

## Taxonomy of Angiosperms

### Very short Answer Questions

**1. What is 'Omega Taxonomy'?**

A: Besides morphological features, information from other sources viz Embryology, Cytology, Palynology, Phytochemistry, Serology also form criteria for taxonomy it is called Omega Taxonomy.

**2. What is Natural system of plant classification? Name the scientists who followed it?**

A: Natural system of classification is a classification in which all the important, mostly, morphological characters are considered in classifying plants into groups.

Bentham & Hooker.

A.P.de Condolle.

**3. Explain the scope and significance of 'Numerical Taxonomy'?**

A: Scope: 1. At the same time hundreds of characters can be considered.

2. As it is numerical, using computers make classification easy and faster.

Significance: 1. Similarities between different groups are known.

2. Both qualitative and quantitative comparisons are made.

**4. What is geocarpy? Name the plant which exhibits this phenomenon?**

A: Development of fruit below the surface of the soil is called geocarpy.

Eg: *Arachis hypogea* (ground nut)

**5. Name the type of pollination mechanism found in the members of Fabaceae?**

A: Pollination mechanism in Fabaceae is 'Piston Mechanism'.

**6. Write the floral formula of *Solanum* plant?**

A:  $\text{Br, Ebrl, } \oplus, \oplus, \overset{\curvearrowright}{K_{(5)}, C_{(5)}, A_5, G_{(2)}}$

**7. Give the technical description of ovary in *Solanum nigrum*?**

A: Superior ovary, bicarpellary, syncarpous, bilocular, ovules on swollen axile placentation.

Carpels arranged obliquely at  $45^{\circ}$  angle.

**8. Give the technical description of anthers of *Allium cepa*?**

A: Stamens are 6 in number arranged in two whorls (3+3), epiphyllous. Each stamen is ditheous, basifixed, introrse, and longitudinal dehiscence.

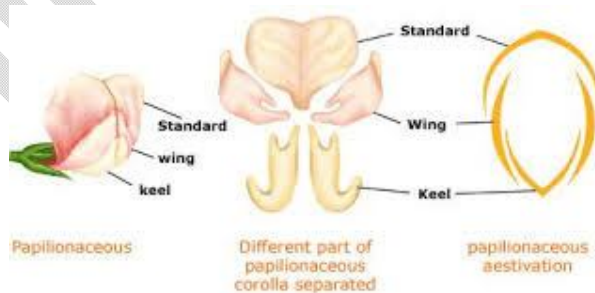
Short Answer questions

1. Write a brief note on semi technical description of a typical flowering plant?

A. The plant is described beginning with its habit, habitat, vegetative characters (root, stem, leaves) and floral characters (inflorescence, flower and its parts) followed by fruit. Then floral diagram and a floral formula are presented. In floral formula, Br stands for bracteates (bracts are present), Ebr stands for ebracteate (bracts are absent). Br1 stands for bracteolate (bracteoles are present), Ebr1 stands for ebracteolates (Bracteoles are absent).  $\oplus$  stands for actinomorphic,  $\%$  stands for zygomorphic flower.  $\sigma$  stands for male flower,  $\rho$  stands for female flower,  $\sigma\rho$  stands for bisexual flower, K for calyx, C for corolla, P for perianth, A for androecium and G for Gynoecium.  $\underline{G}$  stands for superior ovary  $\overline{G}$  stands for inferior ovary. Floral formula also indicates the number of free or united (within brackets) numbers of each whorl and also show cohesion or adhesion of stamens. Floral diagram provides information about the number of parts of a flower, their arrangement and the relation they have with one another. The mother axis represents the posterior side of the flower indicates as a dot or circle at the top of the floral diagram. K, C, A and G are drawn in successive whorls. The bract represents the anterior side of the flower and is indicated at the bottom of the floral diagram.

2. Describe the non – essential floral parts of plants belonging to Fabaceae?

A.



