A LECTURE NOTE

ON

DISASTER MANAGEMENT

(TH-4)

By :- Pritiranjan Priyadarshi Patro

Sr. Lecturer in Civil Engineering

GOVERNMENT POLYTECHNIC, MALKANGIRI

At- Pradhaniguda

INTRODUCTION

Definitions:

Disaster:

The term disaster owes its origin to the French word “Desastre” which is a combination of two words ‘des’ meaning bad and ‘aster’ meaning star. Thus the term refers to ‘Bad or Evil star’.

- A disaster can be defined as “A serious disruption in the functioning of the community or a society causing wide spread material, economic, social or environmental losses which exceed the ability of the affected society to cope using its own resources”.
- A disaster is a result from the combination of hazard, vulnerability and 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. Any hazard – flood, earthquake or cyclone which is a triggering event along with greater vulnerability (inadequate access to resources, sick and old people, lack of awareness etc) would lead to disaster causing greater loss to life and property.

Hazards:

The word ‘hazard’ owes its origin to the word ‘hasard’ in old French and ‘az-zahr’ in Arabic meaning ‘chance’ or ‘luck’.

- Hazard may be defined as “a dangerous condition or event, that threat or have the potential for causing injury to life or damage to property or the environment.”
- Hazards can be grouped into two broad categories:
    1. Natural Hazard
    2. Manmade Hazard

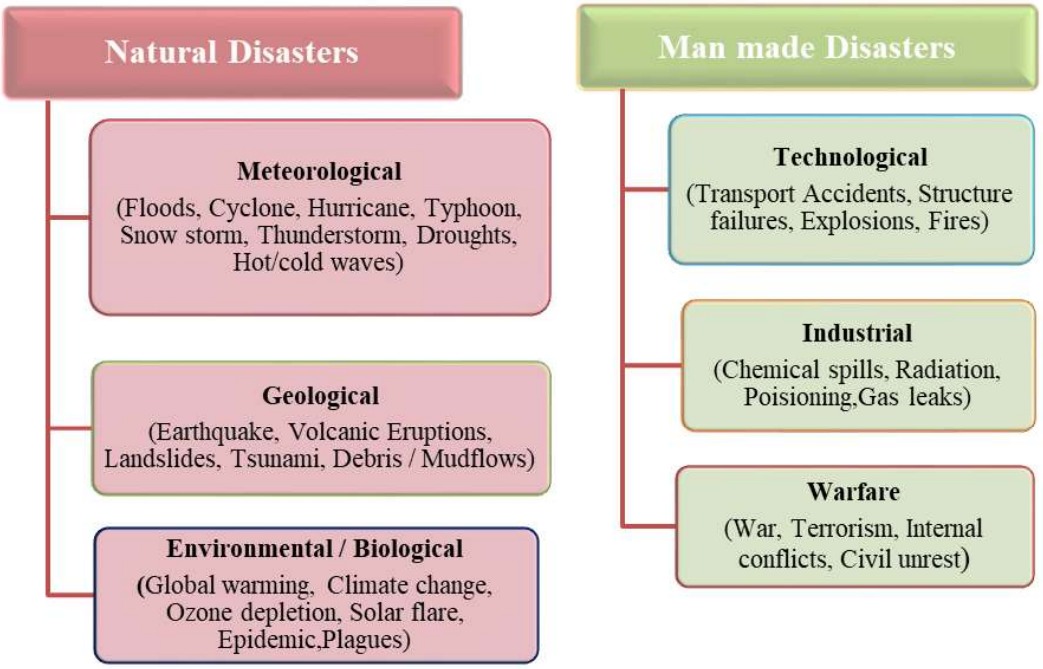
Natural hazards are hazards which are caused because of natural phenomena (hazards with meteorological, geological or even biological origin).

- 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.
- For example flooding may be caused because of heavy rains, landslide or blocking of drains with human waste.

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.

Various Types of Disasters:



Difference between Disaster and Hazard:

Difference between disaster and hazard?

Hazard	Disaster
A hazard is a situation where there is a threat to life, health, environment or property.	A disaster is an event that completely disrupts the normal ways of a community. It brings on human, economical, and environmental losses to the community which the community cannot bear on its own.
Hazard are occurred at the place which has less population	Disasters are mainly occurred at over populated area.
Hazard is caused by negligence	Disaster is a results of differential behavior of nature due to many conditions.
Hazards are natural or manmade phenomenon that are a feature of our planet and cannot be prevented.	These hazards are termed as disasters when they cause widespread destruction of property and human lives.
In their dormant state, hazards just pose a threat to life and property.	Once a hazard becomes active and is no longer just a threat, it becomes a disaster.

Vulnerability:

Vulnerability may be defined as “The extent to which a community, structure, services or geographic area is likely to be damaged or disrupted by the impact of particular hazard, on account of their nature, construction and proximity to hazardous terrains or a disaster prone area.”

