KTU NOTES

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KTU STUDY MATERIALS | SYLLABUS | LIVE NOTIFICATIONS | SOLVED QUESTION PAPERS

MODULE 1

SYSTEMS OF EARTH AND KEY TERMS IN DISASTER MANAGEMENT

SYLLABUS:

Systems of earth: Lithosphere - composition, rocks, soils; Atmosphere-layers, ozone layer, greenhouse effect, weather, cyclones, atmospheric circulations, Indian Monsoon; hydrosphere Oceans, inland water bodies; biosphere.

Definition and meaning of key terms in Disaster Risk Reduction and Management- disaster, hazard, exposure, vulnerability, risk, risk assessment, risk mapping, capacity, resilience, disaster risk reduction, disaster risk management, early warning systems, disaster preparedness, disaster prevention, disaster mitigation, disaster response, damage assessment, crisis counselling, needs assessment.

PERVIOUS KTU QUESTIONS(CE)

1. a) Explain the difference between Hazards and Disaster. (8)
   b) Define the terms Risk, Vulnerability and crisis. (7)
2. Explain the concept of 'Green House effect. (8)
3. Explain the origin of Cyclones, types and its impacts. (10)
4. What is the purpose of Disaster Management? (5)
5. Explain the term Vulnerability with respect to earthquake. (7)
6. Explain the below terms. (10)
   a) Exposure
   b) Resilience
   c) Disaster risk reduction
   d) Capacity
7. What is disaster mitigation? (6)
8. Explain the below terms. (10)
   a) Early warning Systems
   b) Disaster Preparedness
   c) Disaster Risk Management
   d) Disaster Prevention

DISASTER MANAGEMENT

Disaster management refers to the conservation of lives and property during natural or human-made disasters. Disaster management plans are multi-layered and are planned to address issues such as floods, hurricanes, fires, mass failure of utilities, rapid spread of disease and droughts. Disaster management can be of either natural disasters or man-made disasters.

LITHOSPHERE

Earth has four concentric zones. The innermost zone is the 'Inner core. This zone is a solid mass of iron which has a radius of about 1,216 km, covering the inner core is the outer core. This is a layer of molten liquid containing nickel and iron. It is about 2,270 km thick. The outer core is covered by solid 'Mantle', which is about 2,900 km thick. The outermost hardened exterior zone is known as Crust. The crust varies in thickness from about 5 km. The crust and the mantle which is hard and brittle is lithosphere

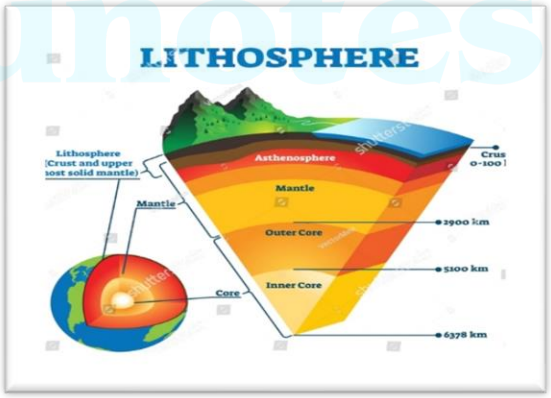


Fig 1: Structure of the earth and Lithosphere

Lithosphere is the outer layer (oceanic and continental) of earth that includes the crust and solid part of the mantle. Lithosphere interacts with atmosphere, hydrosphere and biosphere and forms Pedosphere. Pedosphere has both biotic and abiotic components.

There are two types of Lithospheres:

1. The oceanic lithosphere which is about 5 km to 8 km thick composed of basalt.
2. The continental lithosphere which is 30 km to 40 km thick.

Earth has seven major plates, which includes Africa. Antarctica, Australia, Eurasia, North America, South America and Pacifica, and a number of minor ones. A few important minor plates include Adria. Arabia. Caribbean. Nazca, Philippines, etc. These plates are composed of oceanic and continental lithosphere. They move independently over the mantle relative to one another, below the outer rigid lithosphere. This area known as asthenosphere is about 100 km to 200 km thick, they move with at restricted independence from the seven large plates.

The plates periodically reorganize themselves with new plate boundaries being formed, while certain others closing up. In addition to these movements, the plates also change in shape. The plates have three different motions:

1. They are Moving apart, thereby creating divergent boundaries
2. Gliding horizontally along each other, thereby creating wrench and transform boundaries
3. Moving towards one another, and creating convergent boundaries

Composition of Lithosphere

The lithosphere contains minerals, rocks and soil. It has more than 100 chemical elements and most of them are rare. More than 99 percentage of the volume includes elements like oxygen, silicon, aluminum, iron, calcium, sodium, potassium and magnesium. Only a few elements are present in pure forms in the earth's crust called native elements, they include copper, gold, lead, mercury, nickel, platinum and silver. These elements contained in ores are found in different combinations as minerals. Minerals are naturally occurring, inorganic, crystalline solids that have definite chemical compositions. Certain minerals are composed of single element. For instance, diamond and graphite composed of only carbon. Below table shows elements present in earth crust.

S. No.	*Elements*	*Per cent*
1	Oxygen	46.6
2	Silicon	27.7
3	Aluminum	8.1
4	Iron	5.0
5	Calcium	3.6
6	Sodium	2.8
7	Potassium	2.6
8	Magnesium	2.1

ROCKS

Lithosphere has various types of rocks. Rocks are naturally occurring hard and consolidated inorganic materials, composed of one or a large number of minerals. Certain other materials, like coal and limestone are developed from plant and animal remains.

There are various types of rocks. They are:

1. Igneous Rocks
2. Sedimentary Rocks
3. Metamorphic Rocks

Igneous Rocks

These rocks are formed by solidification of magma in the interior, or lava on the surface of earth. Igneous rocks are composed of primary minerals, which are predominantly silicates. They sometimes overlap with sedimentary and metamorphic rocks.