In Fabaceae, non – essential floral parts are Calyx and Corolla.

**Calyx:** Sepals 5, gamosepalous, imbricate aestivation, odd sepal anterior.

**Corolla:** Petals 5, polypetalous, papilionaceous type consists of a large posterior petal (standard) two lateral (wings). Two anterior fused petals (keel) enclosing essential organs.

They show vexillary/descending imbricate aestivation.

3. Give an account of floral diagram?

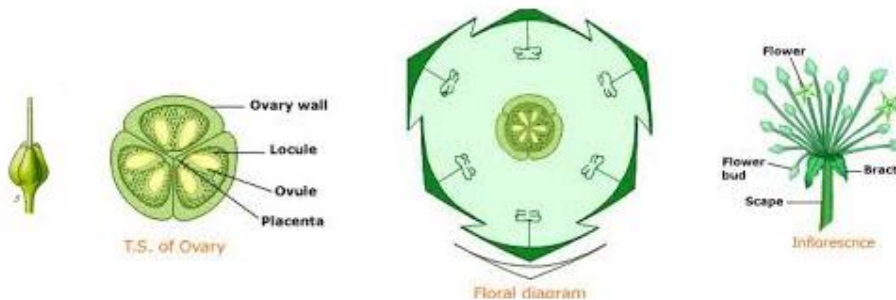
A.



A floral diagram represents the number of parts of flower, the structure, arrangement, aestivation, cohesion and adhesion of stamens and position with respect to mother axis. The mother axis represents the posterior side of the flower and is indicated as dot at the top of the floral diagram. K, C, A, G are drawn in successive whorls. Calyx the outermost and the gynoecium being the centre represented are by T.S. of ovary. The bract represents the anterior side of the flower and is indicated at the bottom of the floral diagram.

4. Describe the essential floral parts of plants belonging to Liliaceae?

A.



The essential floral parts of Liliaceae are Androecium and Gynoecium.

**Androecium** : Six stamens in two whorls, free or epiphyllous, anthers are ditheous basifixed, introrse and dehisce longitudinally.

**Gynoecium** : Tricarpellary, syncarpous, trilocular superior ovary with many ovules on axile placentation. Style is terminal and stigma is trifid and capitate.

**5. Write a brief account on the class of Dicotyledonae of Bentham and Hooker's classification?**

A. In Bentham and Hooker's classification, the class Dicotyledonae was divided into three sub classes namely Polypetalae, Gamopetalae and Monochlamydeae. Polypetalae, sub class is divided into three series namely Thalamiflorae (6 orders), Disciflorae (4 orders) and Calyciflorae (5 orders). Gamopetalae, sub class is divided into three series namely Inferae (3 orders), Heteromerae (3 orders) and Bicarpellate (4 orders). Monochlamydeae was divided into eight series.

**6. Explain floral formula?**

A. The floral formula is represented by some symbols of floral parts. In it, Br stands for bracteates (bracts are present), Ebr stands for ebracteate (bracts are absent). Brl stands for bracteolate (bracteoles are present).

Ebrl stands for ebracteolates (Bracteoles are absent).

⊕ stands for actinomorphic flower.

% stands for zygomorphic flower.

♂ stands for male, ♀ stands for female, ♂♀ stands for bisexual flower. K stands for calyx, C for corolla, P for perianth, A for Androecium and G for Gynoecium.  $\underline{G}$  stands for superior ovary  $\overline{G}$  stands for inferior ovary. Floral formula also indicates the number of free or united numbers of the corresponding whorl. It also shows cohesion or adhesion of stamens.

**7. Give economic importance of plants belonging to Fabaceae?**

A.