Vulnerabilities can be categorized into:

1. Physical vulnerability
2. Socio-economic vulnerability

Physical Vulnerability: It includes notions of who and what may be damaged or destroyed by natural hazard such as earthquakes or floods. It is based on the physical condition of people and elements at risk, such as buildings, infrastructure etc; and their proximity, location and nature of the hazard. It also relates to the technical capability of building and structures to resist the forces acting upon them during a hazard event.

Socio-economic Vulnerability: The degree to which a population is affected by a hazard will not merely lie in the physical components of vulnerability but also on the socioeconomic conditions. The socio-economic condition of the people also determines the intensity of the impact. For example, people who are poor and living in the sea coast don’t have the money to construct strong concrete houses. They are generally at risk and lose their shelters whenever there is strong wind or cyclone. Because of their poverty they too are not able to rebuild their houses.

Capacity:

Capacity can be defined as “resources, means and strengths which exist in households and communities and which enable them to cope with, withstand, prepare for, prevent, mitigate or quickly recover from a disaster”.

Capacities could be:

1. Physical capacity
2. Socio-economic capacity

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.

Socio-economic Capacity: In most of the disasters, people suffer their greatest losses in the physical and material realm. 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.

Risk:

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.

Disaster Risk Reduction:

Disaster Risk Reduction can take place in the following ways:

1. **Preparedness:**
   This protective process embraces measures which enable governments, communities and individuals to respond rapidly to disaster situations to cope with them effectively. Preparedness includes the formulation of viable emergency plans, the development of warning systems, the maintenance of inventories and the training of personnel. It may also embrace search and rescue measures as well as evacuation plans for areas that may be at risk from a recurring disaster. Preparedness therefore encompasses those measures taken before a disaster event which are aimed at minimising loss of life, disruption of critical services, and damage when the disaster occurs.
2. **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.

Disaster Management Cycle:

Disaster Risk Management includes sum total of all activities, programmes 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 three key stages of activities that are taken up within disaster risk management are:

(i) Pre-disaster
(ii) Disaster occurrence
(iii) Post disaster

Pre-disaster (Before a disaster):

It includes the activities taken to reduce human and property losses caused by a potential hazard. For example 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.

Disaster occurrence (During a disaster):

It includes the initiatives taken to ensure that the needs and provisions of victims are met and suffering is minimized. Activities taken under this stage are called emergency response activities.

Post-disaster (After a disaster):

It includes the 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.

EARTHQUAKES

Definition:

Earthquake can be defined as the sudden shaking of the earth crust. It is one of the most destructive natural hazards. They may occur at any time of the year, day or night, with sudden impact and little warning.

Cause of Earthquake:

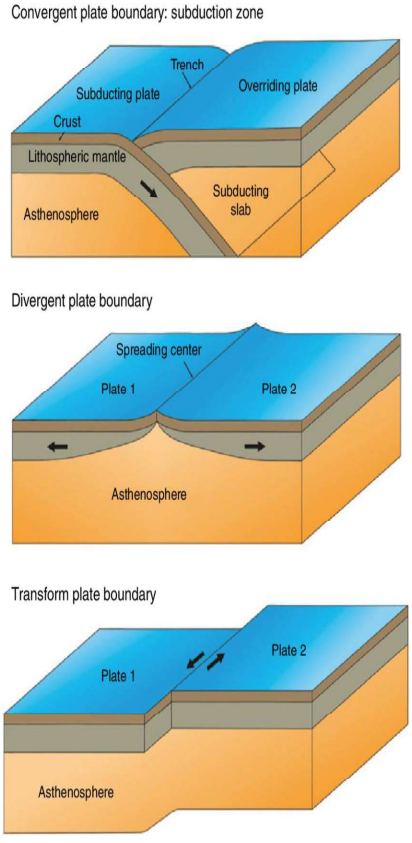
The earth's crust is a rocky layer of varying thickness ranging from a depth of about 10 kilometres under the sea to 65 kilometres under the continents. The crust is not one piece but consists of portions called 'plates' which vary in size from a few hundred to thousands of kilometres. The 'theory of plate tectonics' holds that the plates ride up on the more mobile mantle, and are driven by some yet unconfirmed mechanisms, perhaps thermal convection currents. When these plates contact each other, stress arises in the crust. These stresses can be classified according to the type of movement along the plate's boundaries:

a) Pulling away from each other,

b) Pushing against one another and

c) Sliding sideways relative to each other.

All these movements are associated with earthquakes.



Convergent - where crust is destroyed as one plate dives under another.

Divergent - where new crust is generated as the plates pull away from each other.

Transformational - where crust is neither produced nor destroyed as the plates slide horizontally past each other.

The areas of stress at plate boundaries which release accumulated energy by slipping or rupturing are known as 'faults'. The theory of 'elasticity' says that the crust is continuously stressed by the movement of the tectonic plates; it eventually reaches a point of maximum supportable strain. A rupture then occurs along the fault and the rock rebounds under its own elastic stresses until the strain is relieved. The fault rupture generates vibration called seismic (from the Greek 'seismos' meaning shock or earthquake) waves, which radiates from the focus in all directions. The point of rupture is called the 'focus' and may be located near the surface or deep below it. The point on the surface directly above the focus is termed as the 'epicentre' of the earthquake.