Sedimentary Rocks

Sedimentary rocks are formed by the precipitation from solutions, and consolidation of remnants of biotic components like plants and animals. These rocks contain both original primary minerals (Quartz, Mica) and altered as well as newly synthesized secondary minerals (Clay, calcite, gypsum).

Metamorphic Rocks

Also known as Thermal rocks as they are formed from pre-existing rocks (igneous or sedimentary) due to change in the temperature and pressure in solid state is known as metamorphic rocks. These rocks are formed when magma intrudes through pre-existing igneous or sedimentary rocks. All types of pre-existing rocks could undergo metamorphism. Further, igneous and metamorphic rocks get weathered and form sediments. These sediments get deposited and lithified into sedimentary rocks

SOIL

Soil is the surface layer of the land. It is a natural body that contains a variable mixture of broken and weathered materials and decaying organic matter, which covers the earth in a thin layer. It takes long period of time for the soil to form through the natural process. The formation takes place from the weathering and decomposition of rocks and minerals. Soil is a dynamic layer of earth's crust which is constantly changing and developing. The upper limit of soil is air or water and its lateral margins grade to deep water or barren areas of rock or even ice.

Soil accomplishes various functions, which include the following:

1. It provides mechanical support to the plant.
2. It has the ability of holding water as it has the property of porosity. This ability makes soil a reservoir of water
3. Soil provides micro and macro nutrients, as well as ideal pH required for the growth of the micro-organisms, plants and animals.
4. Soil prevents excessive leaching of nutrients.
5. Soil houses bacteria that fix nitrogen and other elements; fungi, protozoa and other micro-organisms. These organisms' aids in the decomposition of organic matte

Different types of soil are given below:

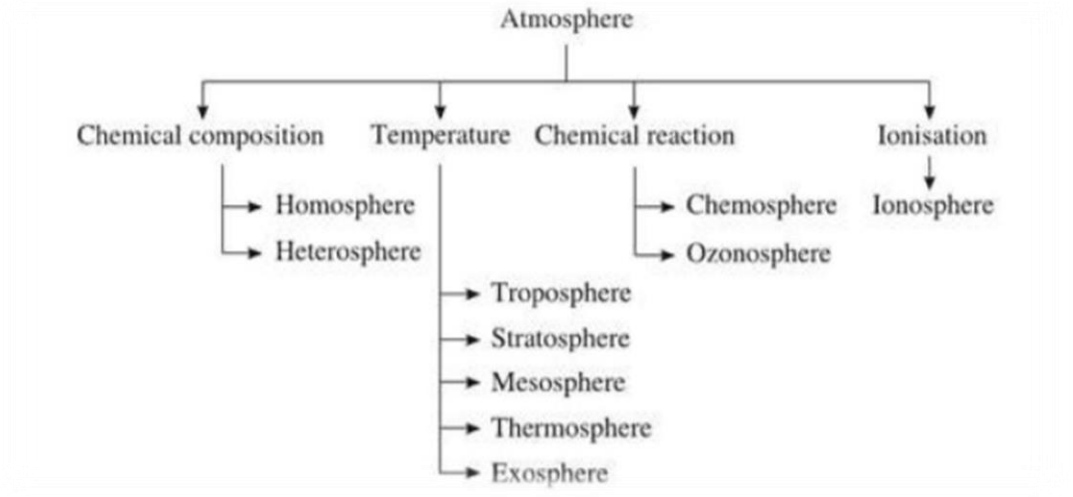
S.No.	Soil	Details
1	Volcanic ash	Volcanic ash is fine grained, and has the property of weathering relatively easily. Plants invade a new deposit of volcanic ash quickly and colonise it very fast. This could happen even within a few years' time. The soils that result from volcanic ash, known as Andisols, are fine textured. It is fertile and normally rich in organic matter and plant nutrients. These soils are likely to be found in places where there are active and recently extinct volcanoes. It is estimated that these soils cover approximately 124 million ha of land (0.84 per cent of earth's surface).
2	Granite	Granite is a coarse-grained rock. It has about 25 per cent quartz and 65 per cent orthoclase. It may also have small amounts of mica and hornblende. Soils that develop from granite are usually sandy in nature. They are normally low in nutrient content, with characteristics like being friable, permeable, acidic, and low in base status. This soil has very little cohesion or consolidation, and is highly susceptible to erosion.
3	Limestone	Limestone rocks mainly contain calcite. They also have considerable quantities of impurities of other carbonates, silt, clay, quartz, iron, and so on. Soils that result from limestone are clayey. It could also be in the form of clay loams and sandy loams.
4	Sandstone	Sandstone mostly consists of sand sized quartz. It could also have impurities such as feldspar and mica, and other agents, like silica, iron, and lime. Soils that are formed from sandstone are not fertile, usually coarse textured and acidic in nature. However, the characteristics of sandstone soils are dependent on the particular type of sandstone—whether grain size or mineralogical composition.
5	Basalt	Basalt is fine textured in nature. It is rich in ferromagnesian and calcic plagioclase minerals. Basalt gets weathered relatively easily to form fine-grained clay minerals. The soils that originate from Basalt are fine textured in nature. It has good amount of the minerals and has a high base status.

LAYERS OF ATMOSPHERE

Atmosphere is the various gases that encircle the earth. The gases contained in the atmosphere include nitrogen, oxygen, argon, carbon dioxide, neon, etc., The below table shows the composition of gases present in the atmosphere.

S.No.	Gas	Per cent
1	Nitrogen	78.80
2	Oxygen	20.95
3	Argon	0.93
4	Carbon dioxide	0.03
5	Neon	0.0018
6	Helium	0.00052
7	Methane	0.00015
8	Krypton	0.00011
9	Hydrogen, carbon monoxide, ozone, etc.	Less than 0.0001

Atmosphere contains water vapor, certain other fine materials like soot, dust of rock and soil, sores, pollens and salt grains from sea water. The atmosphere is divided in to a number of concentric layers that extend from sea level to outer space. Atmosphere is classified in to various types as shown below:



Based on chemical composition atmosphere is divided in to two.