- 1) Pulses like red gram (*Cajanus cajan*), black gram (*Phaseolus mungo*), green gram (*Phaseolus aureus*), Bengal gram (*Cicer arietinum*) are a rich source of proteins.
- 2) Pods of *Dolichos*, *Glycine* are used as vegetables.
- 3) Seeds of *Pisum* and *Arachis* are edible.
- 4) Groundnut oil from *Arachis hypogaea* seeds and soyabean oil from seeds of *Glycine max* are used in cooking.
- 5) *Crotalaria*, *Phaseolus* is used as fodder.
- 6) The oil from the seeds of *Derris indica* is used in the making of medicines.
- 7) Several crops are used in crop rotation due to their nitrogen fixing ability.
- 8) Seeds of *Trigonella* are used as condiment and medicine. The leaves are used as

vegetable.

9) *Sesbania* and *Tephrosia* are used as green manure.

10) Fibre from *Crotalaria* is used in making ropes.

11) *Indigofera* yields blue dye, which is used as a fabric whitener.

12) Wood from *Pterocarpus* is used for making musical instruments.

13) Wood from *Dalbergia* is used for making furniture.

### LONG ANSWER TYPE QUESTIONS:

1. Describe the characteristics of plants belonging to Fabaceae?

A.

#### Vegetative characteristics:

**Habitat:** Most of the members of this family are mesophytes.

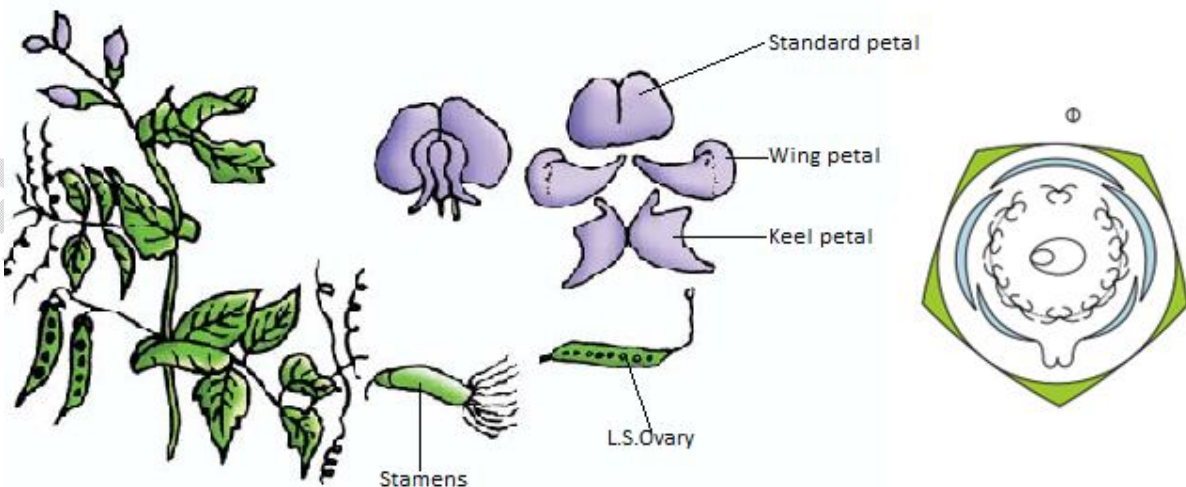
**Habit:** The plants are annual herbs, some are shrubs, some others are trees. Some are weak stemmed that climb as twiners (*Dolichos*) or with tendrils (*Pisum*).

**Root system:** It is tap root system. The roots bear root nodules in which the symbiotic nitrogen fixing bacteria. Rhizobia are present.

**Stem:** It is aerial, erect, herbaceous or woody. In some plants stem is weak and prostrate or twinner (*Dolichos*) or a tendril climber (*Pisum*, *Lathyrus*).

**Leaf:** Leaves are cauline, alternate, stipulae, petiolate and dorsiventral. The leaf base is pulvinus. They are simple or pinnately compound. In *Pisum* are modified into tendrils.

Venation is reticulate.