- Earthquakes can be of three types based on the focal depth:

  (i)Deep:- 300 to 700 kms from the earth surface

  (ii)Medium:- 60 to 300 kms

  (iii)Shallow: less than 60 kms

- The deep focus earthquakes are rarely destructive because by the time the waves reach the surface the impact reduces. Shallow focus earthquakes are more common and are extremely damaging because of their proximity to the surface.

Measurement of Earthquake:

Earthquakes can be described by the use of two distinctively different scales of measurement demonstrating magnitude and intensity.

- Earthquake magnitude or amount of energy released is determined by the use of a **seismograph**' which is an instrument that continuously records ground vibration. The scale was developed by a seismologist named Charles Richter. An earthquake with a magnitude 7.5 on the **Richter scale** releases 30 times the energy than one with 6.5 magnitudes. An earthquake of magnitude 3 is the smallest normally felt by humans. The largest earthquake that has been recorded with this system is 9.25 (Alaska, 1969 and Chile, 1960).
- The second type of scale, the earthquake intensity scale measures the effects of an earthquake where it occurs. The most widely used scale of this type was developed in 1902 by Mercalli an Italian seismologist. The scale was extended and modified to suit the modern times. It is called the **Modified Mercalli Scale,** which expresses the intensity of earthquake effect on people, structure and the earth's surface in values from I to XII. With an intensity of VI and below most of the people can feel the shake and there are cracks on the walls, but with an intensity of XII there is general panic with buildings collapsing totally and there is a total disruption in normal life.

Typical adverse effects:

- Damage occurs to human settlement, buildings, structures and infrastructure, especially bridges, elevated roads, railways, water towers, pipelines, electrical generating facilities.
- Aftershocks of an earthquake can cause much greater damage to already weakened structures.
- Secondary effects include fires, dam failure and landslides which may block water ways and also cause flooding.
- Damage may occur to facilities using or manufacturing dangerous materials resulting in possible chemical spills.
- There may also be a breakdown of communication facilities.
- There are large number of casualties because of the poor engineering design of the buildings and close proximity of the people. About 95 per cent of the people who are killed or who are affected by the earthquake is because of the building collapse.
- There is also a huge loss to the public health system, transport and communication and water supply in the affected areas.

Possible risk reduction measures:

Community preparedness: Community preparedness is vital for mitigating earthquake impact. The most effective way to save you even in a slightest shaking is 'DROP, COVER and HOLD'.

Planning: The Bureau of Indian Standards has published building codes and guidelines for safe construction of buildings against earthquakes. Before the buildings are constructed the building plans have to be checked by the Municipality, according to the laid down bylaws. Many existing lifeline buildings such as hospitals, schools and fire stations may not be built with earthquake safety measures. Their earthquake safety needs to be upgraded by retrofitting techniques.

Public education: Public education is educating the public on causes and characteristics of an earthquake and preparedness measures. It can be created through sensitization and training programme for community, architects, engineers, builders, masons, teachers, government functionaries teachers and students.

Engineered structures: Buildings need to be designed and constructed as per the building by laws to withstand ground shaking. Architectural and engineering inputs need to be put together to improve building design and construction practices. The soil type needs to be analyzed before construction. Building structures on soft soil should be avoided. Buildings on soft soil are more likely to get damaged even if the magnitude of the earthquake is not strong. Similar problems persist in the buildings constructed on the river banks which have alluvial soil.

TSUNAMI

Definition:

The term Tsunami has been derived from a Japanese term Tsu meaning 'harbor' and nami meaning 'waves'. Tsunamis are popularly called tidal waves but they actually have nothing to do with the tides. These waves which often affect distant shores, originate by rapid displacement of water from the lake or the sea either by seismic activity, landslides, volcanic eruptions or large meteoroid impacts. Whatever the cause may be sea water is displaced with a violent motion and swells up, ultimately surging over land with great destructive power.

Causes of Tsunami:

The geological movements that cause tsunamis are produced in three major ways.

Earthquake: The most common of these are fault movements on the sea floor, accompanied by an earth-quake. They release huge amount of energy and have the capacity to cross oceans. The degree of movement depends on how fast the earthquake occurs and how much water is displaced.

Landslide: The second most common cause of the tsunami is a landslide either occurring under water or originating above the sea and then plunging into the water. The largest tsunami ever produced by a landslide was in Lituya Bay, Alaska 1958. The massive rock slide produced a wave that reached a high water mark of 50 - 150 meters above the shoreline.

Volcano: The third major cause of tsunami is volcanic activity. The flank of a volcano located near the shore or under water may be uplifted or depressed similar to the action of a fault, or, the volcano may actually explode. In 1883, the violent explosion of the famous volcano, Krakotoa in Indonesia, produced tsunami measuring 40 meters which crushed upon Java and Sumatra. Over 36,000 people lost their lives in this tyrant waves.

Predictability:

There are two distinct types of tsunami warning:

a) International tsunami warning systems and

b) Regional warning systems.

