Q 1. Multiple choice/fill in the blanks/one sentence answer 10 x 2 = 20

- **aceae**
- **Mallow family**
- **spikelet**
- **evergreeen**
- **Nitrogenous Anthocyanin**
- **Cyperaceae**
- The specimen or element selected as the type of a species when a holotype has not been defined
- Homonym is a name for a taxon that is identical in spelling to another such name that belongs to a different taxon. According to ICBN the first published of two or more homonyms is to be used: a later homonym is "illegitimate" and is not to be used unless conserved
- Herbaria are collections of dried preserved specimens that document the identity of plants and fungi. They represent reference collections with many and varied functions including identification, research and education.
- The hill forests of Nilgiris are locally known as Sholas

Q 2. Long answer type (attempt any four) 4 x 10 = 40

- What are the important principles of ICBN? What are the various rules and recommendations of ICBN?

Answer: Following are the important principles of ICBN

Principle I
Botanical nomenclature is independent of zoological and bacteriological nomenclature. The Code applies equally to names of taxonomic groups treated as plants whether or not these groups were originally so treated Principle II
The application of names of taxonomic groups is determined by means of nomenclatural types.
Principle III
The nomenclature of a taxonomic group is based upon priority of publication.
Principle IV
Each taxonomic group with a particular circumscription, position, and rank can bear

only one correct name, the earliest that is in accordance with the Rules, except in specified cases.

Principle V

Scientific names of taxonomic groups are treated as Latin regardless of their derivation.

Principle VI

The Rules of nomenclature are retroactive unless expressly limited.

Recommendations of ICBN

ARTICLE 16

Typification above the family rank is automatic only if the name is based on a genus name. In that case, the genus serves as type for the suborder, order, subdivision, and division.

ARTICLE 17

The principle of priority does not apply to ranks higher than family, but name construction does so. Names of these ranks can be derived in two ways, but since the ICBN does not deal with nomenclature of such ranks, the door is open for name construction on other bases also. For example, the name of an order could be derived from a person's name, either because a genus was named in honor of a person, or because the author of the order name wishes to do this.

ARTICLE 18

Here is a distinction between legitimate and validly published. a family name based on an illegitimate genus name is illegitimate, even if validly published. Its illegitimacy is based on this article. As usual, this illegitimacy can be overturned by conservation.

ARTICLE 19

All infra-familial units based on the same type retain the same name-stem, and are to be considered as autonyms.

ARTICLE 20

Genus names can be composed with complete flexibility, as long as they conform to number and declension.

ARTICLE 21

No specific direction to use the genus name, because this would only be for the autonymic hierarchy. For non-autonymic hierarchies, some other infra-generic epithet must be used, not usually based on a species epithet.

ARTICLE 22

Here is the formal introduction of the term autonym at the infrageneric rank. Note that autonymic infrageneric names are not followed by an author's name, for they were not "authored" in the strict sense.

ARTICLE 23

Throughout the ICBN, polynomials are inadmissible.

ARTICLE 26

Infraspecific autonyms do not have authors unless made explicit.

Autonyms are typified by one specimen, which serves the entire hierarchy

ARTICLE 27
This article avoids creation of homonyms (identical names with different types).

- What is molecular taxonomy? Discuss the role of molecular taxonomy.

Answer

Molecular taxonomy is a branch of biology that focuses on using tools from genetics like PCR and DNA sequencing to address questions of evolution and biogeography in plants.