**Floral characteristics:**

**Inflorescence:** It is usually an axillary or terminal raceme (*Crotalaria*).

**Flower:** Flowers are bracteates, bracteoles may be present or absent, pedicellate, complete, zygomorphic, bisexual, pentamerous and perigynous. The thalamus is cup shaped.

**Calyx:** There are five sepals which are fused. The aestivation is valvate. The odd sepal is anterior in position.

**Corolla:** It consists of five petals which are free (Polypetalous). The corolla is papilionaceous. The posterior petal is largest and is called 'Standard petal or Vexillum'. The two lateral parts are called 'Wings of Alae'. The two boat shaped petals are called 'Keel or Carina'. These are fused and enclose the essential organs. The aestivation is 'descendingly imbricate'.

**Androecium :** It consists of 10 stamens. Usually the filaments of the stamens unite to form two bundles of 9 + 1 (Diadelphous) as in *Dolichos*, *Tephrosia*, *Pisum*, etc., or a single bundle (Monadelphous) as in *Crotalaria*, *Arachis*, etc. Anthers are dithecous, introrse and dehisce longitudinally.

**Gynoecium :** It consists of monocarpellary, unilocular, half – inferior ovary. Usually many pendulous ovules are arranged in two vertical rows on marginal placentation. Style is long and curved at the apex. Stigma is capitate.

**Floral formula:**

$$B r, B r l, \%, \overset{\uparrow}{\oplus}, K_{(5)}, C_{1+2(2)}, A_{(10) \text{ or } (9)+1}, \underline{G}_{-1}$$

**Pollination:** As flowers are protandrous, usually cross pollination occurs. In *Lathyrus* and *Pisum*, there is self pollination.

**Fruit:** Mostly the fruit is a legume or pod (*Pisum*, *Cajanus*, *Dolichos*). In *Arachis* the pods are geocarpic.

**Seed:** It is non – endospermic and dicotyledonous. The cotyledons store proteins in large quantities.

**2. Write about the key characteristics of Solanaceae?**

A.

**Vegetative characteristics:**

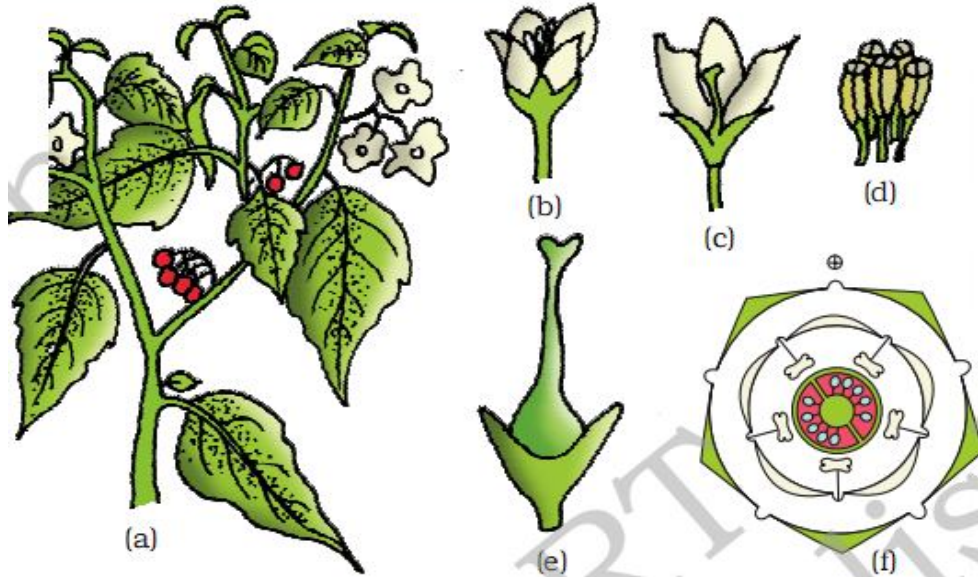
**Habitat:** These plants are mostly mesophytes. A few are xerophytes.

