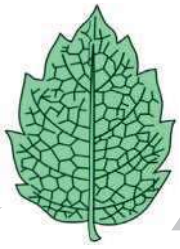


Chapter - 5 Morphology of Flowering Plants

Points to Remember

Morphology : The study of various features, forms and relative position of different organs of the organism is known as morphology. It may be further divided into internal and external morphology. It deals with external forms like shape, size, colour, structure and relative position of different organs.

Anatomy : It deals with the study of internal structure exposed after dissection and opening of various parts of an organ.

Histology : The study of tissues, their composition and structure.

Adaptation : Any alteration in the structure or function of an organism or any of its part that results from natural selection and by which the organism becomes better fitted to survive and multiply in its environment.

The Root

The root is underground part of the plant and develops from elongation of radicle of the embryo.

Characteristics : It is inside the soil, chlorophyll is absent, absence of nodes, internodes, leaves and buds; positive geotropic and hydrotropic and negative phototropic.

Main functions of root system :

1. Absorption of water and minerals from the soil.
2. Provides anchorage to plant parts.
3. Stores reserve food material and synthesises plant growth regulators (cytokinins)

Various types of root

↓

Tap root	Fibrous root	Adventitious root
↓	↓	↓
Originates from radical Dicotyledonous plants, e.g., gram, pea, mango, mustard.	Originates from base of the stem Monocotyledonous plants, e.g., wheat, paddy, grasses.	Originates from parts of the plant other than radicle Banyan tree (Prop roots) Maize (stilt roots) Rhizophora (Respiratory roots)

Regions of Roots

Root Cap : The root is covered at the apex by the thimble-like structure which protect the tender apical part.

Region of meristematic activity : Cells of this region have the capability to divide; cells are small, thin walled with dense protoplasm.

Region of elongation : Cell of this region are elongated and enlarged. This region is responsible for the growth of root in length.

Region of Maturation : This region has differentiated and matured cells. Some epidermal cells form very fine and delicate thread like structures called root hairs.

Modifications of Root : Roots are modified for support, storage of food, respiration.

- **For support :** Prop roots in banyan tree, stilt roots in maize and sugarcane.
- **For respiration :** Pneumatophores in Rhizophora (Mangrove).
- **For storage of food :** Fusiform (radish), Napiform (turnip), Conical (carrot), Fasiculated fleshy roots (Asparagus).

The Stem

Stem is the aerial part of the plant and develops from plumule of the embryo. It bears nodes and internodes.

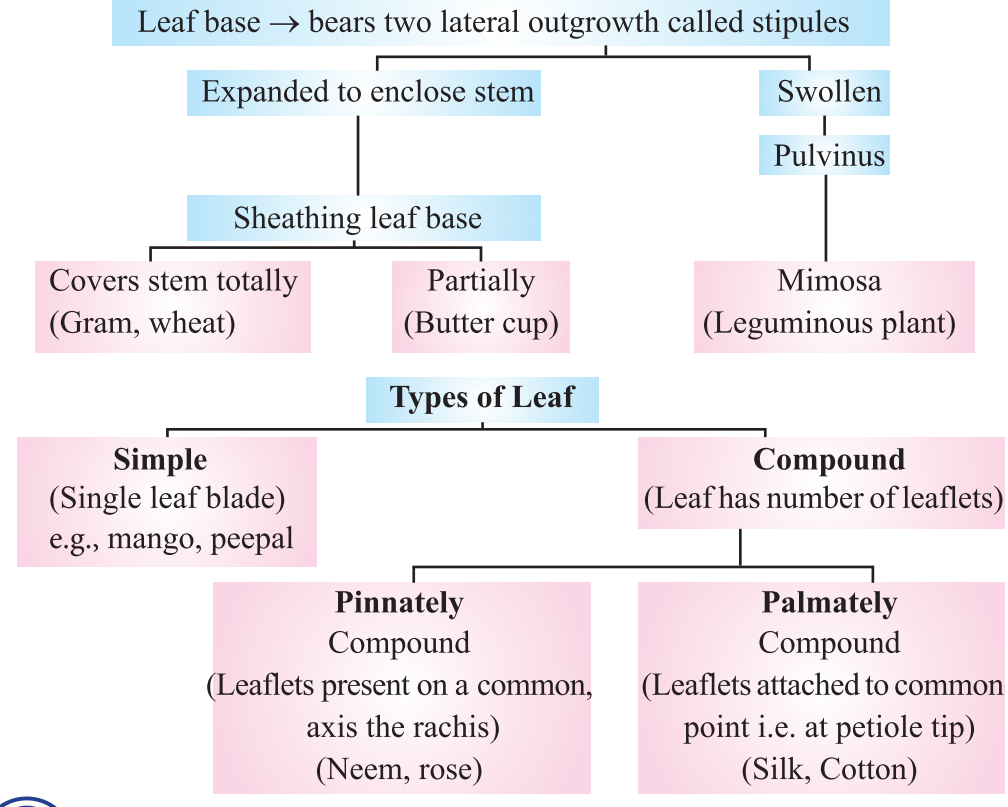
Functions of stem : Exposure of leaves, conduction of water and minerals, translocation of food, exposure of flowers and fruits.