- **International Tsunami Warning Systems**: Shortly after the Hilo Tsunami (1946), the Pacific Tsunami Warning System (PTWS) was developed with its operational center at the Pacific Tsunami Warning Center (PTWC) near Honolulu, Hawaii. The PTWC is able to alert countries several hours before the tsunami strikes. The warning includes predicted arrival time at selected coastal communities where the tsunami could travel in few hours. A tsunami watch is issued with subsequent arrival time to other geographic areas.

- **Regional Warning Systems** usually use seismic data about nearby earthquakes to determine if there is a possible local threat of a tsunami. Such systems are capable enough to provide warnings to the general public in less than 15 minutes. In India, the Survey of India maintains a tide gauge network along the coast of India. The day-to-day maintenance of the gauge is carried with the assistance from authorities of the ports. Apart from the tide gauge, tsunami can be detected with the help of radars. The 2004 Indian Ocean tsunami, recorded data from four radars and recorded the height of tsunami waves two hours after the earthquake. It should be noted that the satellites observations of the Indian Ocean tsunami would not have been of any use in delivering warnings, as the data took five hours to process and it was pure chance that the satellites were overhead at that time. However, in future it is possible that the space-based observation might play a direct role in tsunami warning.

Typical adverse effects:

- Local tsunami events or those less than 30 minutes from the source cause the majority of damage. The force of the water can raze everything in its path.
- It is normally the flooding affect of the tsunami that causes major destruction to the human settlements, roads and infrastructure thereby disrupting the normal functioning of the society.
- As the waves withdraw towards the ocean they sweep out the foundations of the buildings, the beaches get destroyed and the houses carried out to sea.
- Damage to ports and airports may prevent importation of needed food and medical supplies.
- Apart from the physical damage, there is a huge impact on the public health system.
- Deaths mainly occur because of drowning as water inundates homes. Many people get washed away or crushed by the giant waves and some are crushed by the debris, causes.
- Availability of drinking water has always been a major problem in areas affected by a disaster.
- Sewage pipes may be damaged causing major sewage disposal problems.
- Open wells and other ground water may be contaminated by salt water and debris and sewage.
- Flooding in the locality may lead to crop loss, loss of livelihood like boats and nets, environmental degradation etc.

Possible risk reduction measures:

In certain tsunami prone countries some measures have been taken to reduce the damage caused on shore. Japan has implemented an extensive programme of building tsunami walls of up to 4.5m (13.5 ft) high in front of populated coastal areas. Other localities have built flood gates and channels to redirect the water from incoming tsunamis. However,framed structures in the area. The wall may have succeeded in slowing down and moderating the height of the tsunami but it did not prevent major destruction and loss of life.

Site Planning and Land Management:

Site planning determines the location, configuration, and density of development on particular sites and is, therefore, an important tool in reducing tsunami risk.

- The designation and zoning of tsunami hazard areas for such open-space uses as agriculture, parks and recreation, or natural hazard areas is recommended as the first land use planning strategy. This strategy is designed to keep development at a minimum in hazard areas.
- In areas where it is not feasible to restrict land to open-space uses, other land use planning measures can be used. These include strategically controlling the type of development and uses allowed in hazard areas, and avoiding high-value and high occupancy uses to the greatest degree possible.

Engineering structures:

Most of the habitation of the fishing community is seen in the coastal areas. The houses constructed by them are mainly of light weight materials without any engineering inputs. Therefore there is an urgent need to educate the community about the good construction practices that they should adopt such as:

- Site selection – Avoid building or living in buildings within several hundred feet of the coastline as these areas are more likely to experience damage from tsunamis.
- Construct the structure on a higher ground level with respect to mean sea level.
- Elevate coastal homes: Most tsunami waves are less than 3 meters in height. Elevating house will help reduce damage to property from most tsunamis.
- Construction of water breakers to reduce the velocity of waves.
- Use of water and corrosion resistant materials for construction.
- Construction of community halls at higher locations, which can act as shelters at the time of a disaster.

Flood management:

Flooding will result from a tsunami. Tsunami waves will flood the coastal areas. Flood mitigation measures could be incorporated.

CYCLONES

Definition:

Cyclone is a region of low atmospheric pressure surrounded by high atmospheric pressure resulting in swirling atmospheric disturbance accompanied by powerful winds blowing in anticlockwise direction in the Northern Hemisphere and in the clockwise direction in the Southern Hemisphere. They occur mainly in the tropical and temperate regions of the world.

Cyclones are known by different names in different parts of the world:

- **Typhoons** in the Northwest Pacific Ocean west of the dateline
- **Hurricanes** in the North Atlantic Ocean, the Northeast Pacific Ocean east of the dateline, or the South Pacific Ocean.
- **Tropical cyclones** -the Southwest Pacific Ocean and Southeast Indian Ocean.
- **Severe cyclonic storm"** (the North Indian Ocean)
- **Tropical cyclone** (the Southwest Indian Ocean)
- **Willie-Willie** in Australia
- **Tornado** in South America

General Characteristics:

Cyclones in India are moderate in nature. Some of the general characteristics of a cyclone are:

1. Strong winds

2. Exceptional rain

3. Storm surge

The development of a cyclone covers three stages namely

(a) Formation and initial development state:

Four atmospheric/ oceanic conditions are necessary for the formation of a cyclone:

- A warm sea temperature in excess of 26 degree centigrade, to a depth of 60 meters, which provides abundant water vapour in the air by evaporation.
- High relative humidity (degree to which the air is saturated by water vapor) of the atmosphere to a height of about 7000 meters, facilitates condensation of water vapor into droplets and clouds, releases heat energy and induces drop in pressure.