A close corollary, and the central theme of this paper, is that everything makes a lot more sense in the light of phylogeny. Systematics is in the midst of a renaissance, heralded by the widespread application of new analytical approaches and the introduction of molecular techniques. Molecular phylogenetic analyses are now common place, and they have provided unparalleled insights into relationships at all levels of plant phylogeny. At deep levels, molecular studies have revealed that charophyte green algae are the closest relatives of the land plants and suggested that liverworts are sister to all other extant land plants. Other studies have suggested that lycopods are sister to all other vascular plants and clarified relationships among the ferns. The impact of molecular phylogenetics on the angiosperms has been particularly dramatic--some of the largest phylogenetic analyses yet conducted have involved the angiosperms. Inferences from three genes (rbcL, atpB, 18S rDNA) agree in the major features of angiosperm phylogeny and have resulted in a reclassification of the angiosperms. This ordinal-level reclassification is perhaps the most dramatic and important change in higher-level angiosperm taxonomy in the past 200 years. At lower taxonomic levels, phylogenetic analyses have revealed the closest relatives of many crops and 'model organisms' for studies of molecular genetics, concomitantly pointing to possible relatives for use in comparative studies and plant breeding. Furthermore, phylogenetic information has contributed to new perspectives on the evolution of polyploid genomes. The phylogenetic trees now available at all levels of

the taxonomic hierarchy for angiosperms and other green plants should play a pivotal role in comparative studies in diverse fields from ecology to molecular evolution and comparative genetics.

- Describe the tools and techniques in preparation of Herbarium. Mention importance of herbarium.

Answer

The correct methods of preparing plant specimens for the herbarium are as many and varied as the correct methods of baking a cake. Every practitioner finds a convenient method that he will defend against all intruders. The truly correct method of preparing herbarium specimens is that which produces the most representative dried sample in the shortest possible time.

The Herbarium Specimen

The most important element in botanical collecting is the permanent record produced, which is a specimen or a suite of specimens representing a living plant. For most purposes, an identifiable specimen can be defined as one with either flowers or fruits, or both, because most botanical literature discusses the differences in kinds of plants in terms of reproductive structures. This is generally true for all groups of plants including the seaweeds, mushrooms, mosses, and ferns, as well as the seed bearing plants. Specimens of ferns and seed bearing plants tend to be more bulky and difficult to prepare so this bulletin will be concerned with these plants. These, in fact, are the "vascular plants" of the title, because they include in their structures a system of tubes for transport of liquid (the vascular system)

Preparing an Effective Herbarium Specimen

An effective herbarium specimen not only is identifiable and serves as a record of the species, but also shows the range of variation of the species in the place where the specimen originated. Although the standardization of the size of mounting paper in the herbaria of the United States has resulted in the universal exchangeability and storability of specimens, it has tended, at the same time, to bias the collector in favor of a specimen that will look neat when fastened to the herbarium sheet. In spite of the fact that it must eventually fit a standard size herbarium sheet, a sample should be selected first for its value as a representative of foliar size and variation, inflorescence size and variation, and stem aspect of the population of the species. The specimen should be selected next for its complete normalcy unless that specimen is to show the damaging effects of fungal or insect attack. Finally, the specimen should be attractive once it is mounted if it is possible to prepare a pretty as well as a representative specimen. Many times it will be impossible to find representative specimens that are also attractive after they are pressed.

Field pressing equipment is needed to prepare adequate botanical specimens.

Recording the Data

One of the most important aspects of preparing an effective herbarium specimen is recording accompanying data. Although the collector always hopes that the vivid colors of a beautiful flower will be captured, this is rarely the case. Almost all flower colors

undergo some change in the process of drying. Similarly, odors vanish for the most part, although the members of the mint family and a few others may retain some odor. Sizes and shapes of plants often cannot be seen in the prepared specimen. These facts and many other details are needed or helpful in making a correct identification.

Pressing the Specimen

Actual pressing of the herbarium specimen involves two problems: (1) Pressure sufficient to prevent curling of leaves and other plant parts during drying; and (2) removal of the moisture in the plant tissue as rapidly as possible without changing the appearance of the specimen

Drying the Specimen

Ordinarily, each specimen is laid into a fold of newsprint in the field press or at intervals as the collecting bag or vasculum is emptied. After they have been collected, specimens should not be left unpressed any longer than necessary. Although enough material for 2 or even 3 specimens may be crammed into a single fold under emergency conditions, this is not recommended as a general practice. Leaves and inflorescences tend to become entangled and stems make pressure marks on leaves and petals.