**Habit:** Mostly annual or perennial herbs. Some are shrubs (*Cestrum* sps).

**Root system:** Tap root system.

**Stem:** It is aerial, erect and mostly herbaceous. Stem is in underground tuber in *Solanum tuberosum* (potato). Bicollateral vascular bundles are present in the stem.

**Leaf:** Leaves are exstipulate, petiolate and show alternate phyllotaxy. They are usually or pinnately lobed. Venation is reticulate.



**Floral characters:**

**Inflorescence:** It is usually cymose type. It may be terminal or axillary in position. In some species of *Solanum*, it is an axillary. In *Datura*, it is solitary and terminal, panicle in tobacco.

**Flower:** The flowers are bracteates or ebracteate, ebracteolate, pedicellate, actinomorphic, complete, bisexual, pentamerous and hypogynous.

**Calyx:** It consists of 5 sepals which are fused (gamosepalous) and persistent (*Capsicum*, *Solanum*). The aestivation is valvate.

**Corolla:** The corolla consists of 5 petals and is gamopetalous. The aestivation is valvate or twisted (*Datura*).

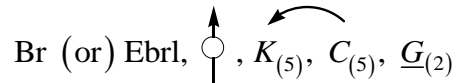
**Androecium :** There are five epipetalous stamens alternating with the petals and are free.

Anthers are ditheous, basifixed and introrse. The dehiscence may be longitudinal (*Datura*) or porous (*Solanum*).

**Gynoecium :** The ovary is superior, bicarpellary and syncarpous. It is oblique in position due to the tilting of posterior carpel to the right and anterior carpel to the left at an angle of  $45^\circ$ .

Usually bilocular occasionally unilocular (*Capsicum*). There are numerous anatropous ovules

arranged on axile placentation on swollen placenta. The style is terminal and stigma is capitate.



**Floral formula:**

**Pollination:** Flowers are usually protandrous. Some species of *Solanum* are protogynous. Cross pollination through insects (entomophily) is common.

**Fruit:** The fruit is mostly berry (*Capsicum, Solanum, Lycopersicon,* ). It is capsule in *Datura*.

**Seeds:** The seeds are endospermic and dicotyledonous.

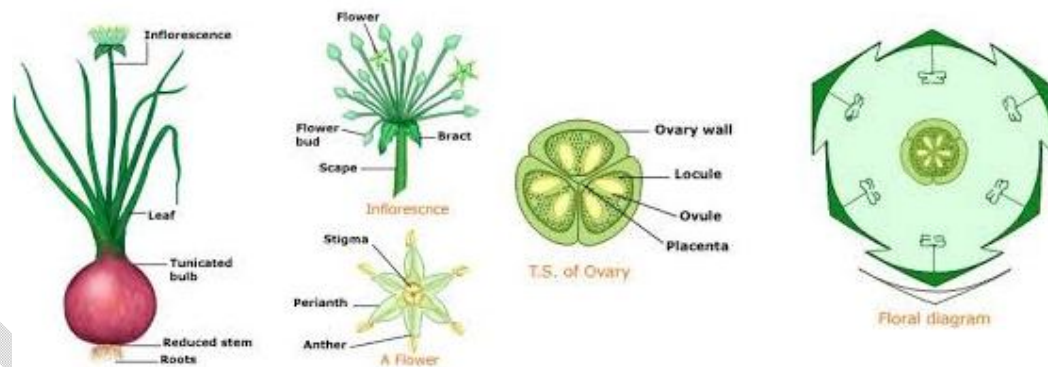
**3. Give an account of the family Liliaceae?**

A.

**Vegetative characteristics:**

**Habitat:** Plants may be mesophytes as well as xerophytes (*Asparagus, Ruscus, Aloe*) are found in this family.

**Habit:** Plants are mostly perennial herbs. In some plants like *Dracaena, Yucca, Aloe,* etc Shrubs or trees are also found and few are climbers (*Gloriosa*).