- Atmospheric instability (an above average decrease of temperature with altitude) encourages considerable vertical cumulus cloud convection when condensation of rising air occurs.
- A location of at least 4-5 latitude degrees from the Equator allow the influence of the force due to the earth's rotation (Coriolis force) to take effect in inducing cyclonic wind circulation around low pressure centers.

(b) **Fully matured:**

The main feature of a fully mature tropical cyclone is a spiral pattern of highly turbulent giant cumulus thundercloud bands. These bands spiral inwards and form a dense highly active central cloud core which raps around a relatively calm zone. This is called the "eye" of a cyclone. The eye looks like a black hole or a dot surrounded by thick clouds. The outer circumference of the thick cloud is called the 'eye wall'.

(c) Weakening or decay:

A tropical cyclone begins to weaken as soon as its source of warm moist air is abruptly cut off. This is possible when the cyclone hits the land, on the cyclone moves to a higher altitude or when there is the interference of another low pressure.

Indian Hazard Zones:

The 7516.6 kilometres long Indian coastline is the earth's most cyclone battered stretch of the world. Around 8 per cent of the total land area in India is prone to cyclones. About two-third of the cyclones that occur in the Indian coastline occur in the Bay of Bengal. The states which are generally affected in the east coast are West-Bengal, Orissa, Andhra Pradesh, Tamil Nadu and on the west coast Gujarat, Maharashtra, Goa, Karnataka and Kerala.

Warning:

- Low pressure and the development can be detected hours or days before it causes damage.
- The satellites track the movement of these cyclones based on which the people are evacuated from areas lively to be affected. It is difficult to predict the accuracy.
- Accurate landfall predictions can give only a few hours' notice to threatened population.
- India has one of the best cyclone warning systems in the world. The India Meteorological Department (IMD) is the nodal department for wind detection, tracking and forecasting cyclones.
- Cyclone tracking is done through INSAT satellite.
- Cyclone warning is disseminated by several means such as satellite based disaster warning systems, radio, television, telephone, fax, high priority telegram, public announcements and bulletins in press. These warnings are disseminated to the general public, the fishing community especially those in the sea, port authorities, commercial aviation and the government machinery.

Typical Adverse effects:

High winds cause major damage to infrastructure and housing, in particular fragile constructions. They are generally followed by heavy rains and floods and, in flat coastal areas by storm surge riding on tidal waves and inundating the land over long distances of even up to 15 kilometres inland.

Physical damage: structures will be damaged or destroyed by the wind force, flooding and storm surge. Light pitched roofs of most structures especially the ones fitted on to industrial buildings will suffer severe damage.

Casualties and public health: caused by flooding and flying elements, contamination of water supplies may lead to viral outbreaks, diarrhoea, and malaria.

Water supplies: Ground and pipe water supply may get contaminated by flood waters. Crops and food supplies – high winds and rains ruin the standing crop and food stock lying in low lying areas. Plantation type crops such as banana and coconut are extremely vulnerable. Salt from the sea water may get deposited on the agricultural land and increase the salinity. The loss of the crop may lead to acute food shortage.

Communication: severe disruption in the communication links as the wind may bring down the electricity and communication towers, telephone poles, telephone lines, antennas and satellite disk and broadcasting services. Transport lines (road and rail) may be curtailed, Lack of proper communication affects effective distribution of relief materials.

Possible Risk Reduction Measures:

Coastal belt plantation - Green belt plantation along the coastal line in a scientific interweaving pattern can reduce the effect of the hazard. Providing a cover through green belt sustains less damage. Forests act as a wide buffer zone against strong winds and flash floods. Without the forest the cyclone travel freely inland. The lack of protective forest cover allows water to inundate large areas and cause destruction. With the loss of the forest cover each consecutive cyclone can penetrate further inland.

Hazard mapping – Meteorological records of the wind speed and the directions give the probability of the winds in the region. Cyclones can be predicted several days in advance. The onset is extensive and often very destructive. Past records and paths can give the pattern of occurrence for particular wind speeds. A hazard map will illustrate the areas vulnerable to cyclone in any given year. It will be useful to estimate the severity of the cyclone and various damage intensities in the region. The map is prepared with data inputs of past climatological records, history of wind speed, frequency of flooding etc.

Land use control designed so that least critical activities are placed in vulnerable areas. Location of settlements in the floodplains is at utmost risk. Sitting of key facilities must be marked in the land use. Policies should be in place to regulate land use and building codes should be enforced.