1. **Homosphere**

   Homosphere Extends to a distance of about 88Km from the surface of earth. It consists of gases like nitrogen, oxygen, argon and carbon dioxide. This layer is homogeneous in composition.

2. **Heterosphere**

   The atmosphere lies above homosphere is heterosphere. The air composition is not uniform. The lower most layer have the heaviest molecules and upper layer has the lightest elements. Based on the gases present, heterosphere is further divided to four.

   a. **Molecular Nitrogen Layer**(88Km-200Km)
   b. **Oxygen Layer** (200Km-1125Km)
   c. **Helium Layer** (1125Km-3540Km)
   d. **Hydrogen Layer** (3540Km-9660Km)

Based on the temperature, the atmosphere is divided into four parts.

1. **Troposphere**

   The bottom dense part, containing 70 percent of the mass, close to the ground is troposphere. It reaches up to 11 km from the ground. Clouds, storms, fog and haze are found only in troposphere. The temperature in this layer decreases at about -6.4°C/km with height. This decrease of

temperature with altitude is called lapse rate. The boarder of troposphere is called **Tropopause**. Tropopause acts like a lid over troposphere. Temperature stops decreasing with height from tropopause.

2. **Stratosphere**

   Stratosphere is a clear layer above troposphere that extends to a height of about 50 km from earth's surface. This layer does not have clouds, storms or dust. Clouds are not formed since water vapors are absent in these regions. Ozonosphere is an important layer found within stratosphere. Ozone layer is found in this layer. Ozone absorbs and prevents the harmful ultraviolet radiations from reaching earth, thereby protect the life on earth. The maximum concentration of ozone occurs at 22 km from the ground level. Above the stratosphere, there is a small layer called stratopause where temperature neither increases nor decreases with height.

3. **Mesosphere**

   The portion of the atmosphere above stratosphere, between 50 km and 80 km is known as mesosphere. It starts from the edge of Stratopause. Though the temperature in mesosphere near stratosphere is higher by about 10°, it falls to -75°C at 80 km. The density of air at this height is about 1/1000 as that of sea level. Mesosphere plays a crucial role in radio communication as ionisation occurs here. The sunlight passing through this layer converts individual molecules to charged ions. These ionised particles are concentrated as a zone in this layer, which is named D-layer. The D-layer reflects radio waves transmitted from earth. Just above the mesosphere is a small layer called Mesopause, where temperature is stable.

4. **Thermosphere**

   Thermosphere extends from 80 km to about 60,000 km from earth. Here the temperature increases to about 2000°C. The property of thermosphere is radically different from the others. Ions are abundant in thermosphere. In thermosphere that most of the approaching meteoroids burn up before reaching earth.

5. **Exosphere**

   The region beyond thermosphere is called exosphere. It consists of only hydrogen and helium atoms. This region has very high temperature due to solar radiation.

Base on the chemical reaction atmosphere is classifies in to two.

1. Chemosphere

A region of the upper atmosphere between altitudes of 40 and 80 km in which chemical processes driven by sunlight are significant. The chemosphere overlaps the upper stratosphere and the mesosphere

2.Ozonosphere

In this region intense chemical reaction takes place with the help of oxygen. Ozone layer is present in this region.

OZONE LAYER

Ozonosphere is an important layer found within stratosphere. Ozone is found in this layer. Ozone absorbs and prevents the harmful ultraviolet radiations from reaching earth, thereby protecting life. Without Ozone layer, life would not have been possible on earth. The maximum concentration of ozone occurs at 22 km from the ground level.

Depletion of ozone layer

Due to human activities ozone layer is becoming thin. The thinning of this layer is called ***ozone depletion***. The ozone layer is located in the lower part of the stratosphere between 15 km and 35 km. Concentration of ozone is the maximum at about 25-30 km. The level of ozone is maintained at this level by Ozone-Oxygen Cycle. When ultra-violet radiation that spread out from the sun strikes the oxygen molecule, it splits the molecule into two individual oxygen atoms. The oxygen atoms, thus produced, combines with Oxygen (O_2) molecule and produce ozone molecule (O_3). This reaction is aided by either Nitrogen or Oxygen, which absorbs the excess energy that is liberated. Ozone thus formed will be split by ultra-violet rays into a molecule of oxygen and an atom of oxygen (O). It is through this repeated circular ozone and oxygen formation that the concentration of ozone is maintained in the stratosphere. The concentration of ozone in the atmosphere is determined by the rate of its formation and destruction in the above manner. Due to severe depletion of ozone in the atmosphere 'ozone holes' are created. Ozone holes, which were discovered in 1985, are overhead areas having less than 220 Dobson Units (DU). The chemistry of ozone depletion by CFCS, BFCS and Nitric oxides are now discussed.

Depletion by CFCs and BFCs

CFCS and BFCS are stable compounds in the atmosphere that have the property of living longer (50 to 100 years). Due to their long life, they rise up to the stratosphere. Through the action of UV radiation from the Sun on these compounds, Chlorine (Cl) and Bromine (Br) radicals are released. These radicals act as catalysts, and initiate breaking down of ozone molecules. It is estimated that a single such radical of either Cl or Br is capable of breaking down over a lakh of ozone molecules. Due action, Ozone concentration is decreasing at a drastic rate of four percent per decade. As a result of the inherent long life of CFCs and BFCs, they continue to deplete ozone layer in a recurrent manner.

Depletion by Nitric Oxide

One molecule of nitric oxide (NO) combines with ozone; it gets oxidised to nitrogen dioxide and Oxygen. This NO2 combines with another O3 molecule to become NO3 (Nitrate) and O2. The NO2 and NO3 then combine to form N2O5 (Dinitrogen pentoxide). Even the atomic oxygen(O) readily combines with NO2 to yield NO3. Due to this series of actions and reactions, ozone is completely utilised, and thereby depleted. Large quantities of nitrogen are emitted by aircrafts that community decided to withdraw the operation of jet aircrafts that emit oxides of nitrogen. This step has also helped in reducing the depletion of ozone to a very large extent near stratosphere.