Importance of herbarium

Herbaria are essential for the study of plant taxonomy, the study of geographic distributions, and the stabilizing of nomenclature. Thus, it is desirable to include in a specimen as much of the plant as possible (e.g., flowers, stems, leaves, seed, and fruit). Linnaeus's herbarium now belongs to the Linnean Society in England.

Specimens housed in herbaria may be used to catalogue or identify the flora of an area. A large collection from a single area is used in writing a field guide or manual to aid in the identification of plants that grow there. With more specimens available, the author of the guide will better understand the variability of form in the plants and the natural distribution over which the plants grow.

Herbaria also preserve a historical record of change in vegetation over time. In some cases, plants become extinct in one area or may become extinct altogether. In such cases, specimens preserved in a herbarium can represent the only record of the plant's original distribution. Environmental scientists make use of such data to track changes in climate and human impact.

Many kinds of scientists use herbaria to preserve voucher specimens, representative samples of plants used in a particular study to demonstrate precisely the source of their data.

They may also be a repository of viable seeds for rare species.

- Give taxonomic description of family Asteraceae with suitable diagram

Answer

The Asteraceae is one of the largest plant families (the largest dicot family, and second only to the Orchidaceae in flowering plants), having 2 subfamilies, 13 tribes (these are all 'above' the generic level), 1,100 genera, and about 25,000 species. It occurs throughout the world, with its greatest diversity in the semi-arid tropics (not abundant in the tropical rainforest). It grows from the arctic to the tropics, from high elevation to very low elevation.

Distinctive features of Asteraceae

Inflorescence

a. Inflorescence consists of several small flowers, called florets, that are crowded together, sessile, on a receptacle. This inflorescence is often mistaken for a single flower. Compositae refers to the superficial resemblance of the head to a single, large flower. What looks like an ordinary flower is really a composite of small florets.

b. The inflorescence is called a **capitulum**, or head.

c. The flower cluster is surrounded by bracts, called **involucral bracts**, or **phyllaries**, and the whole structure is referred to as an **involucre**.

d. Some members of the family have only one row (uniseriate) of involucral bracts (Senecio); others have several rows.

e. The arrangement (how many rows; whether the bracts are overlapping or side by side) and the texture of bracts are often important in identifying the genus.

f. In some species, some or all the florets are subtended by their own bracts. These bracts are attached to the receptacle, and are referred to as **receptacular bracts**, or **chaff**. They are generally not visible unless you pull apart the capitulum. Species without chaff are said to have a 'naked' receptacle. The **receptacle** is the enlarged portion of the peduncle upon which the florets are borne.

Flower

a. **Disk florets** - In most members of Asteraceae, the central florets have a radially symmetrical, tubular corolla, with 5 short lobes. These florets are called **disk florets**. They form the central disk of the capitulum in typical daisies. Disk florets are often perfect flowers. The entire inflorescence may be composed of disk florets only (a

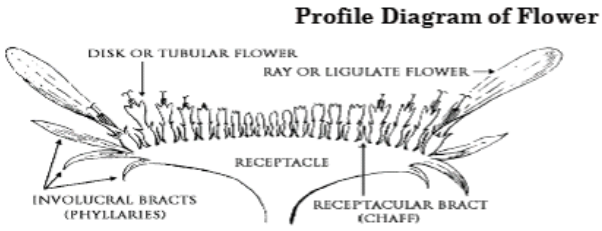
condition referred to as **homogamous**); when so, the inflorescence is said to be **discoid**.

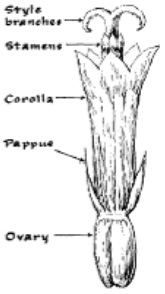
b. **Ray florets** - Surrounding the disk florets are sometimes an outer ring of **ray florets**. These have zygomorphic symmetry, and are usually either sterile or pistillate, with **3 apical teeth**. Ray florets are strap-shaped, imperfect, and never occur alone in the inflorescence (a condition referred to as **heterogamous**). They are always associated with disk florets (although disk florets may occur without ray florets), and form a circle around the margin of the head, the center filled with disk florets.

