



Avinashilingam Institute for Home Science and Higher Education for Women

(Deemed to be University under Category 'A' by MHRD, Estd. u/s 3 of UGC Act 1956)

Re-accredited with 'A+' Grade by NAAC. Recognised by UGC Under Section 12B

Coimbatore - 641 043, Tamil Nadu, India

Bachelor's Degree Examination –November 2019
III Semester

Class : II UG
Major : Botany

Time: 3 hours
Max. Marks: 100

18BBOC08 Taxonomy of Angiosperms

Part A

10 x 1 = 10

Choose the correct answer

- Who is considered as the Father of Taxonomy?
a. Aristotle b. Linnaeus c. Earnst Haccker d. Whittaker
- Bentham and Hooker's classification is a _____.
a. Natural systems of classification b. Artificial systems of classification
c. Sexual systems of classification d. Phylogenetic systems of classification
- What is the term given to a duplicate specimen of original type?
a. Lectotype b. Holotype c. Isotype d. Neotype
- Taxonomic group of any rank or unit viz. family, order, etc., is called
a. Taxon b. Division c. Cader d. Cohort
- Which are of the following characters applies to family Malvaceae
a. Inferior ovary b. Zygomorphic flowers c. Monoadelphous stamens d. Very few stamens
- Floral diagram represents
a. Structure of flower b. Arrangement and number floral parts
c. Position of flower d. All of the above
- Largest dicot family is
a. Fabaceae b. Solanaceae c. Asteraceae d. Laminaceae
- In Euphorbiaceae inflorescence is
a. Raceme b. Cyme c. Cyathium d. Solitary
- The fruits of grasses is
a. Caryopsis b. Capsule c. Regma d. Siliqua
- Birthwort family is
a. Poaceae b. Aristolochiaceae c. Liliaceae d. Lamiaceae

Part B

5 x 6 = 30

Answer ALL questions

Each answer should not exceed 400 words or two pages

- 11.a. Write the objectives of Plant Taxonomy.
(or)
- 11.b. List out the merits of Bentham and Hooker's classification.
- 12.a. Explain the various Type methods.
(or)
- 12.b. Give an account on Herbaria in India.
- 13.a. Describe the floral characters of Malvaceae.
(or)
- 13.b. Write the economic importance of the family Rutaceae.
- 14.a. Briefly explain the floral characters of Asteraceae.
(or)
- 14.b. Discuss the economic importance of Asclepiadaceae.
- 15.a. Explain the characters and distribution of Orchidaceae.
(or)
- 15.b. Write the economic importance of Poaceae.

Part C

5 x 12 = 60

Answer ALL questions

Each answer should not exceed 800 words or four pages

- 16.a. Explain Bentham and Hooker's classification.
(or)
- 16.b. Outline the phylogenetic classification of Angiosperms.
- 17.a. How will you prepare key? Explain in detail.
(or)
- 17.b. Explain the methods of herbarium preparation.
- 18.a. Describe the salient features, characters and economic importance of Leguminosae.
(or)
- 18.b. Compare the diagnostic characters of Annonaceae and Apiaceae.
- 19.a. Enumerate the floral characters of Asclepiadaceae.
(or)
- 19.b. Write a detailed account on Verbenaceae.
- 20.a. List out the economic importance of Euphorbiaceae and Amaranthaceae.
(or)
- 20.b. Compare the floral characters of Aristolochiaceae and Liliaceae.

Scheme of Evaluation Set I

Part A

1. b) Linnaeus
2. a) Natural systems of classification
3. c. Isotype
4. a. Taxon
5. c. Monoadelphous stamens
6. c. Position of flower
7. c. Asteraceae
8. c. Cyathium
9. a. Caryopsis
10. b. Aristolochiaceae

Part B

11. a. Following are the main objectives of Taxonomy:

- i) Inventory of world's fauna
- ii) To provide a method for identification and communication
- iii) To produce a coherent and universal system of classification
- iv) To demonstrate the evolutionary implications of plant diversity
- v) To provide single Latin "Scientific name" for every group of plants in the world, both living and extinct.
- vi) To arrange plants in such a way as to give us an idea about the sequence of their evolution from simpler, earlier and more primitive type to more complexes, more recent, more advanced type in different periods of history.