GREEN HOUSE EFFECT

Certain physical processes that take place in the troposphere are responsible for the weather and climate of that particular place. To understand clearly about the process of greenhouse effect, it is needed to know about Incoming solar radiation and the outgoing radiation.

Incoming Solar Radiation

Atmosphere behaves like a complex mega heat engine. A large number of processes like air movements (storms and cyclones), evaporation and formation of clouds, precipitation, etc. take place in the atmosphere. Only two in a billionth of the solar energy reaches Earth, of which only a small portion is responsible for the physical and biological processes. Solar radiation contains X-rays, gamma rays,

ultraviolet (UV) rays, visible light, infrared rays, microwaves, radio waves etc. Of all the energy received by earth: UV, visible and infrared portions constitute over 95 per cent. The harmful UV radiation is prevented from reaching earth by the ozone layer. The solar radiation which ultimately reaches the earth comprises mainly of visible light, which is composed of seven colours. While travelling through the atmosphere, a portion of the radiation energy is reflected by clouds, and some are scattered and absorbed by gases and particles. The scattered radiation that reaches earth is called diffuse radiation. Only a small quantity of the scattered radiation (22 per cent) reaches earth's surface.

Outgoing Solar radiation

If the entire energy that is received from sun retained in its earth's surface, the planet would be very hot and would become an inhabitable place. The earth, after heating up of its surface, reflects a certain amount of energy. Some of this heat energy is transmitted to the upper layers of air through conduction. The heat energy so emitted from the earth's surface is in the form of long wave radiation, and is called outgoing radiation. While a portion of the outgoing radiation is absorbed by certain gases in the atmosphere and retained as heat energy and the remaining energy escapes into the outer space. Gases capable of absorbing outgoing radiation are carbon dioxide, carbon monoxide, water vapour, etc. They are called Green House Gases (GHG). Due to the effect of Greenhouse gases, Earth is prevented from cooling down drastically. GHGS thus act like a blanket and provide earth with an ideal climate for life to flourish. This known as Greenhouse effect. The intensity of Greenhouse effect varies from place to place depending upon the concentration of GHGS. For instance, the quantity of vapour-and carbon dioxide is less in dry places like deserts. The usage of carbon dioxide and the release of oxygen is high in places were like forests where trees are in abundance.

WEATHER

When radiation from insolation strikes earth, its top layer gets heated. The heat energy so created through the interplay of insolation and outgoing radiation is transferred to the overlying atmosphere through activities like conduction and convection. Due to this, as well as the movement of earth, air moves in all directions-both horizontally and vertically. This movement of air is the basis of weather. Weather is the atmospheric conditions that exist for a short duration which can span over few hours to a number of days. Weather conditions can fluctuate very often. The average weather or atmospheric conditions over a fairly long period of time like months, years or even decades; in a particular area is called **climate**.

TEMPERATURE

Temperature is the index of heat that is sensible. It indicates the kinetic energy of molecules, or the speed at which the molecules move. While in air and water, molecules keep on moving and change their location very often and in solids the molecules involve in a vibration movement and not moving. The speed at which this vibration takes place is described as temperature. A body having higher temperature has the property of transmitting it to another one having lower temperature. Temperature is measured using thermometer, and is reported in either Celsius, Kelvin or Fahrenheit scales. The earth's temperature varies in an altitudinal and horizontal manner in the troposphere

Altitudinal Variation

In the troposphere, temperature decreases with height. It decreases at a rate of -6.4°C/km. This rate at which temperature decreases with height is called lapse rate. The lapse rate is not uniform and it varies due to different conditions like pollution in the atmosphere.

Horizontal Temperature Variation

Temperature varies at different times of the day at different locations due to various reasons and factors. It also varies at different months and seasons of the year. A few reasons for this variation are :

(a)The hour of the day:

More solar energy is received during the noon, when sun's rays strike vertically overhead; than hours in the morning hours, when the rays strike at angles.

(b)Insolation:

The phenomenon of day and night occurs as a result of the revolution and rotation of earth. Due to revolution one half of the globe is exposed to sunlight and the other half is in darkness. The temperature of any given area is based on the insolation of that area. The length of daylight and the angle at which the rays fall on earth also determine the amount of insolation and the temperature of that particular area.

(c) Distance from the Equator:

The sun rays strike in perpendicular manner on the equator. Near to the poles it strikes at an angle. Due to this, areas farther away from equator will experience lesser temperature as compared to the areas near the equator.

(d) The tilt of the axis:

The earth's axis is tilted at angle of 66½ degrees to the plane of the ecliptic. This tilt is maintained throughout its orbit. This tilting of the axis leads to seasonal variations. Due to this, the months closer to June are summer months in this hemisphere. During this period, the northern hemisphere receives greater amount of solar energy, and hence, higher temperature. Places near to the equator receive more solar energy resulting in higher temperature.

(e) Distance from the Equator:

The heating of earth's surface differs according to the type of the surface in an area. For instance, rocky surfaces get heated rapidly, while water takes considerably long time to get heated up. In the same way, rocky surfaces loose heat rapidly as against water which loose heat slowly. In any given place, different types of surfaces exist. Hence, there will be a mixture of heating and cooling properties.

CYCLONES

The atmospheric pressure in a given area has an important role to play with respect to the formation of a cyclone. When a flow of air moves along curved isobars which is a net centripetal acceleration pulls it toward the centre of a curvature, making the air to rotate. Such wind (called gradient wind) is called cyclone. If the movement of the gradient wind is in the anticlockwise direction in the northern hemisphere. It is called cyclone and anticyclone in southern hemisphere.