Modifications of Stem :

In some plants the stems are modified to perform the function of storage of food, support, protection and vegetative propagation.

- **For food storage :** Rhizome (ginger, turmeric), Tuber (potato), Bulb (onion), Corm (Colocasia, Amorphophallus/Zamin-kand)
- **For support :** Stem tendrils of watermelon, grapevine, cucumber, pumpkins.
- **For protection :** Axilliary buds of stem of Citrus, Bougainvillea get modified into pointed thorns. They protect the plants from animals.
- **For vegetative propagation :** Underground stems of grass (runner), strawberry (stolons), lateral branches of mint and jasmine, Eichhornia (offsets).
- **For assimilation of food :** Flattened stem of *Opuntia* and cylindrical stem of *Euphorbia* contains chlorophyll and performs photosynthesis.

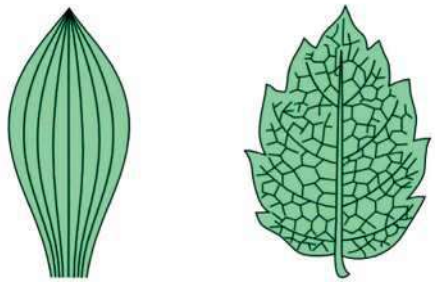
The Leaf : Develops from shoot apical meristem, flattened, green structure acropetally arranged manufacture the food by photosynthesis. It has bud in axil. A typical leaf has leaf base, petiole and lamina (leaf blade). In some leguminous plants the leaf base may become swollen which is called as pulvinus.



Venation : The arrangement of veins and veinlets in the lamina of leaf.

Types of Venation :

1. **Reticulate :** Veinlets form a network as in leaves of dicotyledonous plants (China rose, peepal).
2. **Parallel :** Veins are parallel to each other as in leaves of monocotyledonous plants (grass, maize,sugarcane).



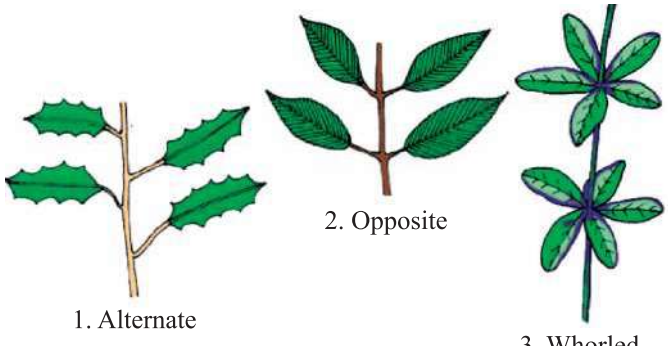
1. Reticulate 2. Parallel

Types of Venation

Phyllotaxy : The pattern of arrangement of leaves on the stem or branch.