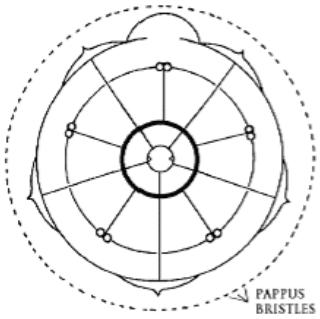
c. **Ligulate floret** – the best known weedy composite, the common dandelion, has a third kind of floret, a ligulate floret. These resemble ray florets with their zygomorphic symmetry, but ligulate florets are perfect (bisexual), and have **5 apical teeth** at the end of the strap.

d. **Bilabiate floret** – These florets have zygomorphic symmetry, but not so much as the ray or ligule. They have 3-4 lobes on the lower (long) lip, and 1-2 lobes on the upper (shorter) lip. They are also bisexual, can be represented by thistles, and are relatively rare in the U.S.

Floral formula: * or X, K∞, C (5), A (5), G $\overline{(2)}$ achene

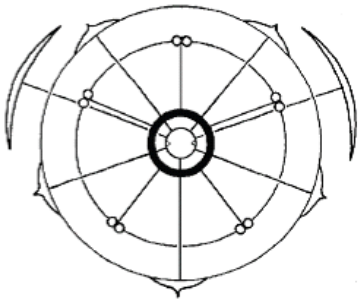






Ligulate Flower

Tubular Flower



- What are the various phytogeographical regions of the India?

Answer: Following are the important phytogeographical regions of the India

Chattarjee (1962), India can be divided into nine phytogeographical regions.

Western Himalayas

This region comprises north and south Kashmir, part of Punjab and Kumaon region of Uttaranchal. Average annual rainfall in the region is 100-200 cm. The region is wet in outer southern ranges and slightly dry in the inner areas. At high altitudes, snowfall occurs during winters. The region is subdivided into three zones.

- Submontane (lower, tropical and subtropical) zone: This zone includes outer

Himalayas i.e. regions of Siwalik Hills and adjoining areas from 300 to 1500 m altitude. Average annual rainfall of the zone is around 100 cm. The vegetation consists of subtropical dry evergreen, subtropical pine and tropical moist deciduous forests.

- Temperate (montane) zone: This zone extends in the western Himalayas between the altitudes 1500 and 3500 m. The climate is wet between the altitudes 1500 and 1800 m and is drier at higher altitude. The vegetation consists of wet forests, Himalayan moist and Himalayan dry temperate forests.
- Alpine zone: This zone extends between 3500 m and 5000 m altitudes. The rainfall is very scanty and climate is very cool and dry. The vegetation consists of alpine forests.

Eastern Himalayas

This region extends in the Himalyas from east of Nepal up to Arunachal. The climate is warmer and wetter than in western Himalayas. Tree line and snow line are higher by about 300 m than in the western Himalayas. The tropical temperature and rainfall conditions result in vegetation of the region having greater general species diversity, greater variety of oaks but lesser variety of conifers than in the western Himalayas. This region is also divided into three zones.

- Submontane (lower, tropical and subtropical) zone: This zone extends from the foothills up to the 1850 m altitude. The climate is nearly tropical and subtropical. The vegetation consists of subtropical broad-leaved forests, pine forests and wet temperate forests.
- Temperate (montane) zone: The zone extends from 1850 m to 4000 m altitude, about 500 m higher than in the western Himalayas. The vegetation consists of typical temperate forests with oaks and *Rhododendron* at lower and conifers at higher altitudes.
- Alpine zone: This zone extends from 4000-5000 m altitude. The climate is very cool and dry. The vegetation consists of alpine forests.

Indus plain

This region comprises a part of Punjab, Delhi, Rajasthan, a part of Gujrat and Cutch.

The climate has very dry and hot summers alternating with dry and cold winters. The annual rainfall is generally less than 70 cm and may be 10-15 cm in some areas. Most of the region is desert today though it had dense forests about 2000 years ago that were destroyed due to biotic factors particularly extensive cattle grazing. The vegetation today consists of tropical thorn forests and grasslands in some areas.

