\,\male\female K_{(5)}\underline{C_{(5)}}\,A_5\,\underline{\underline{G}}_{(2)}$ (d) $\oplus\,\male\female K_{(5)}C_{(5)}\overline{A}_5\,\overline{\overline{G}}_{(2)}$

Directions (Q.Nos. 69-70) *In each of the following questions a statement of Assertion is given followed by a corresponding statement of Reason just below it. Of the statements, mark the correct answer as*
(a) If both Assertion and Reason are true and Reason is the correct explanation of Assertion
(b) If both Assertion and Reason are true, but Reason is not the correct explanation of Assertion
(c) If Assertion is true, but Reason is false
(d) If both Assertion and Reason are false

69 **Assertion** Pneumatophores contain lenticels that bring exchange of gases.
Reason Pneumatophores possess stomata on their surface to regulate transpiration from their surface.

70 **Assertion** In cymose tap root system, oldest branch lies very near the growing point of the root, while the youngest branch is farthest away from it.
Reason In cymose tap root system, the primary root itself stops growing.

DAY PRACTICE SESSION 2

PROGRESSIVE QUESTIONS EXERCISE

1 Most of the economically important fibre yielding plants belong to family
(a) Malvaceae (b) Solanaceae
(c) Cruciferae (d) Poaceae

2 Stem tendrils developed from axillary buds are found in which of the following?
(a) Pumpkin and grapevine
(b) *Alstonia* and grapevine
(c) Strawberry and grapevine
(d) Strawberry and pumpkin

3 In *Duranta*, the nature of vasculated defensive structure represents the modification of
(a) axillary bud as in *Bougainvillea*
(b) terminal bud as in *Carissa*
(c) stipules as in *Acacia*
(d) apical bud as in *Artabotrys*

4 The spines present in water chestnut (*Trapa*) are the modification of persistent
(a) corolla (b) calyx
(c) androecium (d) gynoecium

5 In *Asparagus,* fasciculated roots are found which are
(a) modification of tap root
(b) modification of adventitious root
(c) modification for additional support
(d) not a root modification

6 The leafless stem of onion, which is produced to bear flower is called
(a) thalamus (b) scape
(c) torus (d) pedicel

7 Convergent evolution is observed in which of the following pairs?
(a) Lemon, Tomato (b) Onion, Tomato
(c) Potato, Sweet potato (d) Potato, Lemon

8 In *Cyathium*, the ratio between female to male flower is
(a) 1 : 1 (b) 1 : Many
(c) Many : 1 (d) Many : Many

9 Which of the following members of family–Solanaceae is rich in source of vitamin-C?
(a) Tomato (b) Guava
(c) Gooseberry (d) Strawberry

10 Treating the tomato plants with low concentration of gibberellic acid and auxins results in
(a) highly resistant
(b) parthenocarpic plants
(c) very tall shoots
(d) regressive fruit growth

11 Castor (*Ricinus communis*) is a dicot having albuminus seeds. In these seeds, there is a specific outgrowth, called
(a) coleorhiza (b) coleoptile
(c) caruncle (d) scutellum

12 Which of these is an example of actinomorphic flower with valvate aestivation?
(a) *Cassia* (b) *Canna* (c) Cotton (d) Brinjal

13 The correct statement is
(a) Spike, spadix or catkin inflorescence give rise to sorosis type fruit
(b) In pineapple (*Ananas*) and jack fruit (*Artocarpus*), rachis, bracts and perianth are used for eating
(c) In mulberry, fleshy perianth is eaten
(d) All of the above

14 Which of the following is not correct?
(a) Endospermic dicot seeds — Papaya
(b) Non-endospermic dicot seeds — *Vallisneria*
(c) Endospermic monocot seeds — Maize
(d) Non-endospermic monocot seeds — *Pothos*

15 Which one of the following statements is correct?
(a) Seeds of orchids have oil rich endosperm
(b) Placentation in primrose is basal
(c) Flower of tulip is a modified shoot
(d) In tomato, fruit is a capsule