Types of phyllotaxy

Alternate	Opposite	Whorled
(Single leaf at a node)in alternate manner e.g., China rose Mustard,	(Two leaves at a node) in opposite manner e.g., Calotropis, guava	(More than two leaves in a whorl at a node) e.g., Nerium, Alstonia



1. Alternate 2. Opposite 3. Whorled

Types of Phyllotaxy

Functions of Leaf

photosynthesis, gaseous exchange, transpiration.

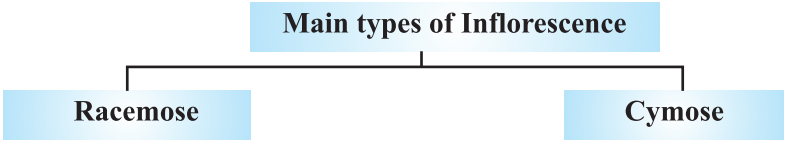
Modifications of Leaves :

Type		Function		Example
● Tendrils	:	(Climbing)	—	Sweet Pea, Pea
● Spines	:	(Protection)	—	Aloe, Opuntia, Argemone
● Pitcher	:	(Nutrition)	—	Nepenthes
● Hook	:	(Support)	—	Cat's nail
● Fleshy Leaves	:	(Storaged food)	—	Onion and Garlic

Inflorescene

The arrangement of flowers on the floral axis (Peduncle)

Main types of Inflorescence



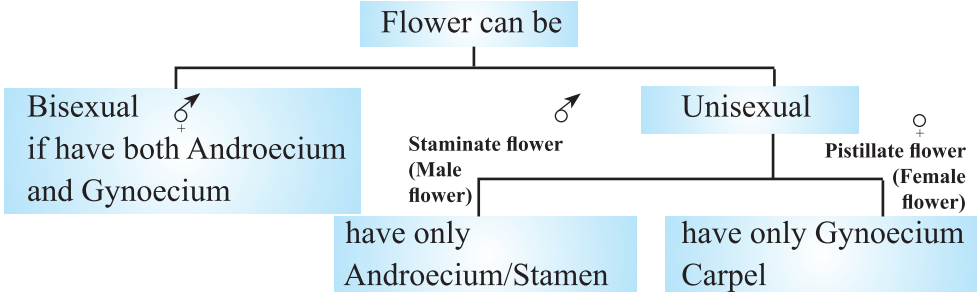
1. It is indefinite inflorescence
2. Main axis continues to grow and flowers borne in acropetal succession e.g. : Radish, Mustard, Amaranthus

1. It is definite inflorescence
2. Main axis terminates in flowers and the flowers borne in basipetal succession e.g. : Cotton, Jasmine, Calotropis

Mnemonic : RU = Racemose unlimited growth CL = Cymose limited growth

Special Inflorescence type— *Ficus, Salvia, Euphorbia,* Sunflower

Flower—Modified shoot meant for reproduction



On the basis of symmetry flower can be :

Actinomorphic ⊕ (Radial symmetry)	Zygomorphic % (Bilateral symmetry)	Asymmetric (Irregular)
Flower can be divided into two equal halves in any radial plane passing through centre eg : Mustard, Datura, Chilli	Flower can be divided into two similar halves only in one plane eg : Pea, bean, Gulmohar, Cassia	Flower cannot be divided in two similar halves by any vertical plane passing through centre eg : Canna