During a cyclone, the surface air moves towards the centre having low pressure and hence converges. The converged air has the property of ascending in the centre within the low-pressure area. The reverse happens in a high-pressure area. Air tends to sink in the centre of a high-pressure area during anticyclones.

Cyclones	Anti cyclones
It is a low pressure system with surroundings of high pressure.	It is a high pressure system with surroundings of low pressure.
It blows anti clockwise in the Northern Hemisphere.	It blows clockwise in the Northern Hemisphere.
It blows clockwise in the Southern Hemisphere.	It blows anti clockwise in the Southern Hemisphere.
It is associated with cloudy skies, heavy rainfall with stormy winds.	It is associated with clear skies, mild winds and dry conditions.
It can cause great damage to lives and property if precautions are not taken.	The weather is settled and pleasant.

ATMOSPHERIC CIRCULATIONS

When Earth rotates on its axis, the rotation causes the deflection in the wind flow due to Coriolis force. ***Coriolis force*** is a force which is produced due to the rotation of the earth. In addition to this, a low-pressure belt is formed over the tropical regions, since the equatorial region is heated throughout the year. This belt is called the ***Inter-Tropical Convergent Zone (ITCZ)***. This zone is also known as doldrums. This is not a conspicuous belt, but a discontinuous one that fluctuates in its position and intensity. Even with disruptions like weather fronts and storms, there is a consistent pattern to how air moves around our planet's atmosphere. This pattern, called ***atmospheric circulation***.

This is caused because the Sun heats the Earth more at the equator than at the poles. It's also affected by the spin of the Earth. In the tropics, near the equator, warm air rises. When it gets about 10-15 km (6-9 miles) above the Earth surface it starts to flow away from the equator and towards the poles. Air that rose just north of the equator flows north. Air that rose just south of the equator flows south. When the air cools, it drops back to the ground, flows back towards the Equator, and warm again. Now the warmed air rises again, and the pattern repeats. This pattern, known as convection, happens on a global scale. It also happens on a small scale within individual storms.

The Indian Monsoon

Monsoon is a regional wind that blows towards land at a certain season and blow from the landmasses during other season. These wind blows in the opposite direction in summer and winter. Though monsoon winds blow over all parts of the world, it is well-developed over India and the South-east Asian regions. The Indian subcontinent has two types of winds.

1. **South-West Monsoon**
2. **North-East Monsoon**

South-West Monsoon

The south-east trade winds originate from the southern hemisphere in the Indian Ocean. When these winds cross the equator, they get deflected towards the right by the Coriolis force, becoming the south-west trade winds. These winds gather large quantities of moisture as they pass over the Indian Ocean.

As the SW monsoon winds approaches the Indian Peninsula, they are diverted into two-the Arabian Sea Branch and the Bay of Bengal Branch. When the moisture laden Arabian Sea branch reaches the south-western side of India, they are blocked by the Western Ghats. When the mountain range blocks the horizontal flow, the wind ascends along the slope of the mountain range, gets cooled down and form clouds. These clouds then result in precipitation. Kerala gets the south-west monsoon mostly during early June every year. These winds then take a west turn and continue their journey, and spread over the northern parts of India bringing in rains to these areas. Monsoon winds normally reach Delhi in the first week of July and could last till end September/early October.

North-East Monsoon

Since North-East winds originate mainly from the land masses of the north-east region of India, they are relatively dry. When these winds pass over the Bay Bengal towards south, they gather moisture and cause rainfalls over parts of Odisha, Andhra Pradesh and Tamil Nadu. Cyclone formation is common over Bay of Bengal during the north-east monsoon season. The cyclones also bring in abundant rainfall over Odisha, Andhra Pradesh, Telangana and Tamil Nadu.

HYDROSPHERE

Hydrosphere forms over 70 per cent of the earth's surface. In terms of area, it comes to 3,62,000 km^2. Water is found in the oceans as well as on land. Life is made possible on earth due to the availability of water. The hydrosphere has a direct influence on weather and climate conditions on Earth. This occurs due to the important role played by the worldwide oceanic circulations. The average depth of oceans is around 3.7 km. The floor of the oceans has mountain ranges and valleys, isolated volcanic peaks, and vast plains. Many of these mountain ranges and valleys exceed in size of their counterparts on land. As on date less than 10 per cent of the ocean floor has been surveyed.

OCEANS

Water in oceans is saline in nature. This salinity occurs due to the dissolved materials (mainly salts) contained in it. The mean salinity of sea water is around 34.7 g/kg. The lowest value being 33 and highest being 36 g/kg. Though sea water contains a mixture of several dissociated salts, NaCl is the most important one. Additional salts are always added to the oceans through various processes. However, seawater salinity is stable due to various mechanisms that remove salt from the oceans. Salt is spread to the atmosphere when wind blows sprays of sea water. The salt particles in the atmosphere enable water molecules to stick to it, and this falls on the land with rain and snow.

a) Oceans as moderator of climate

Water in oceans is constantly in movement in regular patterns due to the activity of winds. These movements of water in oceans are called ***ocean circulations or ocean currents***. These currents arise due to the interplay of wind and water. Oceans as Moderator of Climate Oceanic circulations have a profound and significant influence in heating up the globe, and hence, its climate. When water moves up from the colder and deeper parts of the ocean to the warmer surface, the heat is carried with it. Due to the interplay of various factors, the ocean water moves around the globe, and with it the heat or cold is transferred. This heat transfer plays a major role in impacting earth's climate. When extremes of incidents, like rainfall or droughts occur, the normal path of the ocean current can be disturbed and climate change could occur.

b) Oceans as Heat Reservoir

Oceans play a role of a heat reservoir, moderating extreme temperatures. The water in the upper portion of oceans store higher heat than in the entire atmosphere. During spring and summer seasons, the oceans

are cooler than the nearby lands. During winters oceans are warmer than the land masses. Due to this temperature difference in sea and land, there is heat energy transfer from land to water and vice-versa.

c) Oceans as Carbon Reservoir

The oceans are the largest carbon reservoirs of earth. Periodically it gives off large amounts of carbon into the atmosphere. Through certain biological and chemical exchange processes it plays an important role in carbon cycle.

d) Oceans and Sea Ice

The sea ice plays an important element in the Earth's climate system, The polar ice extends between 17 and 27 million km2, depending on the seasons. It covers around one-tenth of the land area and 6.5 per cent of the oceans. Of the total ice, about 90 per cent is located in the Antarctic as ice shelf. nine per cent in the Greenland ice sheet and the balance in the various glaciers around the world. It is estimated that if all the ice in Greenland and Antarctica is to suddenly melt, the sea would rise to an approximate height of 70 m.