11.b Merits of Bentham and Hooker's System:

1. The description of families and genera is very accurate.
2. The system is very handy for identification purposes.
3. The system is of great practical convenience.
The British and Commonwealth herbaria therefore still adopt this system in arrangement of families.
4. Each family had a synopsis at the beginning which is very useful in identification.
5. The system starts from Ranales, which are now universally considered to be most primitive living angiosperms.
6. Larger genera subdivided into subgenera and sections.
7. They believed in evolution through reduction and hence placed monocots after dicots; even in dicots, the dichlamydeous polypetalae and gamopetalae were placed before the uniseriate monochlamydeae.
8. The gamopetalae placed after polypetalae is justified since union of petals is considered to be an advanced feature.
9. The polypetalae includes Thalamiflorae and Calyciflorae of de Candolle. But Bentham and Hooker distinguished a new series Disciflorae which includes orders which cannot be assigned to Thalamiflorae or Calyciflorae.
10. The 3 series – Thalamiflorae, Disciflorae and Calyciflorae show gradual evolutionary advance from marked hypogyny to epigyny.
11. Treating Cucurbitaceae and Umbelliferae (Apiaceae) at the end of Polypetalae as connecting links between poly- and gamopetalous families.
12. Creation of Monochlamydeae at the end of Dicots.
13. Disputed families included in Ordines anomali.
14. Placing of unisexual monocot families after bisexual families e.g. Palmae and Araceae after Liliaceae.
15. The series Glumaceae with extremely reduced flowers and inflorescences, placed at the end of

the flowering plants.

16. The system was never conceived by its authors on the basis of phylogeny. The theory of organic evolution (theory of descent) was announced independently by Darwin and Wallace in 1859. So, any criticism of the system on the basis of phylogeny is not too justified.

12.a Qualitative Research

Qualitative research seeks to explore a specific phenomena, not prove a prediction, according to "Qualitative Research Methods: A Data Collector's Field Guide," published by Family Health International. Often used in the social sciences and education, qualitative methodologies use interviews, focus groups and observations to collect data. Qualitative methods provide rich, contextual explorations of the topic that are often personally or culturally meaningful.

Quantitative Methods

Quantitative research is more objective than qualitative methods. In this type of methodology, the researcher crafts a hypothesis and then tests it through structured means. Instead of exploring or describing a phenomena, quantitative methods deal with facts and statistics. This type of research is often used in science or medicine.

Mixed Methods

Mixed methods combine qualitative and quantitative research. This type of methodology uses several different measures that include both contextual understanding like interviews or observations along with facts or statistics. Using mixed methods can help the researcher investigate a topic on multiple levels, gaining different views and a comprehensive look at the subject. A mixed methodology meshes more than one philosophical perspective, allowing for the integration of different theories and ideas.

Methodologies and Design

Within each major methodology are various designs. These provide a framework or philosophy for the study, and are different than the actual methods used. For example, a case study design focuses on exploring and describing a specific instance, person or group. A researcher may use observations, interviews or self-reports from the subject to create a complete picture. This picture, or case, provides a detailed example of a phenomenon that can then be generalized to a similar population.

12.b. A herbarium is a collection of plants, which have been dried, pressed, mounted on herbarium sheets, identified and classified according to some approved system of classification. The greatest herbarium of the world is at the Royal Botanic Gardens, Kew, England, possessing about six million specimens. A few good herbaria are there in our country. The biggest herbarium of our country is at the Indian Botanic Garden, Calcutta, possessing about one million specimens.

Some herbaria are:

- 1-Forest Research Institute (FRI), Dehradun
- 2- Herbarium of the Indian Botanic Gardens, Calcutta
- 3-Herbarium of the National Botanic Gardens, Lucknow
- 4-Madras Herbarium, Agricultural College and Research Institute, Coimbatore
- 5- Herbarium of the Division of Botany, Indian Agricultural Research Institute, (I.A.R.I.), New Delhi....etc.

13.a Floral characters:

Inflorescence:

Solitary axillary (Hibiscus, Urena), solitary terminal (Abutilon), raceme (Althaea), panicle (Kydia).

Flower:

Pedicellate, bracteate, bracteolate in the form of epicalyx, hermaphrodite rarely unisexual (Napaea), complete, actinomorphic, pentamerous, hypogynous.

Epicalyx:

Epicalyx 3 (Gossypium), 7 to 9 (Althaea) and in a few totally absent (Abutilon, Sida).

Calyx:

Sepals five, connate at the base, persistent, sometimes forming a tube (Urena), valvate aestivation.

Corolla:

Petals 5, polypetalous sometimes slightly connate at the base with the staminal tube-thus epipetalous, large showy, twisted. Prominent veins can be observed on the petals.

Androecium:

Stamens indefinite, monadelphous, forming a staminal tube; epipetalous staminal tube united with the corolla, anthers monothealous, reniform, basifixed, filament short, introrse.

Gynoecium:

Multicarpellary usually five (Hibiscus) or ten (Althaea) indefinite (Abutilon) or 3 (Kydia); syncarpous, ovary superior, penta or multilocular with axile placentation, ovules one to many in each loculus; style one, long, passing through the staminal tube; stigma correspond to the number of carpels.

Fruit:

Schizocarpic carcerulus (Abutilon, Malva, Sida), capsule (Hibiscus, Gossypium), berry (Malvaviscus).