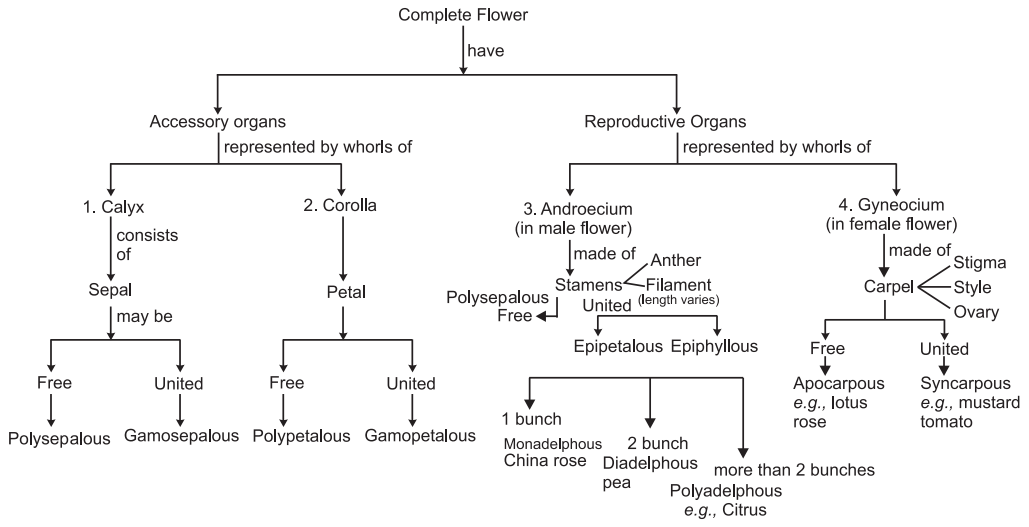
On the basis of floral appendages flower can be :

Trimerous (multiples of 3)	Tetramerous (multiples of 4)	Pentamerous (multiples of 5)

Thalamus/Receptacle : Swollen end of flower stalk (pedicel) which bears four whorls of flower viz., Calyx (K), Corolla (C), Androecium (A) and Gynoecium (G).

On the basis of position of Calyx, corolla and androecium with respect to ovary, flower can be:

Hypogynous (Superior Ovary)	Perigynous (Half inferior ovary)	Epigynous (inferior ovary)
$\underline{G}$ above, K, C, A Mustard, China rose, Brinjal	G at par/same level as K, C, A Plum, Rose, Peach	$\overline{G}$ below K, C, A Guava, Cucumber ray florets (sun flower)



Bract—Reduced leaf base found at the base of pedicel. Flowers with bracts are called bracteale and without bracts are called ebracteate.

Perianth : If calyx and corolla are not distinguishable, they are called perianth.

Example : Lily

Aestivation: The mode of arrangement of sepals or petals in floral bud.

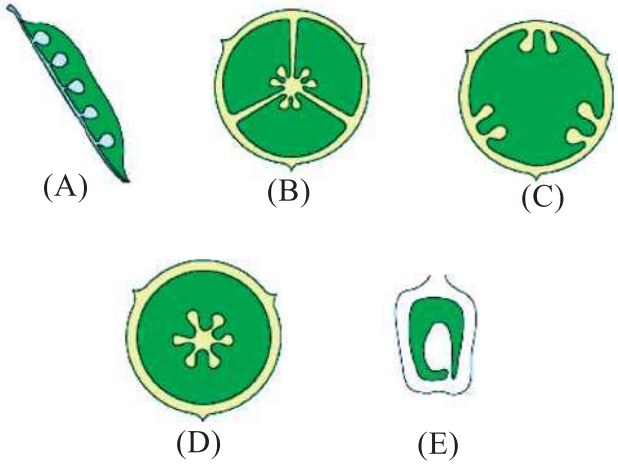
Types of aestivation :

1. **Valvate :** Sepals or petals just touch one another at the margin, without overlapping. e.g., Calotropis
2. **Twisted :** Sepals or petals overlap the next sepal or petal e.g., China rose, Cotton, ladyfinger.
3. **Imbricate :** The margins of sepals or petals overlap one another but not in any definite direction, e.g., Cassia, Gulmohar.
4. **Vexillary :** The largest petal (standard) overlaps the two lateral petals (wings) which in turn overlap two smallest anterior petals (keel) e.g., Bean, Pea.

Placentation : The arrangement of ovules within the ovary.