Engineered structures – structures need to be built to withstand wind forces. Good site selection is also important. Majority of the buildings in coastal areas are built with locally available materials and have no engineering inputs. Good construction practice should be adopted such as: -

- Cyclonic wind storms inundate the coastal areas. It is advised to construct on stilts or on earth mound.
- Houses can be strengthened to resist wind and flood damage. All elements holding the structures need to be properly anchored to resist the uplift or flying off of the objects. For example, avoid large overhangs of roofs, and the projections should be tied down.
- A row of planted trees will act as a shield. It reduces the energy.
- Buildings should be wind and water resistant.
- Buildings storing food supplies must be protected against the winds and water.
- Protect river embankments.
- Communication lines should be installed underground.
- Provide strong halls for community shelter in vulnerable locations.

Flood management – Torrential rains, strong wind and storm range leads to flooding in the cyclone affected areas. There are possibilities of landslides too. Flood mitigation measures could be incorporated

Improving vegetation cover – The roots of the plants and trees keep the soil intact and prevent erosion and slow runoff to prevent or lessen flooding. The use of tree planted in rows will act as a windbreak. Coastal shelterbelt plantations can be developed to break severe wind speeds. It minimizes devastating effects. The Orissa calamity has also highlighted the need for urgent measures like shelterbelt plantation along cyclone-prone coastal areas. Species chosen for this purpose should not only be able to withstand the impact of strong cyclonic winds, but also check soil erosion.

FLOODS

Definition:

Flood is a state of high water level along a river channel or on the coast that leads to inundation of land, which is not usually submerged. Floods may happen gradually and also may take hours or even happen suddenly without any warning due to breach in the embankment, spill over, heavy rains etc.

Causes of Floods:

- Heavy rainfall
- Heavy siltation of the river bed reduces the water carrying capacity of the rivers/stream.
- Blockages in the drains lead to flooding of the area.
- Landslides blocking the flow of the stream.
- Construction of dams and reservoirs
- In areas prone to cyclone, strong winds accompanied by heavy down pour along with storm surge leads to flooding.

Indian Hazard Zones:

Floods occur in almost all the river basins of the country. Around 12 per cent (40 million hectare) of land in India is prone to floods. Most of the flood affected areas lie in the Ganga basin, Brahmaputra basin (comprising of Barak, Tista, Torsa,Subansiri, Sankosh, Dihang and Luhit), the northwestern river basin (comprising Jhelum, Chenab, Ravi, Sutlej, Beas and the Ghagra), peninsular river basin (Tapti, Narmada, Mahanadi, Baitarani, Godavari, krishna, Pennar and the Kaveri) and the coastal regions of Andhra Pradesh, Tamilnadu, orissa and Kerela. Assam, Uttar Pradesh, Bihar and Orissa are some of the states who have been severely prone to floods. Our country receives an annual rainfall of 1200 mm, 85% of which is concentrated in 3-4 months i.e June to September. Due to the intense and periodic rain, most of the rivers of the country are fed with huge quantity of water, much beyond their carrying capacity.

Warning:

- With the advancement of technology such as satellite and remote-sensing equipments flood waves can be tracked as the water level rises.
- Heavy precipitation will give sufficient warning of the coming river flood.
- High tides with high winds may indicate flooding in the coastal areas.
- Evacuation is possible with suitable monitoring and warning. Warning is issued by the Central Water Commission (CWC), Irrigation & Flood Control Department, and Water Resources Department.CWC maintains close liaison with the administrative and state engineering agencies, local civil authorities to communicate advance warning for appropriate mitigation and preparedness measures.

Typical Adverse Effects:

- The most important consequence of floods is the loss of life and property.
- Structures like houses, bridges; roads etc. get damaged by the gushing water, landslides triggered on account of water getting saturated, boats and fishing nets get damaged. There is huge loss to life and livestock caused by drowning.
- Lack of proper drinking water facilities, contamination of water (well, ground water, piped water supply) leads to outbreak of epidemics, diarrhoea, viral infection, malaria and many other infectious diseases.
- Flooding also leads to a large area of agricultural land getting inundated as a result there is a huge crop loss. This results in shortage of food, and animal fodder.
- Floods may also affect the soil characteristics. The land may be rendered infertile due to erosion of top layer or may turn saline if sea water floods the area.

Possible Risk Reduction Measures:

Mapping of the flood prone areas is a primary step involved in reducing the risk of the region. Historical records give the indication of the flood inundation areas and the period of occurrence and the extent of the coverage. Warning can be issued looking into the earlier marked heights of the water levels in case of potential threat. In the coastal areas the tide levels and the land characteristics will determine the submergence areas. Flood hazard mapping will give the proper indication of water flow during floods.

Land use control will reduce danger of life and property when waters inundate the flood plains and the coastal areas. The number of casualties is related to the population in the area at risk. In areas where people already have built their settlements, measures should be taken to relocate to better sites so as to reduce vulnerability. No major development should be permitted in the areas which are subjected to high flooding. Important facilities like hospitals, schools should be built in safe areas. In urban areas, water holding areas can be created like ponds, lakes or low-lying areas.