Seed:

Non-endospermic, in some genera seed coat is densely tomentose (Gossypium).

Pollination:

Entomophilous. Insects are attracted for nectar, showy nature of corolla and protandrous flowers.

Floral formula:

$\oplus \delta \text{ Epi } 3-7 \text{ K } (5) \overset{\curvearrowright}{\text{C}} 5 \text{ A } (\alpha) \text{ G } (5-\alpha)$

13.b. Economic Importance of Rutaceae:

1. Fruits:

The genus Citrus provides a number of fruits:

- (a) *C. aurantifolia* (H-Kaghzi nimbu) has citric acid in its fruits and used in bilous vomiting. The fruit wall has essential oils.
- (b) *C. aurantium* var. *bergamia* (H-Nimbu). The ripe fruit is digestive and a tonic, fruit wall gives oil of bergamot.
- (c) *C. aurantium* var. *bigardia*. (H-Khatta). Rich in pro-vitamins A and vitamin B. Oil present in fruit wall.
- (d) *C. maxima* (H-Chakotra) produces edible fruits.
- (e) *C. sinensis* (H-Musumbi). The fruit is widely used during illness; it purifies blood, reduces thirst and improves appetite.
- (f) *C. reticulata* (H-Santara or Narangi). The ripe fruit is highly nutritive and rich in assimilable calcium, the fruit wall also produces citrus oil.
- (g) *C. limettioides* (H-Mitha Nimbu) is useful in fever and jaundice; oil also obtained from the wall.
- (h) *C. limon* (H-Pahari Nimbu). The juice of ripe fruits is useful in rheumatism and dysentery.
- (i) *Aegle marmelos* (H-Bel). This is normally edible. The fruit is particularly useful in stomach disorders. The plant is considered holy and its leaves used in worshipping the God Shiva.
- (j) *Feronia limonia* (H-Kaith bel). The fruits edible; leaf and bark used medicinally.

2. Medicinal:

Citrus is not only edible but produces vitamins particularly vitamin C (ascorbic acid). *Barosma betulina* produces buchu from its leaves which is useful in urinary diseases.

14.a Habit: Annual or perennial herbs or small shrubs or small tree or climbers.

Roots: Fibrous tap root

Stein: Herbaceous; spiny or without spines; cylindrical, hairy.

Leaves: Petiolate; alternate or opposite; simple; exstiputate;

Inflorescence: Capitulum surrounded at the bases by a group of involucre. The receptacle is flat. The flowers in the receptacles are florets. There are two types of florets:

Homogamous: In this case, all flowers are of same kind.

Heterogamous: In this case, two types of flowers are present in the capitula. Example: Sunflower.

Sunflower has two types of small flowers, disc florets and ray florets. The disc florets are present in the central region. They are tubular and bisexual. The ray florets are present towards the periphery. They are pistillate or neuter.

6. Flower: Sessile; ebracteate: actinomorphic or zygomorphic: pentamerous Regular or irregular; complete or incomplete; unisexual Or hermaphrodite; epigynous;

7. Calyx: .Poorly developed; generally represented by ring of 5 small teeth. They may be present in the form of small scales or hairs or bristles.

8. Corolla: Gamopetalous; tubular with 5-5 lobed or ligulate with 3-4 teeth. Sometimes bilabiate;

9. Stamens: 5 stamens rarely 4; epipetalous; syngenesious (filament free anther united); formitig a tube

which encloses style.

10. Carpel: Bicarpellary; syncarpous; stigma bind ovary inferior; placentation basal.

It Fruits: Achenial one seeded cypselM

12. Seed: non-endospermic seed.

14.b. Economic Importance of Asclepiadaceae

The family Asclepiadaceae contributes several ornamental as well as drug yielding plants.

Hairs obtained from the seeds of several species are used as insulating material for lining jackets and other winter wear.

Asclepias Curassavica, *Ceropegia*, *Stapelia* and *Cryptostegia grandiflora* are ornamental plants of this family.

The roots of *Tylophora indica* are used as medicine for the treatment of respiratory diseases like asthma, bronchitis and whooping cough.

The plant *Cynanchum arnotianum* is used as an insecticide.

The dried roots of *Hemidesmus indicus* is used as a blood purifier. It is used in chronic rheumatism, urinary diseases and also in skin diseases.

Gymnema sylvestre also has many medicinal properties. It is stomachic, stimulant, laxative and diuretic. It is also useful in cough, biliousness and sore eyes.

The latex of *Calotropis gigantean* and *Calotropis procera* is used in tanning industry for deodorizing, removing hair and imparting yellow color to the hides.

The latex of *Cryptostegia grandiflora* is used as the source of rubber on commercial scale.