**Root system:** It is adventitious root system. In *Asparagus* fasciculated tuberous roots are present.



**Stem:** In majority of the species the stem is underground and perennial. It may be a bulb (*Allium*, ), a rhizome (*Gloriosa*) or a corm (*Colchicum*). The aerial stem is weak in tendrill climbers like *Gloriosa*, *Smilax*, etc. Stem is aerial and shows anomalous secondary growth in *Dracaena* and *Yucca*. Branches are modified into cladophylls (*Asparagus*, *Ruscus*).

**Leaf:** The leaves may be radical (*Allium*, *Lilium*) or cauline (*Smilax*, *Gloriosa*). Alternate phyllotaxy is common. Leaves are petiolate, simple stipulate or exstipulate. Venation is usually parallel, but exceptionally reticulate in *Smilax*.

### **Floral characters:**

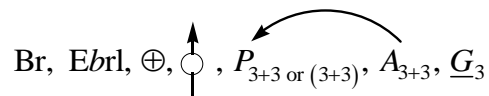
**Inflorescence:** Solitary cyme or umbel or raceme.

**Flower:** The flowers are usually bracteates, ebracteolate, pedicellate, actinomorphic, complete. Bisexual, homochlamydeous, trimerous and hypogynous. Exceptionally flowers are unisexual in *Smilax* and *Ruscus*.

**Perianth :** It consists of six tepals arranged in two whorls of three each. The odd tepal is anterior in position. The aestivation is valvate.

**Androecium :** Stamens are six, arranged in two whorls of three each. Epiphyllous (*Asparagus*). Anthers are ditheous, basifixed, introrse and dehiscence is longitudinal.

**Gynoecium :** It is tricarpellary and syncarpous. The ovary is superior and trilocular with several anatropous ovules on axile placentation. The style is terminal and stigma is trifid and capitate.



### **Floral formula:**

**Pollination:** It is of entomophilous type. Flowers may be protandrous (*Allium*) or protogynous (*Colchicum*).

**Fruit:** It may be a berry (*Asparagus*) or capsule (*Lilium*, *Gloriosa*).

**Seed:** It is endospermic with straight or sometimes curved embryo and monocotyledonous. Polyembryony is seen in some members (*Allium*).

4. Write the characteristics of plants that are necessary for classification. Describe them in brief.

A. Vegetative characters:

**Habit:** Herbs (Plants grow to a height of 1 – 3 feet)

Shrubs (Plants which grow in the form of a bush)

Trees (Plants with erect, woody branched or unbranched)

**Habitat: Hydrophytes:** (Plants which grow in water)

**Mesophytes :** (Plants which grow in moderate climatic conditions)

**Xerophytes :** (Plants which grow in dry areas)

**Root system: Tap root system:** (The main root called Tap root, which in turn forms lateral roots and rootlets)

**Ex:** Dicots

**Fibrous root system:** (Cluster of roots which arise from the base of the stem)

**Ex:** Monocots

**Stem:** Aerial (which grows aerially) or underground (which grows into the soil), erect (stands in upright position) or creeping (which grows on the soil horizontally), tendrils (climbing with the help of tendrils), Stragglers (woody plants that climb up with the help of hooks or thorns), Lianas (large woody perennial twinnings), branched (stem with branches) or unbranched (stem without branches) green or brown or black in colour.