Gangetic plain

This region covers part of Delhi, Uttar Pradesh, Bihar, West Bengal and part of Orissa. Average annual rainfall ranges from 50 cm to 150 cm from east to west. The vegetation consists of tropical moist deciduous forests, dry deciduous forests, thorn forests and mangrove forests.

Assam

The region covers most of the Assam. The climate is characterized by very high temperature and rainfall. The vegetation consists of tropical evergreen and wet temperate forests in the lower plains while hilly tracts up to 1700 m altitude have subtropical pine forests.

Central India

This region comprises part of Orissa, Madhya Pradesh, Vindhyan region and Gujrat. The areas are mostly hilly with some places at 500-700 m altitude. The average annual rainfall is 100-170 cm. Biotic disturbances are very common in this region resulting in degradation of forests into thorny forests in the open area. The vegetation consists of tropical moist deciduous forests, chiefly Sal forests in areas of annual rainfall above 150 cm and mixed deciduous forest in areas of 125-150 cm annual rainfall. Tropical thorn forests are found in the areas of annual rainfall below 125 cm.

Western coast of Malabar

This is a small region extending from Gujrat to Kanyakumari along Western Ghats. The climate is warm humid having annual rainfall over 400 cm. The climate is tropical on the coasts and temperate in the hills. The vegetation consists of tropical wet evergreen, moist evergreen and moist deciduous forests. Wet temperate forests (Sholas) are present in Nilgiri while mangrove forests are found in the saline swamps on the coasts.

Deccan

The region comprises southern Peninsular India from southern Madhya Pradesh up to Kanyakumari excluding the Western Ghats. The average annual rainfall in the region is about 100 cm. The vegetation consists of tropical dry evergreen, dry deciduous and swamp forests.

Andaman and Nicobar

This region includes Andaman and Nicobar Islands. The climate of the region is warm and humid with very high temperature and annual rainfall. The vegetation consists of littoral mangrove, evergreen, semi-evergreen and deciduous forests.

- Discuss phenitic versus phylogenetic systems of classification.

Answer

- **Phenetic classification**
    - **Classified by looks:**
        - *Phenotypic classification* is concerned with grouping individual species into phenotypic categories (taxons) based on how organisms "look," "look" broadly defined.
        - Note that once upon a time in the not so distant past taxonomists were not equipped to classify beyond the level of phenotypic groupings except via inference from phenotypic similarities.
    - **Evolutionary dissonance:**
        - Phenotypic similarity and evolutionary relationship do not always map one to one upon each other.
        - In particular, phenotypic comparison can be an imperfect indicator of evolutionary relationship due to:
        - complex correspondences between phenotype to genotype
        - the occurrence of convergent evolution
        - variations between lineages in rates and modes of phenotypic

evolutionary change

- **Phylogenetic classification**
    - *Phylogenetic classification* is concerned with grouping individual species into evolutionary categories.
    - Since the early 1980's (or so) *phylogenetic classfication* has been made much more facile by the invention of molecular taxonomy: The evolutionary classification of organisms based on the nucleotide sequence divergence at individual loci (genes).
    - **Close, though not perfect:**
        - While classification employing nucleic acid sequence information can be non-arbitrary (i.e., classification is dependent only upon what classifying algorithm is employed), the phylogenies produced nevertheless tend to be approximations of evolutionary relationships rather than final words on the matter.
        - This is one reason disagreement can exist even among molecular taxonomists.
        - However, as more and more sequence is utilized in producing a phylogeny the associated uncertainty tends to decline.
    - **Phylogeny from phenotype:**
        - Note that very often these two approaches (phenotypic and phylogenetic classification) fully agree. This is because there usually *is* a correlation between evolutionary relatedness and phenotypic relatedness.
        - However, such things as convergent evolution can really throw a wrench between the two classification philosophies since convergent evolution, by definition, produces phenotypic similarity in the absence of close evolutionary relatedness.
        - The trick to solving these discrepancies is to concentrate on true homologies and ignore convergence.
        - This is easier to say than to implement, however.