WATER ON LAND

Fresh water constitutes the basis for life on land. On land, water is found in all the three states. In liquid form. the water is found in lakes, rivers and streams and also as ground water and soil moisture. The water found in these sources is fresh in nature. In solid form water is found as glacial ice, ice caps and ground ice. The fresh water in earth is perpetually being interchanged between the surface of the earth and atmosphere by a process of ***evaporation and precipitation***. This interchange is known as water cycle or hydrological cycle. In the hydrological cycle, solar energy causes water from the oceans to evaporate and change to atmosphere vapour. Evaporation also takes place from inland water bodies like lakes, rivers, streams, etc. The evaporated water rises to the upper layers of the atmosphere, where it is cooled and condensed. The condensed water falls back to the earth as precipitated form. Rain, snow and dew are different forms of precipitation. The water that falls on the earth runs along the ground and flows into rivers and in turn returns to the sea. A part of the rainwater that falls on the land drip into the ground is known as ground water. The ground water is used by human beings and plants.

BIOSPHERE

Biosphere is an important realm of Earth. The totality of life on earth and its interdependency on abiotic environmental factors. Biosphere consists of the complex interdependency between biotic and abiotic environmental components. Basically, biosphere is a thin envelop that encircles most of the earth, and supports life. It is the global sphere in which the biota interacts with lithosphere, atmosphere and hydrosphere. It is totally dependent on, and involves complex interactions between the atmosphere, hydrosphere, and lithosphere. Biosphere is the spherical terrestrial layer that comprises of the lower part of the atmosphere. the seas and the upper layers of the soil wherein living organisms exist naturally. All forms or life including human beings' dwell in biosphere. The health of the biosphere is determined by the availability of oxygen, moisture, temperature, air pressure and soil.

COMPONENTS OF BIOSPHERE

Biosphere is a giant ecosystem that consists of two major ecosystems:

(a) Terrestrial ecosystem

(b) Aquatic ecosystem

a) Terrestrial ecosystem

The terrestrial ecosystem consists of plants, animals, microorganisms their dependencies and interdependencies with the non-living items around it on the land. A terrestrial ecosystem is made up of either natural ecosystem or artificial/man-made ecosystem.

b) Aquatic ecosystem

Aquatic ecosystem consists of **marine and fresh water ecosystem.** While seas and oceans form the marine ecosystem; the rivers, pond, lakes, and wetlands form fresh water ecosystem. Aquatic ecosystems provide human beings with a wide range of services. Some of the services include the availability of water for day to day uses, foods like fish and crustaceans, breaking down: of chemical and organic wastes, recreation, etc. The aquatic ecosystem provides the human beings with a wealth of natural resources.

DISASTER MANAGEMENT

A sudden occurrence of an accident that causes huge loss of life and property is called as a ***disaster***. It is also called as a ***calamity***. Disaster is an event or series of events, which gives rise to casualties & damage or loss of properties, infrastructures, environment, essential services or means of livelihood on such a scale which is beyond the normal capacity of the affected community to cope with.

Disaster is a result from the combination of ***hazard, vulnerability & insufficient capacity*** or measures to reduce the potential chances of risk. A disaster happens when a hazard impacts on the vulnerable population and causes damage, casualties and disruption. For e.g.: earthquake in an uninhabited desert cannot be considered a disaster, no matter how strong the intensities produced. An earthquake is disastrous only when it affects people, their properties & activities. Thus, disaster occurs only when hazards and vulnerability meet.

Types of Disasters

a) Natural Disaster

A disaster caused by natural factor is called as a natural disaster.

E.g.: Earthquake, flood, cyclone etc.

b) Man-made disaster

A disaster caused due to the human activities.

E.g.: Wars, fire accidents, industrial accidents etc.

HAZARD

A hazard can be defined as a potentially damaging physical event, social and economic disruption or environmental degradation. Typical examples of hazards can be absence of rain (leading to drought) or the abundance thereof (leading to floods). Chemical manufacturing plants near settlements and incorrect agricultural techniques, can also been seen as hazards which could lead to possible disasters. Hazards can be the creation of man or the environment.

Natural hazards

Natural hazards are hazards which are caused because of natural phenomena (hazards with meteorological, geological or even biological origin). Examples of natural hazards are cyclones, tsunamis, earthquake and volcanic eruption which are exclusively of natural origin.
Landslides, floods, drought, fires are socio-natural hazards since their causes are both natural and manmade.

Manmade hazards

Manmade hazards are hazards which are due to human negligence. Manmade hazards are associated with industries or energy generation facilities and include explosions, leakage of toxic waste, pollution, dam failure, wars or civil strife etc.

EXPOSURE

Exposure refers to people, property, systems, or other elements present in hazard zones that are thereby subject to potential losses. Vulnerability: Vulnerability refers to the characteristics and circumstances of a community, system or asset that make it susceptible to the damaging effects of a hazard. There are many aspects of vulnerability, arising from various physical, social, economic, and environmental factors. Examples may include poor design and construction of buildings, inadequate protection of assets, lack of public information and awareness, limited official recognition of risks and preparedness measures.

RISK

There are many aspects of vulnerability, arising from various physical, social, economic, and environmental factors. Examples may include poor design and construction of buildings, inadequate protection of assets, lack of public information and awareness, limited official recognition of risks and preparedness measures.