Construction of engineered structures in the flood plains and strengthening of structures to withstand flood forces and seepage. The buildings should be constructed on an elevated area. If necessary build on stilts or platform.

Flood Control aims to reduce flood damage. This can be done by decreasing the amount of runoff with the help of reforestation, protection of vegetation, clearing of debris from streams and other water holding areas, conservation of ponds and lakes etc. Flood Diversion include levees, embankments, dams and channel improvement. Dams can store water and can release water at a manageable rate. Flood Proofing reduces the risk of damage. Measures include use of sand bags to keep flood water away, blocking or sealing of doors and windows of houses etc. Houses may be elevated by building on raised land. Buildings should be constructed away from water bodies.

Flood Management In India, systematic planning for flood management commenced with the Five Year Plans, particularly with the launching of National Programme of Flood Management in 1954. Structural measures include, storage reservoirs flood embankments, drainage channels, anti erosion works, channel improvement works, detention basins etc. and non-structural measures include flood forecasting, flood plain zoning, flood proofing, disaster preparedness etc. The flood management measures undertaken so far have provided reasonable degree of protection to an area of 15.81 million hectares throughout the country.

DROUGHTS

Definition:

Drought is either absence or deficiency of rainfall from its normal pattern in a region for an extended period of time leading to general suffering in the society. It is interplay between demand that people place on natural supply of water and natural event that provides the water in a given geographical region.

- It is a slow on-set disaster and it is difficult to demarcate the time of its onset and the end.
- Any unusual dry period which results in a shortage of useful water.
- Drought is a normal, recurrent feature of climate. Climate is expected to show some aberrations and drought is just a part of it.
- Drought can occur by improper distribution of rain in time and space, and not just by its amount.
- Drought is negative balance between precipitation and water use (through evaporation, transpiration by plants, domestic and industrial uses etc) in a geographical region.

Causes of Droughts:

- Deficit rainfall
- Over population
- Over grazing
- Deforestation
- Soil erosion
- Excessive use of ground and surface water for growing crops
- Loss of biodiversity

Types of droughts:

Drought proceeds in sequential manner. Its impacts are spread across different domains as listed below.

Meteorological drought:

Meteorological drought is simple absence/deficit of rainfall from the normal. It is the least severe form of drought and is often identified by sunny days and hot weather.

Hydrological drought:

Hydrological drought often leads to reduction of natural stream flows or ground water levels, plus stored water supplies. The main impact is on water resource systems.

Agricultural drought:

This form of drought occurs when moisture level in soil is insufficient to maintain average crop yields. Initial consequences are in the reduced seasonal output of crops and other related production. An extreme agricultural drought can lead to a famine, which is a prolonged shortage of food in a restricted region causing widespread disease and death from starvation.

Socio-economic drought:

Socio-economic drought correlates the supply and demand of goods and services with the three above-mentioned types of drought. When the supply of some goods or services such as water and electricity are weather dependant then drought may cause shortages in supply of these economic goods.

Elements at Risk:

In general, all those elements that are primarily dependent on water are most affected.

- It affects the rain fed crops and then slowly creeps into the irrigated crops.
- People who are dependent on agriculture and areas where the other livelihood opportunities are least developed are greatly affected.
- The herdsman, landless labourer, subsistence farmers, women, children and farm animals are the most vulnerable groups.

Distribution Pattern in India:

- Around 68 per cent of India's total area is drought prone to drought.
- 315 out of a total of 725 Talukas in 99 districts are drought prone.
- 50 million people are annually affected by drought.
- In 2001 more than eight states suffered the impact of severe drought.
- In 2003 most parts of Rajasthan experienced the fourth consecutive year of drought.

Typical adverse effects:

- As the meteorological drought turns into hydrological drought, the impacts start appearing first in agriculture which is most dependants on the soil moisture.
- Irrigated areas are affected much later than the rain fed areas.
- However, regions surrounding perennial rivers tend to continue normal life even when drought conditions are prevailing around. The impacts slowly spread into social fabric as the availability of drinking water diminishes, reduction in energy production, ground water depletion, food shortage, health reduction and loss of life, increased poverty, reduced quality of life and social unrest leading to migration.

Possible Risk Reduction Measures:

There are various mitigation strategies to cope up with drought.

Public Awareness and education: If the community is aware of the dos and don'ts, then half of the problem is solved. This includes awareness on the availability of safe drinking water, water conservation techniques, agricultural drought management strategies like crop contingency plans, construction of rain water harvesting structure. Awareness can be generated by the print, electronic and folk media.

Drought Monitoring: It is continuous observation of the rainfall situation, availability of water in the reservoirs, lakes, rivers etc and comparing with the existing water needs in various sectors of the society.

Water supply augmentation and conservation through rainwater harvesting in houses and farmers' fields increases the content of water available. Water harvesting by either allowing the runoff water from all the fields to a common point (e.g. Farm ponds) or allowing it to infiltrate into the soil where it has fallen (in situ) (e.g. contour bunds, contour cultivation, raised bed planting etc) helps increase water availability for sustained agricultural production.