Types of Placentation :

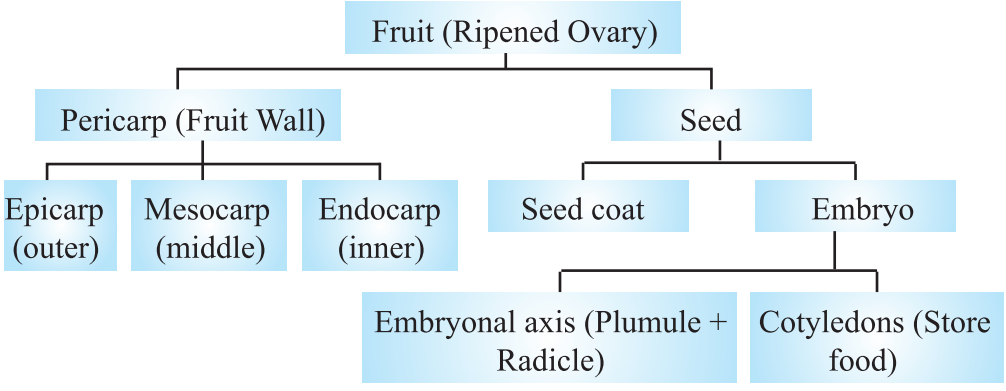
A. **Marginal :** Placenta forms a ridge along the ventral suture of ovary, e.g., Pea.
B. **Axile :** Margins of carpels fuse to form central axis, e.g., China rose, Tomato, Lemon
C. **Perietal :** Ovules develop on inner wall of ovary, e.g., Mustard, Argemone
D. **Free central :** Ovules borne on central axis, lacking septa, e.g., Dianthus, Primrose



E. Basal : Placenta develop at the base of ovary, e.g., Sunflower, Marigold

Placenta : Parenchymatous flattened cushion inside ovary where ovules are borne.

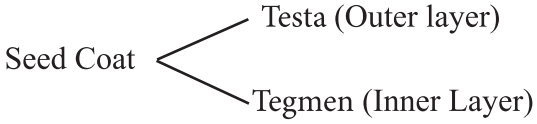
The fruit : After fertilisation, the mature ovary develops into fruit. The parthenocarpic fruits are formed from ovary without fertilisation (seedless fruit-Banana)

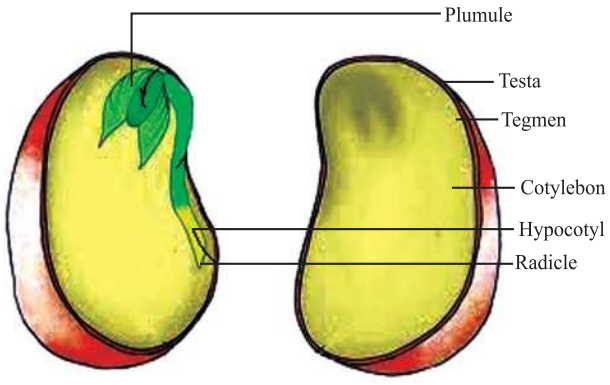


Monocotyledonous seed—Endosperm bulky and stores food, covered by proteinaceous Aleurone layer. Seed has single large cotyledon–scutellum.

Plumule is enclosed in Coleoptile and Radicle is enclosed in Coleorrhiza.

Dicotyledonous Seed—





Hilum —is a scar on the seed coat through which seeds attached to the fruit.
Micropyle—small pore, above hilum
Cotyledons—two; fleshy, full of reserve food materials
Embryonal axis—Radicle and plumule.

Endospermous seed—endosperm present in mature seed. eg. castor

Non-endospermous seed—endosperm not present in mature seeds, eg. bean,

Questions

(SRT) Select Response Type Question (1 mark each)

1. Which part of Opuntia is modified to form spines?
   (a) Root (b) Leaf (c) Flower (d) Stem
2. Which group of plants given below, show pinnately compound leaves?
   (a) Silk Cotton, Maple (b) Tulip, Neem
   (c) Maple, Acacia (d) Neem, Rose, Acacia
3. Which parts in Ginger and Onion are edible respectively?
   (a) Corm & Tuber (b) Bulb & Tuber
   (c) Rhizome & Bulb (d) Corm & Rhizome

CONSTRUCTED RESPONSE TYPE (CRT)

Very Short Answer Question (1 mark each)

4. In mangroves, pneumatophores are the modified adventitious roots. How are these roots helpful to the plant ?
5. Why do various plants have different type of phyllotaxy ?