Risk is a “measure of the expected losses due to a hazard event occurring in a given area over a specific time period. Risk is a function of the probability of particular hazardous event and the losses each would cause.”

The level of risk depends upon:

▪ Nature of the hazard

▪Vulnerability of the elements which are affected

▪Economic value of those elements

A community/locality is said to be at 'risk' when it is exposed to hazards and is likely to be adversely affected by its impact. Risk can be calculated using the following equation.

Risk = Probability of Hazard x Degree of Vulnerability.

There are different ways of dealing with risk, such as:

a) **Risk Acceptance** means an informed decision to accept the possible consequences and likelihood of a particular risk.
b) **Risk Avoidance** is an informed decision to avoid involvement in activities leading to risk realization.
c) **Risk Reduction** refers to the application of appropriate techniques to reduce the likelihood of risk occurrence and its consequences.
d) **Risk Transfer** involves shifting of the burden of risk to another party. One of the most common forms of risk transfer is Insurance.

Risk Assessment

A risk assessment is a process to identify potential hazards and analyze what could happen if a hazard occurs. Disaster risk assessments include: the identification of hazards; a review of the technical characteristics of hazards such as their location, intensity, frequency and probability; the analysis of exposure and vulnerability, including the physical, social, health, environmental and economic dimensions; and the evaluation of the effectiveness of prevailing and alternative coping capacities with respect to likely risk scenarios.

Risk Mapping

Risk mapping is a process of analyzing the hazard, vulnerability and capacity through a scientific methodology. The process of risk map preparation includes analysis of several variables and parameters which are sub-sets of base categories; hazard, vulnerability and capacity. Hence, preparation of multi

hazard risk map is a combination of all risk elements on several hazards. This process is important in risk map preparation and obviously in disaster management field for appropriate implementation of disaster risk reduction activities.

Elements at risk during/after disaster are:

- People
- Livestock
- Rural housing stock
- Houses
- Crops, trees, telephone, electric poles
- Boats, looms, working implements
- Personal property
- Electricity, water and food supplies
- Infrastructure support

Disaster Risk Reduction

Disaster risk reduction involves structural and non-structural measures. Structural measures include the use of physical or engineering solutions (such as ocean wave barriers or earthquake resistant buildings) to avoid disaster or reduce its impacts. Non-structural measures involve the use of policies, laws, education and awareness creation, and practices to avoid or reduce the impacts of disaster.

CAPACITY

Capacity refers to all the strengths, attributes and resources available within a community, organization or society to manage and reduce disaster risks and strengthen resilience. It is important to emphasize people's capacity to anticipate, cope with, resist and recover from disasters, rather than simply focusing on the vulnerability that limits them. The classifications are:

a) **Physical Capacity**

People whose houses have been destroyed by the cyclone or crops have been destroyed by the flood can salvage things from their homes and from their farms. Some family members have skills, which enable them to find employment if they migrate, either temporarily or permanently.

b) Socio-economic Capacity

Rich people have the capacity to recover soon because of their wealth. In fact, they are seldom hit by disasters because they live in safe areas and their houses are built with stronger materials. However, even when everything is destroyed, they have the capacity to cope up with it.

Hazards are always prevalent, but the hazard becomes a disaster only when there is greater vulnerability and less of capacity to cope with it. In other words the frequency or likelihood of a hazard and the vulnerability of the community increases the risk of being severely affected.

MITIGATION

Mitigation embraces measures taken to reduce both the effect of the hazard and the vulnerable conditions to it in order to reduce the scale of a future disaster. Therefore, mitigation activities can be focused on the hazard itself or the elements exposed to the threat. Examples of mitigation measures which are hazard specific include water management in drought prone areas, relocating people away from the hazard prone areas and by strengthening structures to reduce damage when a hazard occurs. In addition to these physical measures, mitigation should also aim at reducing the economic and social vulnerabilities of potential disasters.

a) Structural mitigation: Dams, windbreaks, terracing, hazard resistant buildings.
b) Non-structural mitigation: Education programs and policies, e.g., land-use, zoning, crop diversification, building codes, forecasting and warning.

DISASTER RESILIENCE

Disaster resilience is the ability of individuals, communities, organisations and states to adapt to and recover from hazards, shocks or stresses without compromising long-term prospects for development. Disaster resilience is determined by the degree to which individuals, communities and public and private organisations are capable of organizing themselves to learn from past disasters and reduce their risks to future ones, at international, regional, national and local levels.

The core elements of disaster resilience are as follows:

a) ***Context***: It deals with whose resilience is being built such as a social group, socio-economic or political system, environmental context or institution.
b) ***Disturbance***: These disturbances take two forms Stresses and Shocks.

c) ***Capacity To Respond***: The ability of a system or process to deal with a shock or stress depends on sensitivity and adaptive capacity. Sensitivity is the degree to which a system will be affected by, or will respond to, a given shock or stress. This can vary considerably for different factors within a system. For example, women accounted for up to 80% of those who died during the 2004 Indian Ocean tsunami, and death rates among women were almost four times higher than those among men in the 1991 Bangladesh cyclone. Limited mobility, skills set and social status exacerbated sensitivity to the shock. Adaptive capacity means how well the system can adjust to a disturbance or moderate damage, take advantage of opportunities and cope with the consequences of a transformation.

d) ***Reaction***: A range of responses are possible, including: bounce back better, where capacities are enhanced, exposures are reduced, and the system is more able to deal with future shocks and stresses; bounce back, where pre-existing conditions prevail; or recover, but worse than before, meaning capacities are reduced. In the worst-case scenario, the system collapses, leading to a catastrophic reduction in capacity to cope with the future.

Shocks

Shocks are sudden events that impact on the vulnerability of the system and its components. There are many different types of disaster-related shocks that can strike at different levels. These include disease outbreaks, weather-related and geophysical events including floods, high winds, landslides, droughts or earthquakes. There can also be conflict-related shock such as outbreaks of fighting or violence, or shocks related to economic volatility.