16 Match the following and indicate the correct answer.
(a) Solanaceae–Orange
(b) Brassicaceas–Mustard
(c) Leguminacease–Sunflower
(d) Cucurbitaceae–Cotton

17 In a tetradynamous androecium, one of the following is seen.
(a) Outer whorl of four smaller stamens and inner whorl of two larger stamens
(b) Outer whorl of two larger stamens and inner whorl of four smaller stamens
(c) Outer whorl of four larger stamens and inner whorl of two smaller stamens
(d) Outer whorl of two smaller stamens and inner whorl of four larger stamens

18 Match the following columns.

	Column I		Column II
A.	Tubercular storage roots	1.	*Tinospora*
B.	Pneumatophores	2.	*Heritiera*
C.	Haustoria	3.	*Asparagus*
D.	Prop - roots	4.	*Viscum*
E.	Assimilatory roots	5.	*Screwpine*

Codes

	A	B	C	D	E
(a)	2	3	4	5	1
(b)	3	4	5	1	2
(c)	3	1	2	5	4
(d)	3	2	4	5	1

19 Arrange the following plants in descending order based on the number of carpels they possess.

I. *Papaver* II. *Funaria*

III. *Stellaria* IV. *Rhamnaceae*

Codes

(a) IV, III, I, II (b) II, IV, III, I

(c) II, III, IV, I (d) I, IV, III, II

20 Match the following columns.

	Column I		Column II
A.	*Opuntia*	1.	Stem thorns
B.	*Asparagus*	2.	Phylloclades
C.	*Citrus*	3.	Cladodes

Codes

	A	B	C
(a)	1	2	3
(b)	2	3	1
(c)	3	2	1
(d)	2	1	3

21 Match the following columns.

	Column I (Placentation types)		Column II (Represented in)
A.	Basal	1.	*Dianthus*
B.	Free - central	2.	Pea
C.	Parietal	3.	Lemon
D.	Axile	4.	Marigold
E.	Marginal	5.	*Argemone*

Codes

	A	B	C	D	E
(a)	1	2	3	4	5
(b)	2	3	4	5	1
(c)	4	1	5	3	2
(d)	4	3	5	1	2

22 Which of the following statements are true?

I. If the stem is joined with solid nodes and hollow internodes, it is called caudex.

II. In *Tridax*, the stem is decumbent.

III. Corm is a condensed from of rhizome growing more or less in vertical direction.

IV. Sucker is an underground modification of stem.

V. Biparous type of cymose branching is seen in *Saraca*.

Codes

(a) I, IV and V (b) II and III

(c) II, III and V (d) II and IV

23 Find out the correct sequence of labelling of diagram given below.

(a) *A* – Spike *B* – Raceme
C – Dichasial cyme *D* – Monochasial cyme

(b) *A* – Raceme *B* – Spike
C – Monochasial cyme *D* – Dichasial cyme

(c) *A* – Dichasial cyme *B* – Monochasial cyme
C – Raceme *D* – Spike

(d) *A* – Spike *B* – Dichasial cyme
C – Monochasial cyme *D* – Raceme

24 Parts of two plants were observed. Structure - *A* develops aerially and produces roots when comes in contact with the soil. Structure - *B* develops from underground part of the stem, grows obliquely, becomes aerial and produces roots on its lower surface. Identify respectively the structure of *A* and *B*.

(a) Sucker, Stolon (b) Stolon, Runner

(c) Stolon, Sucker (d) Runner, Stolon

25 Rearrange the following zones as seen in the root in vertical section and choose the correct option.

I. Root hair zone II. Zone of meristems

III. Root cap zone IV. Zone of maturation

V. Zone of elongation

(a) III, I, V, II, IV

(b) I, II, III, IV, V

(c) IV, V, I, III, II

(d) V, IV, III, II, I

26 Identify the wrong expression.

(a) An actinomorphic flower can be dissected into two equal halves from any plane

(b) Type of inflorescence found in mustard is raceme

(c) Mustard has a false septum and is called replum

(d) Plant bearing sterile pistil is called stamniode

27 Two dry fruits (*A* and *B*) were observed. Both developed from unilocular ovaries of monocarpellary gynoecia. In fruit *A*, pericarp and seed coat are free. It liberates the seeds only after the disintegration of the pericrap. Fruit '*B*' dehisced dorsiventrally liberating the seeds. In the following, the former in the pair represents '*A*' and latter '*B*'. To which types of fruits '*A*' and '*B*' respectively belong?