6. State the main function of leaf tendril.
7. Which plant family represent the following floral formula :

$$\oplus \; \overset{\nearrow}{\underset{+}{\mathrm{O}}} \; \mathrm{K}_{(5)} \; \overline{\mathrm{C}_{(5)} \; \mathrm{A}_{5}} \; \underline{\mathrm{G}}_{(2)}$$

8. The endosperm is formed as a result of double fertilisation (triple fusion). What is its function ?
9. Which type of venation do you observe in dicot leaf ?
10. In pea flower, the aestivation in corolla is known as vexillary. Give reason.
11. What is the name given to the cotyledon in case of Monocots.
12. Name the part modified for food storage in the following (a) carrot (b) Radish (c) Potato (d) Dahlia (e) Turmeric (f) Sweet potato

Short Answer Questions-I (2 marks each)

13. Flower is a modified shoot Justify.
14. Name the type of root of the following :
    (a) Roots performing the function of photosynthesis.
    (b) Roots coming above the surface of the soil to absorb air.
    (c) The pillar like roots developed from lateral branches for providing mechanical support.
    (d) Roots coming out of the lower nodes of the stem to provide the support to the plant.
15. Identify the type of tendrils found in the following plants—
    (a) Cucumber (b) Pea (c) Grape vines (d) Water Melon
16. Fill up the blank spaces (a), (b), (c) and (d) in the table given below :

Type of flower	Position of calyx, corolla and respect of the ovary on thalamus	Type of ovary
Hypogynous	..... (a)	Superior
Perigynous	On the rim of the thalamus almost at the same level of ovary.	.....(b).....
..... (c)	..... (d)	Inferior

17. Provide the scientific terms for the following :
    (i) The leaf without a petiole (stalk).
    (ii) The flat and expanded portion of a leaf.
    (iii) Orderly arrangement of leaves on the node.
    (iv) Lateral appendages on either side of the leaf.

18. Differentiate between peduncle and Pedicel

Short Answer Question-II (3 marks each)

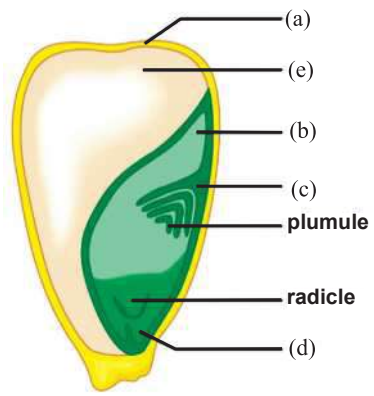
19. Observe the given figure showing various types of placentration. Identify the type of placentation. Give one example of each.

(a) (b) (c)

20. 'Potato is a stem and sweet potato is a root.' Justify the statement on the basis of external features.
21. Define aestivation. Which type of aestivation is found in China rose, Calotropis Gulmohar and Pea?
22. Give two example of each type of phyllotaxy.
23. Differentiate between :
    (a) Actinomorphic flower and Zygomorphic flower
    (b) Apocarpous ovary and Syncarpous ovary
    (c) Racemose inflorescence and Cymose inflorescence
24. Read & observe the following to answer the questions given below

    Seeds either may be monocotyledonous/dicotyledonous. They may vary in shape, size and period of viability.

    (i) In the given structure of a Monocotyledonous seed label the parts a, b, c,d,e. Give the function of part "a"



    (ii) Maize grain is usually called as a fruit and not a seed. Why ?

Long Answer Questions (5 marks each)

25. Describe various stem modifications associated with food storage, climbing and protection.

Assertion and Reason Based

Directions: In the following questions, a statement of assertion (A) is followed by a statement of reason (R). Mark the correct choice as:

(a) If both (A) and (R) are correct and (R) is the correct explanation of (A).

(b) If both (A) and (R) are true, but (R) is not the correct explanation of (A).

(c) If (A) is true but (R) is false.

(d) If both (A) and (R) are false.

26. Assertion: Underground parts of a plant are not always roots.
Reason: Underground stems of potato are modified to store food.

