CHAPTER I. AIR HYGIENE

1.1. ATMOSPHERIC STRUCTURE

The gazeous area surrounding the planet is devided into several concentric spherical strata separated by narrow transition zones.

Atmospheric layers are characterized by differences in chemical composition that produce variations in temperature.

TROPOSPHERE

The troposphere is the atmospheric layer closest to the planet. It is characterised by density of its air and an average vertical temperature change of 6 degrees Celsius per kilometer.

Temperature and water vapor content in the troposphere decrease rapidly with altitude. Water vapor plays a major role in regulating air temperature because it absorbs solar energy and thermal radiation from the planet's surface. The troposphere contains 99% of the water vapor in the atmosphere.

The upper boundary of the layer ranges in height from 8 km in high altitudes, to 18 Km above the equator. Its height also varies with the seasons; highest in the summer and lowest in the winter.

A narrow zone called the tropopause separates the troposphere from the next highest layer called the stratosphere. Air temperature within the tropopause remains constant with increasing altitude.

STRATOSPHERE

The stratosphere is the second major strata of air in the atmosphere. It resides between 10 and 50 Km above the planet's surface. The air temperature in the stratosphere remains relatively constant up to an altitude of 25 Km.

Because the air temperature in the stratosphere increases with altitude, it does not cause convection and has a stabilizing effect on the atmospheric condition in the region. Ozone plays the major role in regulating the thermal regime of the stratosphere, as water vapor content within the layer is very low. Temperature increases with ozone concentration.

The ozone layer is located at an altitude between 20-30 Km. Approximately 90% of the ozone in the atmosphere resides in the stratosphere. Ozone absorbs the bulk of solar ultraviolet radiation in wavelengths from290 nm - 320 nm. These wavelengths are harmful to life because they can be absorbed by the nucleic acid in cells. Increased penetration of ultraviolet radiation to the planet's surface would damage plant life and have harmful environmental consequences. Appreciably large amounts of solar ultraviolet radiation would result in a host of biological effects, such as a dramatic increase in cancers.

Meteorological conditions strongly affect the distribution of ozone. Most ozone production and distruction occurs in the tropical upper stratosphere and occurs at higher latitudes than does production.

MEZOSPHERE

The mezosphere, a layer extending from approximately 50 Km to 80 Km, is characterized by decreasing temperatures. Hence the temperature is lower than that of the troposphere or stratosphere. With increasing distance from Earth's

surface the chemical composition of air becomes strongly dependent on altitude and the atmosphere becomes enriched with lighter gases.

THERMOSPHERE

The termosphere is located above the mezosphere and is separated from it by the mesopause transition layer. The temperature in the termosphere generally increases with altitude. At an altitude of 100-200 Km, the major atmospheric components are still nitrogen and oxygen. At this extreme altitude gas molecules are widely separated.

EXOSPHERE

The exosphere is the most distant atmospheric region from Earth's surface. The upper boundary of the layer extends to heights of 1000 Km and is relatively undefined. The exosphere is a transitional zone between Earth's atmosphere and interplanetary space.

1.2. CLIMATE

The worldwide system of winds, which transports warm and cold air very great distances away from the source regions, influences significantly the climates of the world. This worldwide wind system is called the general circulation of the atmosphere, and it gives rise to the Earth's climate zones. Although the changing of the seasons and the positions of large oceans and continental landmasses affect this climate zones, they provide a general approximation to the different types of climate seen on Earth.

The Earth's general circulation arises as a result of the temperature difference between the equator and the poles. This latitudinal temperature gradient produces atmospheric pressure differences which generate winds that transport the equatorial heat north and south to higher latitudes.

1.2.1. CLIMATE ZONES

A number of climate zones can be traced between the equator and the pole in each hemisphere.

- **Tropical or equatorial zone**

Centred roughly on the equator the tropical zone is a belt of relatively low atmospheric pressure and heavy rainfall associated with thunderstorms, due to the rising air.

- **Subtropical climate**

At about 30^0 north and south of the equator is a subtropical climate belt of generally dry descending air, associated with high atmospheric pressure and clear skies. In the Northern Hemisphere, the belt is centred over the Sahara in Africa. Daytime surface temperatures can often exceed 40^0C, whilst at night, the extensive heat loss due to lack of cloud cover can lower temperatures close to freezing. The intense heat and lack of rainfall is typical of the *desert climate* which is commonly found in the subtropical zone.

During the Northern Hemisphere summer, the subtropical zone moves northward to influence the Mediteranean region. *Mediteranean climates* are characterised by hot dry summers, but much cooler and wetter winters than truly subtropical climates nearer the equator.