**Leaf: Leaf base:** Pulvinus (swollen) or sheathing (broad and surround the stem as envelope).

**Stipules:** Stipulate (Leaf with stipules)

Exstipulate (Leaf without stipules)

**Petiole:** Petiolate (Leaf with petiole)

Sessile (Leaf without petiole)

**Lamina:** Shape – Ovate (oval) or linear (long and slightly broader) Reniform (kidney shaped) Cordate (Heart shaped) Centric (hollow)

**Venation:** Reticulate (Midrib, lateral veins and veinlets are arranged in the form of net like)

**Parallel:** (Mid rib produce lateral veins and veinlets arranged parallel)

**Kind:** Simple (Leaf with undivided lamina)

Compound (Lamina is divided into leaflets)

**Phyllotaxy:** Alternate (only one leaf arises at a node)

Opposite (Two leaves arise at each node)

Whorled (More than 2 leaves arises at each node)

**Floral characters:**

**Inflorescence:** Racemose (Peduncle is long)

Cymose (Peduncle is short)

Special (Verticillaster or Hypanthodium or Cyathium)

**Flower:** Bracteate (The flower with bracts)

Ebracteate (The flower without bracts)

Bracteolate (The flower with bracteoles)

Ebracteolate (The flower without bracteoles)

Pedicellate (The flower with pedicel)

Sessile (The flower without pedicel)

Complete (The flower with all four floral parts)

Incomplete (The flower without any one of the floral parts)

**Arrangement of floral parts: Acyclic:** The floral parts are spirally arranged.

**Cyclic:** The floral parts are arranged in whorls.

**Hemicyclic:** K and C are in whorls and A and G are in spiral manner.

**Sex: Bisexual:** The flower with both sex organs.

**Unisexual:** The flower with any one of the sex organs.

**Gynoecium position: Hypogynous :** The flower with superior ovary

**Epigynous :** The flower with inferior ovary

**Perigynous :** The flower with half superior ovary

**Merosity : Trimerous :** Three parts in each whorl

**Tetramerous:** Four parts in each whorl

**Pentamerous :** Five parts in each whorl

**Symmetry: Actinomorphic :** A flower can be cut into two equal halves in any vertical plane.

**Zygomorphic :** A flower can be cut into two equal halves in one vertical plane.

**Calyx:** Number of sepals 3 or 4 or 5, polysepalous (free) or gamosepalous (fused) valvate (arranged in a whorl) or twisted aestivation (arranged in on whorl with one margin inside and one margin outside). Imbricate aestivation (arranged with overlapping pattern).

**Corolla:** Number of petals, polypetalous (free) or gamopetalous (fused), aestivation (valvate or twisted or imbricate).

**Androecium :** Number of stamens 4 or 5 or 10 or many

Monadelphous : All are in one bundle

Diadelphous : All are in two bundles

Polyadelphous : All are in more than two bundles

Dithecous : Anther with two theca

Monothecous : Anther with one theca

Basifixed : Filament gets attached to the base of the anther

Dorsifixed : Filament gets attached to the dorsal side of the anther

**Dehiscence:** Longitudinal (Breaks vertically)

Transverse (Breaks transversely)

Porous (Pollen grains are released through apical pore)

**Gynoecium:** Monocarpellary – The ovary with one carpel

Bicarpellary – The ovary with two carpels

Tricarpellary – The ovary with three carpels

Tetracarpellary – The ovary with four carpels

Pentacarpellary – The ovary with five carpels

Multicarpellary – The ovary with more than five carpels

Syncarpous : All the carpels are fused

Apocarpous : All the carpels are free

Superior ovary: K, C, A develops from the base of the ovary

Inferior ovary: K, C, A develops from the upper part of the ovary

Half superior ovary: K, C, A develops from the centre (half) of the ovary

Placentation : Marginal (Ovules are arranged on the margins)

Axile (Ovules are arranged on the centre)

Basal (Ovules are arranged at the base of the ovary)

Style: Terminal (develops above the ovary)

Lateral (develops from the lateral side)

Stigma : Capitate (round), bifid divided hairy (with hairs)