27. Assertion: Calyx can be gamosepalous or polysepalous
Reason: Corolla is composed of petals.

Answers

(SRT) Select Response Type Question (1 mark each)

1. (b) Leaves
2. (d) Neem, Rose, Acacia
3. (c) Rhizome & Bulb

CONSTRUCTED RESPONSE TYPE (CRT)

Very Short Answers (1 mark each)

4. Pneumatophores in mangroves help in respiration.
5. For proper exposure of leaves to get sunlight.
6. The leaf tendrils help the plant for climbing.
7. Solanaceae
8. Endosperm stores the food.
9. Reticulate venation.
10. In peas, there are five petals. The largest one (standard) overlaps the two lateral petals (wings) which in turn overlap the two smallest anterior petals (keel).
11. Scutellum.
12. (a) Fleshy tap root (b) Fleshy tap root (c) Stem tuber (d) root tuber (e) Rhizome (f) Fleshy root tuber

Short Answers-I (2 marks each)

13. The flower is considered to be a modified shoot because the internodes in flower are highly condensed and the appendages such as sepals, petals, stamens and carpels(pistil) are generally large in number.
14. (a) Assimilatory roots (b) Respiratory roots/Pneumatophores
    (c) Prop roots (d) Stilt roots
15. (a), (c) and (d) stem tendrils
    (b) leaf tendril
16. (a) Floral parts are situated below the ovary.
    (b) Half inferior
    (c) Epigynous
    (d) Floral parts are situated above the ovary.
17. (i) Sessile (ii) Lamina
    (iii) Phyllotaxy (iv) Stipules
18. **Peduncle** is the axis of inflorescence which generally bears a number of flowers.

    Pedicel is the stalk of the flower which bears a single flower.

Short Answers SA-II (3 marks each)

19. (a) Marginal placentation — Pea
    (b) Parietal placentation — Mustard, Argemone
    (c) Free central placentation — Dianthus, Primrose
20. Potato is the swollen tip of an underground stem branch. It has nodes (eyes) which consist of one or more buds subtended by a leaf scar. Adventitious roots also arise during sprouting. On the other hand sweet potato is a swollen adventitious root (tuberous root). It has no nodes, internodes and buds like a stem, but has root hairs.
21. The mode of arrangement of sepals or petals in a floral bud is known as aestivation.

    China rose – twisted Calotropis – valvate

    Gulmohar – imbricate Pea – vexillary

22.

Type of phyllotaxy	Examples
(i) Alternate	China rose, mustard
(ii) Opposite	Calotropis, guava
(iii) Whorled	Nerium, Alstonia

23. **(a)**

Actinomorphic Flower	Zygomorphic flower
(1) Two equal halves are formed by any vertical division passing through the centre.	(1) Two equal havles are produced only by one vertical division
(2) It has a radial symmetry.	(2) It has a bilateral symmetry.

(b)

Apocarpous Ovary	Syncarpous Ovary
(1) The flower has several free free carpels (ovary).	(1) The flower has fused carpels.
(2) On maturity it forms fruitlet of aggregate type.	(2) On maturity it forms a single fruit.

(c)

Racemose inflorescence	Cymose inflorescence
(1) The main axis has unlimited growth.	(1) The main axis has a limited growth.
(2) Flowers are arranged acropetally i.e., the lower flower are younger	(2) Flowers are arranged basipetally i.e., the lower flowers are older

24. (i) (a) Endosperm (b) Scutellum
(c) Coleoptile (d) Coleorrhiza
(e) Aleurone layer
Function of (a)—Provide nutrition.

(ii) Maize grain is a single seeded fruit in which the seed covering or testa is fused with pericarp or fruit wall. A micropyle is not found but base of style is present.

Long Answers (5 marks each)

25. **Stem Modification :**
- **For food storage :** Ginger (Rhizome), Potato (Tuber), Onion (Bulb), Colocasia (Corm).
- **For climbing (support) :** Sterm tendril (cucumber,grapevine,watermelon)
- **For protection :** Thorn (Bougainvillea, Citrus, Duranta) Refer NCERT, Text Book of Biology for Class XI for description.

26. (b) 27. (b)