(a) Achene and Legume

(b) Nut and Follicle

(c) Cypsella and Siliqua

(d) Pyxidium and Septicidal capsule

28 Consider the following statements

I. In racemose inflorescence, the flowers are borne in a basipetal order.

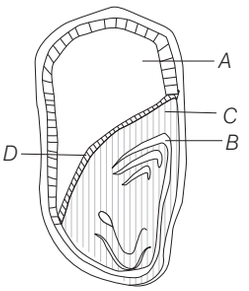
II. Epigynous flowers are seen in rose plant.

III. In brinjal, the ovary is superior.

Of these statements, the correct statement is /are

(a) I and II
(b) I and III
(c) Only III
(d) Only II

29 The diagram of the section of a maize grain is given below. Identify the parts labelled *A*, *B*, *C* and *D*



	A	*B*	*C*	*D*
(a)	Endosperm	Coleoptile	Scutellum	Aleurone layer
(b)	Cotyledon	Coleoptile	Scutellum	Epithelium
(c)	Endosperm	Coleoptile	Scutellum	Epithelium
(d)	Endosperm	Coleoptile	Scutellum	Radicle

Directions (Q. Nos. 30 and 31) In *each of the following questions a statement of Assertion is given followed by a corresponding statement of Reason just below it. Of the statements, mark the correct answer as*

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

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

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

(d) If both Assertion and Reason are false

30 **Assertion** Vivipary is the phenomenon of producing young ones in advanced state of development.

Reason It occurs in mangrove plants like *Rhizophora* and *Sonneratia*, *Agave* and Mammals.

31 **Assertion** Ginger has a prostrate growing rhizome.

Reason Shoot growth is not affected by gravity.

ANSWERS

SESSION 1

1 (d)	**2** (c)	**3** (b)	**4** (b)	**5** (c)	**6** (a)	**7** (c)	**8** (b)	**9** (d)	**10** (b)
11 (d)	**12** (d)	**13** (b)	**14** (c)	**15** (c)	**16** (c)	**17** (b)	**18** (b)	**19** (c)	**20** (b)
21 (b)	**22** (b)	**23** (a)	**24** (a)	**25** (a)	**26** (c)	**27** (b)	**28** (b)	**29** (b)	**30** (b)
31 (a)	**32** (a)	**33** (d)	**34** (a)	**35** (d)	**36** (a)	**37** (d)	**38** (a)	**39** (b)	**40** (c)
41 (d)	**42** (d)	**43** (a)	**44** (d)	**45** (b)	**46** (b)	**47** (a)	**48** (b)	**49** (b)	**50** (a)
51 (d)	**52** (c)	**53** (c)	**54** (b)	**55** (b)	**56** (c)	**57** (a)	**58** (b)	**59** (d)	**60** (a)
61 (a)	**62** (a)	**63** (d)	**64** (c)	**65** (b)	**66** (d)	**67** (d)	**68** (b)	**69** (c)	**70** (a)

SESSION 2

1 (a)	**2** (a)	**3** (a)	**4** (b)	**5** (b)	**6** (b)	**7** (c)	**8** (b)	**9** (a)	**10** (b)
11 (c)	**12** (d)	**13** (d)	**14** (b)	**15** (c)	**16** (b)	**17** (d)	**18** (d)	**19** (d)	**20** (b)
21 (c)	**22** (b)	**23** (b)	**24** (c)	**25** (a)	**26** (d)	**27** (a)	**28** (c)	**29** (b)	**30** (d)
31 (b)									