The bast fibre obtained from the stems of *Asclepias curassavica*, *Tylophora tenius*, *Leptadenia pyrotechnica*, *Marsdenia roylei*, *Calotropis gigantea* and *Cosmostigma racemosa* is used as cordage, fishing nets and twines.

15.a Characters of Orchidaceae:

Perennial herbs, epiphytes or saprophytes may be terrestrial; flowers zygomorphic, hermaphrodite, epigynous, resupinated; perianth 6 in two whorls, the posterior segment of the inner whorl developed as lip or labellum; presence of peculiar structures – Labium, column and Rostellum; Stamens 1-2, one or two staminode pollengrains united into pollinia; gynoecium tricarpellary, inferior unilocular with parietal placentation; the fertile stamen is adherent to the style and forms with it the column or gynostemium, which projects more or less in the centre of flower; Stigma 2 or 3 lobed, in some two fertile and one sterile and modified into rostellum.

Distribution of Orchidaceae:

It is second longest family of angiosperms. It is represented by about 900 genera and 20,000 species, which are cosmopolitan in distribution. In India it is represented by about 130 genera and over 800 species. The family 13 having great variety of flowers in shape, longevity and beauty.

15.b Economic Importance of Poaceae:

The family stands first and foremost in respect of economic importance in whole of Angiosperms. The staple food grains of the population of world is derived from *Oryza sativa* (Rice) and *Triticum aestivum* (Wheat). They are cultivated from time immemorial.

The family has been divided on economic basis as follows:

Food:

Triticum aestivum, *Oryza sativa*, *Zea mays* (Maize), *Hordeum vulgare* (Jaw), *Sorghum vulgare* (Jowar), *Avena sativa* (Oats), *Pennisetum typhoides* (Bajra) are cultivated for cereals and food grains.

Fooder:

Many grasses as *Cynodon dactylon*, *Panicum*, *Cymbopogon*, *Agrostis*, *Poa* are grown for fodder.

Sugar:

Saccharum officinarum (Sugarcane; H. Ganna) is cultivated for gur and sugar.

Building material:

Some species of *Bambusa* e.g. *B. tulda*, *B. vulgaris* are used for scaffolding, thatching huts etc.

Furniture:

Species of *Dendrocalamus* (H. Bent), *Arundinaria*, *Melocalamus* are used in manufacture of furniture.

Aromatic grasses:

Many grasses yield scented oils which are used in perfumery viz. *Vetiveria zizanioides* (H. Khus khus)

yields vetiver oil from the roots. The roots are also woven into curtains. *Andropogon odoratus* (Ginger grass), *Cymbopogon citratus* (Lemon grass), *Cymbopogon martini* (Geranium grass), *Cymbopogon jawarancusa* etc. also yield oil.

Medicinal:

Phragmites karka, *Cymbopogon schoenanthus* etc. are medicinal.

Secale cereale is cultivated for infection of its inflorescence by *Claviceps purpurea* for production of Ergot and for extraction of ergotine. Ergotine is an excellent remedy for uterine contraction.

Paper:

It is manufactured from certain species of grasses and bamboos.

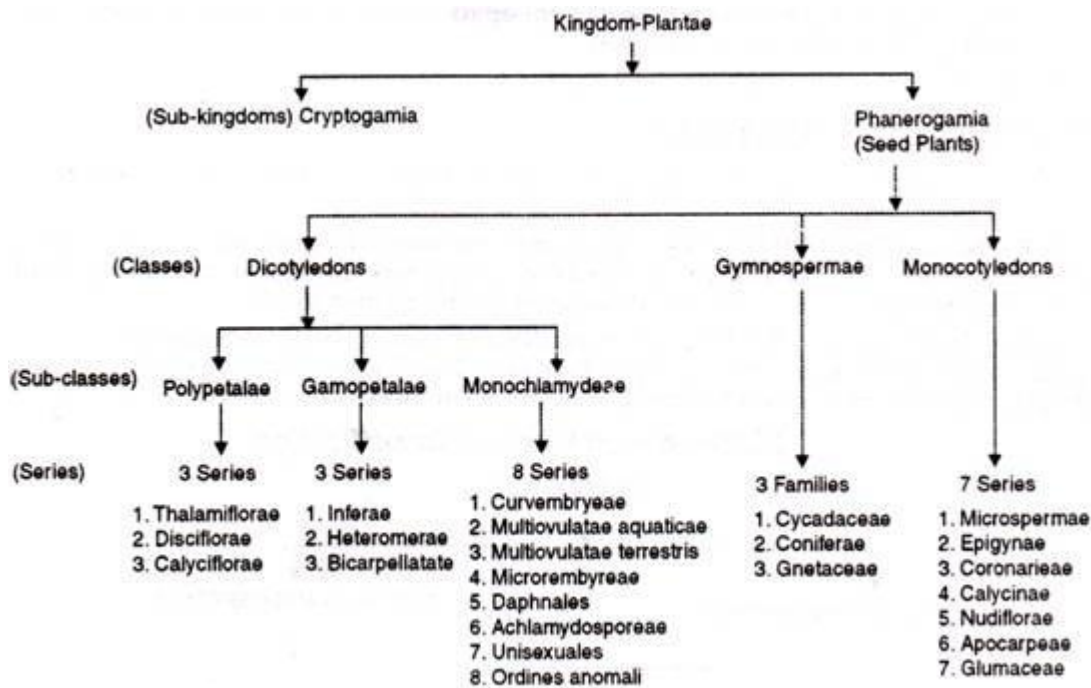
Ornamental:

Rhynchelytrum repens, *Cortaderia selloana* and some species of the tribe Bambusoideae are ornamentals.

Besides these a number of grasses are grown to form fine lawns, play grounds etc.

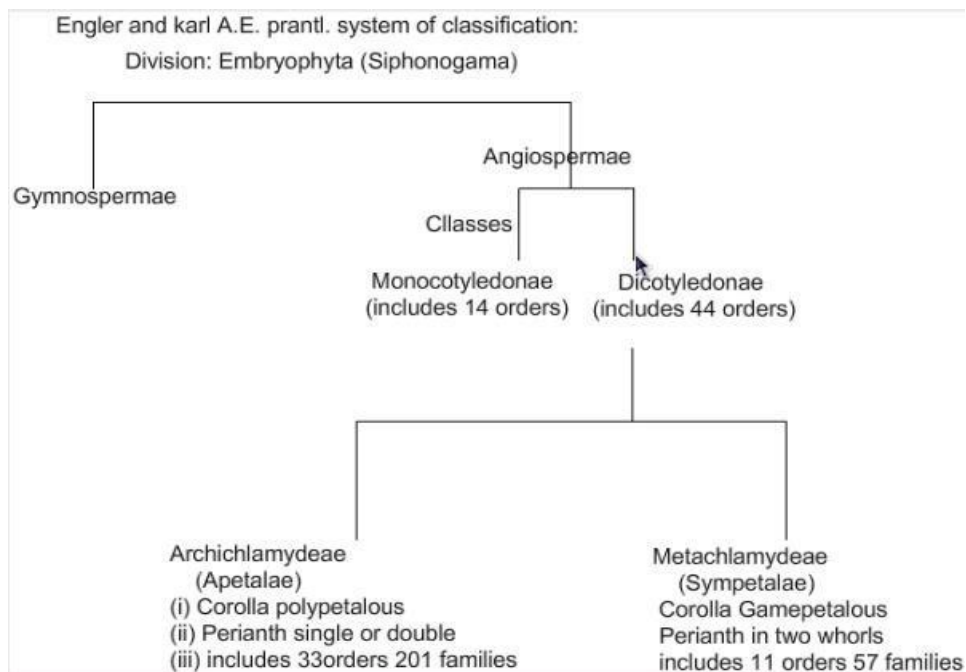
Part C

16.a



1. It is a classification of only the “seed plants” or phanerogams.
2. They described 97,205 species of seed plants belonging to 7,569 genera of 202 families starting from Ranunculaceae up to Gramineae.
3. They classified all the seed plants into 3 groups or classes i.e. Dicotyledons (165 families), gymnosperms (3 families) and monocotyledons (34 families).
4. They included disputed orders among Ordines Anomali which they could not place satisfactorily.
5. Monocotyledons were described after the dicotyledones.
6. The dicotyledons were divided into 3 Divisions (Polypetalae, Gamopetalae and Monochlamydeae) and 14 series. Each series again divided into cohorts (modern orders) and cohorts into orders (modern families).
7. The authors did not mention anything about the origin of the angiosperms.
8. Creation of the Disciflorae, a taxon not described by the earlier taxonomists.
9. Among the Monochlamydeae, major taxa, like the series, were divided on the basis of terrestrial and aquatic habits.
10. Polypetalae carries 82 families, 2610 genera & 31,874 species. Gamopetalae carries 45 families 2619 genera & 34,556 species. Monochlamydae includes 36 families, 801 genera & 11,784 species. Similarly Monocotyledons consist 34 families, 1495 genera and 18,576 species.