Between the subtropical and equatorial zones are regions much drier than the equatorial zone, but receive more rainfall than the desert climates. These regions are often characterised by *Savannah*, scrub and grassland which blossoms during the rainy season and dies off during the prolonged dry season.

- **Temperate climate**

In the mid-latitudes around 50^0 to 60^0 north and south there is a belt of cyclonic low pressure, arising from the convergence of cold polar easterly winds and warm subtropical westerly antitrades. In the Northern Hemisphere, cyclonic depressions tend to develop in an North Atlantic and North Pacific. They are characterised by relatively mild, moist winds that tend to bring frequent cyclonic precipitation (rain and snow), particularly along the west-facing side of continents. The precipitation tends to develop along warm and cold fronts, where cold air from the polar easterlies forces the warm, moist air of the westerlies to rise, which, on cooling, releases the moisture as clouds and ultimately rain and snow. Climate in the mid-latitudes is usually temperate.

- **Polar climate**

At the highest latitudes in the polar regions, the cold air sinks producing high atmospheric pressure. The polar climates are characterised by dry, icy winds that tend to radiate outward from the poles.

1.2.2. CLIMATE CLASSIFICATION

The climate categories are based on the annual and monthly averages of temperature and precipitation.

The Köppen system recognizes five major climatic types:

A. - **Tropical Moist climates**: all months have average temperatures above 18^0C.
B. - **Dry Climates**: with deficient precipitation during most of the year.
C. - **Moist Mid-latitude Climates with Mild Winters**
D. - **Moist Mid-latitude Climates with Cold Winters**
E. - **Polar Climates**: with extremely cold winters and summers.

A. Tropical Moist climates

Tropical moist climates extend northward and southward from the equator to about 15 to 25 degree of latitude. In these climates all months have average temperatures greater than 18^0C. Annual precipitation is greater than 1500 mm. Three minor Köppen climate exist in the A group, and their designation is based on seasonal distribution of rainfall.

Tropical wet is a tropical climate where precipitation occurs all year long. Monthly temperature variations in this climate are less than 3^0C. Because of intence surface heating and high humidity, cumulus and cumulonimbus clouds form early in the afternoons almost every day. Daily highs are about 32^0C, while night time temperatures average 22^0C.

Tropical monsoon climate. Annual rainfall is equal to or greater than Tropical wet, but falls in the 7 to 9 hottest months. During the dry season very little rainfall occurs.

The *tropical wet and dry* or *savanna* has an extended dry season during winter. Precipitation during the wet season is usually less than 1000 ml, and only during the summer season.

B. Dry climates

The most obvious climatic feature of the climate is that potential evaporation and transpiration exceed precipitation. These climates extend from 20 - 35^0 North and South of the equator and in large continental regions of the mid-latitudes often surrounded by mountains.

Minor types of this climate include:

- dry arid (desert);
- dry semiarid (steppe).

C. Moist subtropical mid-latitude climates

This climate generally has warm and humid summers with mild winters. Its extent is from 30 to 50^0 of latitude mainly on the eastern and western borders of most continents. During the winter, the main weather feature is the mid-latitude cyclone. Convective thunderstorms dominate summer months.

Three minor types exist:

- humid subtropical;
- Mediterranean;
- marine.

The humid subtropical climate has hot muggy summers and frequent thunderstorms. Winters are mild and precipitation during this season comes from mid - latitude cyclons.

Marine climates are found on the western coasts of continents. They have a humid climate with short dry summer. Heavy precipitation occurs during the mild winters because of the continuous presence of mid-latitude cyclones.

Mediterranean climates receive rain primarily during winter season from the mid-latitude cyclone. Extreme summer aridity is caused by the sinking air of the subtropical highs and may exist for up to 5 months.

D. Moist Continental Mid-latitude Climates

Moist continental mid-latitude climates have warm to cool summers and cold winters. The location of these climates is poleward of the C climates. The average temperature of the warmest month is greater than 10^0C, while the coldest month is less than -30^0C. Winters are severe with snowstorms, strong winds, and bitter cold from Continental Polar or Arctic air masses.

There are three minor types:

- dry winters;
- dry summers;
- wet all seasons.

E. Polar climates

Polar climates have year-round cold temperature with the warmest month less than 10^0C. Two minor climate types is:

- polar tundra;
- polar ice caps.

Polar tundra is a climate where the soil is permanently frozen to depths of hundreds of meters, a condition known as permafrost. Vegetation is dominated by mosses, lichens, dwarf trees and scattered woody shrubs.

Polar ice caps has a surface that is permanently covered with snow and ice.