5. Describe typical flowering plant in the taxonomic perspective?

- A. The plant is described beginning with vegetative characters like habit (herb or shrub or tree or climber), habitat (hydrophyte, mesophyte or xerophyte), roots (tap root or fibrous root), stem (aerial, erect, herbaceous or woody), leaves (simple or compound, reticulate or parallel venation stipulate or exstipulate, alternate or opposite or cyclic phyllotaxy) and then floral characters. Inflorescence (racemose or cymose) flower and its floral parts followed fruit. After this, a floral diagram and floral formula are presented. The floral formula is represented by some symbols of floral parts. In it, Br stands for bracteate (bracts are present), Ebr stands for ebracteate (bracts are absent), Br1 stands for bracteolate (bracteoles are present), Ebr1 stands for ebracteolates (Bracteoles are absent).  $\oplus$  stands for actinomorphic flower,  $\%$  stands for zygomorphic flower,  $\sigma$  stands for male flower,  $\rho$  stands for female flower,  $\sigma\rho$  stands for bisexual flower, K for calyx, C for corolla, P for perianth, A for androecium and G for Gynoecium.  $\underline{G}$  stands for superior ovary and  $\overline{G}$  stands for inferior ovary. Floral formula also indicates the number of free or united members of the corresponding whorls. It also shows cohesion or adhesion of stamens.

A floral diagram represents the number of parts of flower, the structure, arrangement, aestivation, cohesion and adhesion of stamens and position with respect to mother axis. The mother axis represents the posterior side of the flower and is indicated as dot at the top of the floral diagram. K, C, A, G are drawn in successive whorls. Calyx is the outermost and the gynoecium being the centre represented by T.S. of ovary. The bract represents the anterior side of the flower and is indicated at the bottom of the floral diagram.

**6. Give an account of Bentham and Hooker's classification of plants?**

- A. Bentham and Hooker divided the flowering plants into three classes namely Dicotyledonae, Gymnospermae and Monocotyledonae. Dicotyledonae was divided into three subclasses namely Polypetalae, Gamopetalae and Monochlamydeae. Polypetalae was divided into three series namely Thalamiflorae, Disciflorae, Calyciflorae.

Thalamiflorae includes 6 orders, disciflorae with 4 orders and calyciflorae is with 5 orders. Gamopetalae was divided into three series namely Inferae (3 order), Heretomerae (3 orders) and Bicarpellate (4 orders). Monocotyledonae was divided into seven series. Thus they grouped the flowering plants into 202 natural orders now called as families. Of these 165 families belongs Dicotyledonae, 3 to Gymnospermae and 34 belong to Monocotyledonae.

**7. What is taxonomy? Give a brief account of different types of plant classification?**

A. Plant taxonomy deals with characteristics, identification nomenclature and classification of plants. Several classifications were proposed by different taxonomists based on various criteria. All these classifications can be grouped into 3 types:

(1) Artificial systems, (2) Natural systems, (3) Phylogenetic systems

**1) Artificial systems:** These systems are based on one or few easily comparable characters like morphology, nutritional habits, etc.

**E.g. :** A) Classification of plants into herbs, shrubs, trees, etc on the basis of form by Theophrastus in his book “Historia Plantarum”.

B) Sexual system of Linnaeus, in which he classify the plants on the basis of morphological nature of stamens and carpels.

**2) Natural systems:** These are the systems in which plants are grouped on the basis of their natural relationships taking into consideration all possible morphological characters. They believed that all species are specially created by God and they do not undergo any change.

**E.g :** Classification of Bentham and Hooker.

**3) Phylogenetic systems:** The classification of post – Darwinian period considered evolutionary trends in plants and so they are considered as Phylogenetic systems. In a phylogenetic system, primitive and advanced characters are recognized. While considering the status of a taxon, a comprehensive picture of all the characters is taken into account. The system proposed by Engler and Prantl in their book, “Die Natürlichen Pflanzenfamilien” (1887 – 1893) and by J. Hutchinson (1954) in his book, “Families of flowering plants” are examples. The latest phylogenetic system is APG (Angiospermic Phylogenetic Group) system.