Stresses

Stresses are long-term trends that undermine the potential of a given system or process and increase the vulnerability. These can include natural resource degradation, loss of agricultural production, urbanisation, demographic changes, climate change, political instability and economic decline.

EARLY WARNING SYSTEM (EWS)

EWS is a socio-technical system designed to generate and circulate meaningful warning information in a timely manner to enable a target system take a proactive response to a hazardous threat in order to avoid disaster or reduce its impacts. The term 'socio-technical' because an early warning system comprises all the steps from detection of the threat, through communication to target community or people, to the ability of the target to understand and respond appropriately to the warning.

Disaster Preparedness

It consists of the knowledge and capacities of institutions, communities and individuals to effectively anticipate, respond to, and recover from the impacts of likely, imminent or active hazard events or conditions. Disaster Prevention: Disaster Prevention is the elimination or reduction of the likelihood of occurrence of natural hazard event, or their adverse impacts. Examples of disaster prevention actions include flood protection embankments. Disaster Mitigation: It refers to a set of measures to reduce or neutralise the impact of natural hazards by reducing social, functional, or physical vulnerability.

Disaster Response

Disaster response (relief) is the provision of assistance or intervention through the emergency services during or immediately after a crisis in order to save lives, reduce further impacts on health and public safety and to meet the basic subsistence needs of affected populations.

DAMAGE ASSESSMENT

Damage Assessment is the process for determining the nature and extent of the loss, suffering, and/or harm to the community resulting from a natural, accidental or human-caused disaster. Damages are normally classified as:

a) **Severe**: The target facility or object cannot be used for its intended purpose. Complete reconstruction is required.
b) **Moderate**: The target facility or object cannot be used effectively for its intended purpose unless major repairs are made.

c) **Light**: The target facility or object can be used for intended purpose but minor repairs would be necessary.

EMERGENCY

Emergency is a disruption of the functioning of society, causing human, material or environmental damages and losses which do not exceed the ability of the affected society to cope using only its own resources. Emergency is a situation in which normal operations cannot continue and immediate action is required so as to prevent a disaster. Example – forest fire, oil spills, road accidents, outbreak of epidemics etc.

When an emergency or a disaster affect a city or a region, efforts are conducted initially to care for the wounded, to restore lifelines and basic services, and subsequently to restore livelihoods and to reconstruct communities. Such efforts can be structured in three phases:

(i) **Response phase**: where activities such as search & rescue, rapid damage and needs assessments, and the provision of first aid are conducted; followed by the opening and management of temporary shelters for those left homeless as well as the provision of humanitarian assistance to those affected.

(ii) **Rehabilitation phase**: where basic services and lifelines are restored, even on a temporary basis, including the road network and other essential facilities including bridges, airports, ports and helicopter landing sites.

(iii) **Recovery phase**: where reconstruction efforts are carried out on the basis of a more precise assessment of damage and destruction of infrastructure. In addition, efforts are conducted to reconstruct infrastructure when needed and to restore the livelihoods of those affected.

CRISIS COUNSELLING

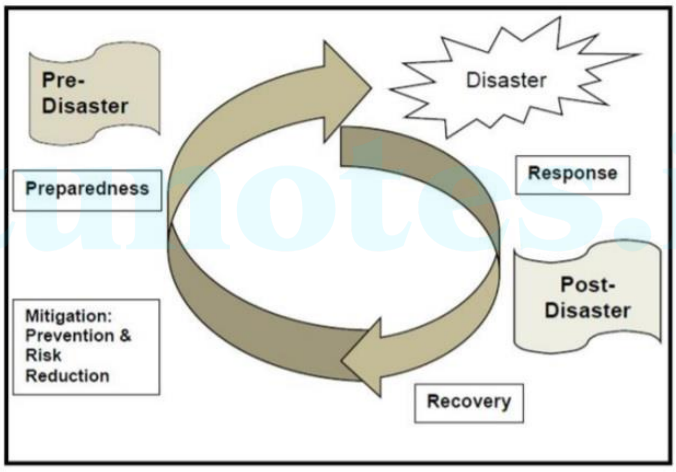
Crisis counselling is the process of alleviating the emotional and psychological disturbances of persons affected by disaster in order to restore a sense of control and mastery and to aid the process of recovery and reconstruction. Normally, disasters overwhelm the physical and psychological capacity of people to cope. This can lead to emotional and psychological disturbances which can affect a person's ability to make right decisions or adopt reasonable responsive actions. Crisis counselling addresses these problems and is a crucial part of ***recovery and reconstruction***.

NEEDS ASSESSMENT

Needs assessment is a process of estimating the financial, technical, and human resources needed to implement the agreed-upon programmes of recovery, reconstruction, and risk management. Post-damage needs assessment is normally a rapid, multi-sectoral assessment that measures the impact of disasters on the society, economy, and environment of the disaster-affected areas.

DISASTER MANAGEMENT CYCLE

Disaster Risk Management includes sum total of all activities, programs and measures which can be taken up before, during and after a disaster with the purpose to avoid a disaster, reduce its impact or recover from its losses.



The steps involved in Disaster management Cycle

The different approaches involved are:

a) ***Before A Disaster (Pre-Disaster):***

Activities taken to reduce human and property losses caused by a potential hazard. E.g.: Carrying out awareness campaigns, strengthening the existing weak structures, preparation of the disaster management plans at household and community level etc. Such risk reduction measures taken under this stage are termed as mitigation and preparedness activities.

b) ***During A Disaster (Disaster Occurrence)***:

Initiatives taken to ensure that the needs and provisions of victims are met and suffering is minimized. Activities taken in this stage are called emergency response activities.

c) ***After A Disaster (Post-Disaster)***:

Initiatives taken in response to a disaster with a purpose to achieve early recovery and rehabilitation of affected communities, immediately after a disaster strikes. These are called as response and recovery activities.