16.b



17.a

1. Shrub or woody vine 2.
1. Herbs 6.
2. Woody vine; petals 7 or more Decumaria.
2. Shrub; petals 4 or 5 3.
3. Leaves alternate or on short spur branches 4.
3. Leaves opposite 5.
4. Leaves pinnately veined; ovary superior; fruit a capsule Itea.
4. Leaves palmately veined; ovary inferior; fruit a berry Ribes.
5. Petals usually 4; stamens 20-40; fruit longitudinally dehiscent, not ribbed Philadelphus
5. Petals usually 5; stamens 8-10; fruit poricidally dehiscent, 10-15 ribbed Hydrangea.
6. Staminodia present; petals more than 10 mm long Parnassia.
6. Staminodia absent; petals less than 10 mm long 7.
7. Leaves ternately decomposed Astilbe.
7. Leaves simple 8.
8. Flowers solitary in leaf axils, or in short, leafy cymes 9.
8. Flowers in racemes or panicles 10.
9. Sepals 4; carpels 2 Chrysosplenium.
9. Sepals 5; carpels 3 Lepuropetalon.
10. Petals pinnatifid or fringed; stem leaves opposite Mitella.
10. Petals not pinnatifid or fringed; stem leaves alternate or absent 11.
11. Ovary 1-celled 12.
11. Ovary 2-celled 13.
12. Inflorescence paniculate; stamens 5 Heuchera.
12. Inflorescence racemose; stamens 10 Tiarella.
13. Stamens 5; leaves palmately lobed Boykinia.
13. Stamens 10; leaves not palmately lobed Saxifraga.

17.b The preparation of a herbarium involves:

- (i) Field visits,
- (ii) Collection of specimens
- (iii) Drying,
- (iv) Mounting on a herbarium sheet,
- (v) Preservation,
- (vi) Labelling and
- (vii) Proper storage.

18.a Diagnostic features :

Mostly herbs, rarely shrubs or trees, often climbing.

Leaves alternate, stipulate, simple, or imparipinnately compound.

Flowers bisexual, zygomorphic, corolla papilionaceous, aestivation descending- imbricate, posterior petals outermost, stamens 10 or 9, monadelphous or diadelphous, rarely free.

Gynoecium monocarpellary, unilocular with marginal placentation.

Fruit a legume or pod.

Vegetative characters:

Habit: Show a wide range of variation in their habit. Usually herbs (*Vicia*, *Pisum*), shrubs (*Cajanus*, *Ulex*) or trees (*Butea*, *Dalbergia*). Climbers are also most common (*Pisum*, *Lathyrus*).

Roots: Branched tap root system. Root nodules containing nitrogen fixing bacteria.

Stem: Aerial, usually erect, sometimes climbing or twiners, branched, cylindrical or angular, herbaceous or woody, solid or fistular.

Leaf: Cauline and ramal, alternate rarely opposite or whorled, stipulate or exstipulate, stipules leaf like (*Pisum*) simple (*Cajanus*) or pinnately (*Pisum*) or palmately (*Crotalaria*) compound, terminal leaflet modifies into a tendril in *Lathyrus*, *Pisum*, *Vicia*. Venation unicostate (*Pisum*) or multicostate (*Crotalaria*) reticulate.

Economic importance

i) Pulses and vegetables:

Almost all pulses belong to this family.

They are sources of protein.

Examples: *Cajanus cajan* (arhar- pigeon pea), *Cicer arietinum* (gram or chana), *Pisum sativum* (matar or pea), *Dolichos lablab* (semi or bean), *Glycine max* (soyabean or bhattamas), *Phaseolus aureus* (mung).

ii) Timber:

Dalbergia sissoo, *Butea* and *Pterocarpus* provide excellent wood for various building purposes, furnitures and fuel.

iii) Oil:

Oil obtained from the seeds of the plants are used for various purposes.

Some are edible (*Arachis hypogea*– ground nut, *Glycine max*– bhattmas), some are used for preparing vegetable ghee (soyabean oil), some (ground nut oil) for preparing soap and cosmetics.

Oil cake is used as fodder.

iv) Green manuring:

Crotalaria juncea, *Medicago sativa*, *Trifolium pratense*, *Sesbania aculeata* (Dhaicha), etc are used to increase the nitrogen content of the soil.

v) Dyes:

Yellow dye obtained from *Butea monosperma*.

Blue dye obtained from the flowers and seeds of *Clitoria ternatea*.

vi) Ornamentals:

Pisum sativum, *Lathyrus*, *Butea*, *Clitoria*, *Clanthus dampieri* (Glory pea) are used as ornamental plants.

vii) Fibres:

Crotalaria, *Sesbania*, etc are used as the source of fibres which is used for making cords, bags and ropes.

viii) Medicines:

Glycyrrhiza glabra, *Clitoria* and *Teramnus labialis* are used as medicines for various diseased conditions.

18. b. Characters of Annonaceae:

Wood aromatic, leaves exstipulate, floral parts usually numerous, free spirally arranged; stamens with distinctive enlarged and flat connective; gynoecium multipistilate, apocarpous.

Characters of Apiaceae:

Stem fistular, leaves alternate, much dissected mostly decomposed, sheathing leaf base; inflorescence umbel or compound umbel occasionally simple; flowers epigynous, pentamerous, regular rarely zygomorphic, hermaphrodite; calyx superior, pentafid or 0; corolla five, polypetalous, often inflexed; stamens 5; carpels 2; syncarpous, bicarpellary with 2 pendulous ovules; honey-disc surrounding the stigmas – stylopodium is present; fruit cremocarp; seeds endospermic and oily.

19.a Floral characters

Inflorescence: The inflorescence is usually a dichasial cyme, arising in the leaf axil or sometimes it is a racemose or umbellate as in *Asclepias* and *Calotropis*.

Flower: The flowers are perfect, hermaphrodite, bracteates, bracteolate, complete, bisexual, actinomorphic, pentamerous and hypogynous. The flowers are comparatively large in *Stapelia*.

Calyx: The calyx consists of five sepals which are united below to form short calyx tube. It shows imbricate or valvate type of aestivation.

Corolla: The corolla has five united petals (gamopetalous) which may be rotate (Calotropis) or companulate or funnel form. They show valvate or twisted aestivation. The corolla tube is in the form of corona with ring of hairs or scale. In Ceropogia the straight or curved corolla is swollen at the base. The corolla lobes are valvate or generally twisted to right. The corolla tube is with a corona which is in the form of a ring of hairs.

Androecium: Stamens are five, epipetalous and inserted at or near the base of the corolla tube. The filaments may be free or may be united to form a tube round the style.

Gynoecium: The gynoecium is bicarpellary and the ovaries of the two carpels are free. The styles are united at their apices and the stigma has five lateral surfaces. The ovary of each carpel is unilocular with single placenta bearing numerous anatropous pendulous ovules. The placentation is marginal.

Pollination: The flowers are perfectly adapted for entomophily or pollination by insects. The pollination mechanism in this family is unique in many ways in view of complicated structure of the flower.

In subfamily Periploceae, the pollen is transferred on to the spoon shaped translators which have a sticky basal disc. The insect while returning from the flower carries the whole translator. The pollen contents may get deposited on the stigmatic surface when the same insect visits another flower.

In subfamily Euasclepiadeae, the insect visiting the flower for nectar traps its legs or proboscis between the osmotically elastic anther wings. The insect while returning carries the sutured corpusculum along with pollen. When this insect visits another flower, the pollen is transferred to the receptive surface of the stigma.

Fruit: The fruit is of two follicles which are close together or divergent. They vary in shape and are membranous to woody.

Seed: The seeds are flattened and commonly bear a terminal tuft of white long silky hair. They help in dispersal. The endosperm is dense and embryo is large.

19.b Characters of Verbenaceae:

Plants herbs, shrubs or trees, leaves simple, exstipulate, opposite or whorled; inflorescence cymose, racemose or spike, flowers hermaphrodite, zygomorphic, hypogynous, calyx gamosepalous, persistent; corolla 5 lobed, gamopetalous sometimes 2 lipped, stamens four, didynamous, unequally paired, epipetalous; carpels two, syncarpous, superior, axile placentation, fruit drupe.

A. Vegetative characters:

Habit:

Mostly annual or perennial herbs, may be shrubs or trees (Tectona) or rarely woody climbers or halophyte (Avicennia) in tropical shores.

Root:

Tap, branched, pneumatophore in Avicennia.

Stem:

Erect, herbaceous or woody, young branches quadrangular, in some branches spiny.

Leaves:

Simple or palmately or pinnately (Peronema) compound, opposite or whorled, exstipulate, entire or divided.

B. Floral characters:

Inflorescence:

Cyme or racemose spikes often with an involucre of coloured bracts; cymose is usually dichasial (Clerodendron).

Flower:

Zygomorphic, hermaphrodite, rarely unisexual by abortion (Aegiphila), hypogynous, pentamerous or tetramerous (Physopsis), rarely actinomorphic (Physopsis) complete.

Calyx:

Sepals 5 lobed, gamosepalous, persistent, bell shaped or tubular, rarely 4 to 8 valvate, inferior.

Corolla:

Petals 5 or 4 lobed, gamopetalous petals unequal, tubular or cylindrical, bi-lipped, imbricate, inferior.

Androecium:

Stamens 4, didynamous, fifth stamen may be staminode or absent rarely 5 present (Tectona), epipetalous, bitheous, filaments free, dorsifixed, introrse, dehiscence longitudinal.

Gynoecium:

Bicarpellary, syncarpous, rarely carpels 4 (Duranta) or 5 (Geunsia) superior in early stage bilocular but soon divided into 4 or many loculed by false septa, axile placentation or free central in Avicennia; style terminal, stigma entire or bilobed.

Fruit:

Drupe rarely schizocarpic capsule enclosed by persistent calyx.

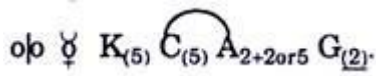
Seed:

Non-endospermic with a straight embryo.

Pollination:

Entomophilous.

Floral formula:



Economically important Verbenaceae include:

Lemon verbena (*Aloysia triphylla*), grown for aroma or flavoring

Verbenas or vervains (*Verbena*), some used in herbalism, others grown in gardens.

20.a Economic importance of Euphorbiaceae

Source of food: The plant *Montt:at* gives starchy food from its tuberous roots.

Oils: Some plants give wood oil, artist oil and other drying oils. These oils are used in paints. These oils are extracted from the seeds of several species.

Lubricant and purgative: Castor oil (*IA* and *Conon* oil (*jL* in are used as purgatives.

Poisons: The milky juice of many plants like *Manillal*. *Mercuriolis* has deadly poisons. Some are very dangerous for stomach. Some can cause blindness of eyes, Therefore, these poisons are used for murder and suicides. These are also used to kill some insects.

Medicinal uses: The fruit of *Phyllanthus emblica* has many medicinal uses.

Rubber: Several species of *Hevea*, *Man/hot* gives common rubber in their latex.

Box wood: Box wood ;s obtained from *Buxus* specie It is best wood for wood engraving.

Ornamental plants: The plants of this family have attractive colours. So they am commonly used as ornamental plants. Examples: *Euphorbiu splencLens*. *Euphorbia pulcherrima*, castor bean.

Dyes: *Chrozophora* gives dye.

Economic importance of Amaranthaceae:

Some species, such as spinach (*Spinacia oleracea*) or forms of beet (*Beta vulgaris*) (beetroot, chard), are used as vegetables. Forms of *Beta vulgaris* include fodder beet (*Mangelwurzel*) and sugar beet. The seeds of *Amaranthus*, lamb's quarters (*Chenopodium berlandieri*), quinoa (*Chenopodium quinoa*) and kañiwa (*Chenopodium pallidicaule*) are edible and are used as pseudocereals.

Dysphania ambrosioides (epazote) and *Dysphania anthelmintica* are used as medicinal herbs. Several amaranth species are also used indirectly as a source of soda ash, such as members of the genus *Salicornia* (see glasswort).

A number of species are popular garden ornamental plants, especially species from the genera *Alternanthera*, *Amaranthus*, *Celosia*, and *Iresine*. Other species are considered weeds, e.g., redroot pigweed (*Amaranthus retroflexus*) and alligatorweed (*Alternanthera philoxeroides*), and several are problematic invasive species, particularly in North America, including *Kali tragus* and *Bassia scoparia*. Many species are known to cause pollen allergies.

20.b Floral characters:

Inflorescence:

Variable-solitary (*Tulipa*, *Fritillaria*), paniced raceme (*Asphodelus*), cymose umbel (*Allium*, *Smilax*), solitary axillary (*Gloriosa*).

Flower:

Pedicellate, actinomorphic or zygomorphic (*Lilium*, *Hemerocallis*), hermaphrodite or unisexual in *Smilax*, *Ruscus*; hypogynous, complete or incomplete (in unisexual flowers), trimerous rarely 2 or 4-merous (*Maianthemum*, *Paris*).

Perianth:

6, in two words of three each, polyphyllous (*Lilium*, *Tulipa*) or gamophyllous (*Aloe*, *Asparagus*) and of various shapes; petaloid or sepaloid; imbricate in bud, usually valvate aestivation, perianth may be scarious or membranous.

Androecium:

Stamens 6 or 3 (Ruscus), 8 in Paris; polyandrous, epiphyllous, antiphyllous, filaments long, anthers versatile or basifixed, ditheous, introrse or extrorse. In Ruscus outer whorl of stamens is reduced to staminodes.

Gynoecium:

Tricarpellary, syncarpous, ovary superior or half inferior, trilocular or unilocular with two ovules, axile placentation, style simple; stigma trilobed or 3-parted.

Fruit:

A berry (Asparagus, Smilax), capsule (Asphodelus).

Seed:

Endospermic; endosperm horny or cartilagenous.

Pollination:

Entomophilous rarely self-pollination.

Floral characters:

Inflorescence:

Either solitary or clustered or in racemes of spikes.,

Flower:

Hermaphrodite, actinomorphic or zygomorphic, epigynous and with haplochlamydous trimerous perianth usually.

Perianth:

3 petaloid, united, 3-lobed or unilateral often bizarrely coloured occasionally an inner whorl of 3 minute teeth (vestigial corolla) present.

Androecium:

Stamens 6-36. free or adnate to style and producing a column or gynostemium, filaments short and thick or anthers sessile, bitheous dehiscent longitudinally.

Gynoecium:

Carpels usually 6 rarely 4, connate in an inferior six chambered, rarely four chambered ovary. Ovules anatropous, many on axile placentas.

Fruit:

Septicidal capsule with basal dehiscence.

Seed:

Endospermic and small.

Pollination:

Entomophilous.