Expansion of irrigation facilities reduces the drought vulnerability.

Land use based on its capability helps in optimum use of land and water and can avoid the undue demand created due to their misuse.

Livelihood planning identifies those livelihoods which are least affected by the drought. Some of such livelihoods include increased off-farm employment opportunities, collection of non-timber forest produce from the community forests, raising goats, carpentry etc.

Drought planning: the basic goal of drought planning is to improve the effectiveness of preparedness and response efforts by enhancing monitoring, mitigation and response measures.

- Planning would help in effective coordination among state and national agencies in dealing with the drought. Components of drought plan include establishing drought taskforce which is a team of specialists who can advise the government in taking decision to deal with drought situation, establishing coordination mechanism among various agencies which deal with the droughts, providing crop insurance schemes to the farmers to cope with the drought related crop losses, and public awareness generation.

LANDSLIDES

Definition :

The term 'landslide' includes all varieties of mass movements of hill slopes and can be defined as the downward and outward movement of slope forming materials composed of rocks, soils, artificial fills or combination of all these materials along surfaces of separation by falling, sliding and flowing, either slowly or quickly from one place to another.

Causes of Landslides:

There are several causes of landslide. Some of the major causes are as follows:

- **Geological Weak material:** Weakness in the composition and structure of rock or soil may also cause landslides.
- **Erosion:** Erosion of slope toe due to cutting down of vegetation, construction of roads might increase the vulnerability of the terrain to slide down.
- **Intense rainfall:** Storms that produce intense rainfall for periods as short as several hours or have a more moderate intensity lasting several days have triggered abundant landslides. Heavy melting of snow in the hilly terrains also results in landslide.
- **Human Excavation** of slope and its toe, loading of slope/toe, draw down in reservoir, mining, deforestation, irrigation, vibration/blast, Water leakage from services.
- **Earthquake shaking** has triggered landslides in many different topographic and geologic settings. Rock falls, soil slides and rockslides from steep slopes involving relatively thin or shallow disaggregated soils or rock, or both have been the most abundant types of landslides triggered by historical earthquakes.
- **Volcanic eruption:** Deposition of loose volcanic ash on hillsides commonly is followed by accelerated erosion and frequent mud or debris flows triggered by intense rainfall.

Distribution Pattern in India:

Landslides constitute a major natural hazard in our country, which accounts for considerable loss of life and damage to communication routes, human settlements, agricultural fields and forest lands. The Indian subcontinent, with diverse physiographic, seismic, tectonic and climatological conditions is subjected to varying degree of landslide hazards; the Himalayas including North-eastern mountains ranges being the worst affected, followed by a section of Western Ghats and the Vindhyas. Removal of vegetation and toe erosion has also triggered slides. Torrential rainfall on the deforested slopes is the main factor in the Peninsular India namely in Western Ghats and Nilgiris.

Typical Adverse Effects of Landslides:

- The most common elements at risk are the settlements built on the steep slopes, built at the toe and those built at the mouth of the streams emerging from the mountain valley.
- All those buildings constructed without appropriate foundation for a given soil and in sloppy areas are also at risk.
- Roads, communication lines are vulnerable.

Possible risk reduction measures:

Hazard mapping locates areas prone to slope failures. This will help to avoid building settlements in such areas. These maps will also serve as a tool for mitigation planning.

Land use practices such as:

- Areas covered by degraded natural vegetation in upper slopes are to be afforested with suitable species. Existing patches of natural vegetation (forest and natural grass land) in good condition, should be preserved
- Any developmental activity initiated in the area should be taken up only after a detailed study of the region has been carried out.
- In construction of roads, irrigation canals etc. proper care is to be taken to avoid blockage of natural drainage
- Total avoidance of settlement in the risk zone should be made mandatory.
- Relocate settlements and infrastructure that fall in the possible path of the landslide
- No construction of buildings in areas beyond a certain degree of slope

Retaining Walls can be built to stop land from slipping (these walls are commonly seen along roads in hill stations). These are constructed to prevent smaller sized and secondary landslides that often occur along the toe portion of the larger landslides.

Surface Drainage Control Works: The surface drainage control works are implemented to control the movement of landslides accompanied by infiltration of rain water and spring flows.

Engineered structures with strong foundations can withstand or take the ground movement forces. Underground installations (pipes, cables, etc.) should be made flexible to move in order to withstand forces caused by the landslide

Increasing vegetation cover is the cheapest and most effective way of arresting landslides. This helps to bind the top layer of the soil with layers below, while preventing excessive run-off and soil erosion.

Insurance will assist individuals whose homes are likely to be damaged by landslides or by any other natural hazards.

FOREST FIRES

Definition:

The most common hazard in forests is forests fire. Forests fires are as old as the forests themselves. They pose a threat not only to the forest wealth but also to the entire regime to fauna and flora seriously disturbing the bio-diversity and the ecology and environment of a region. During summer, when there is no rain for months, the forests become littered with dry senescent leaves and twinges, which could burst into flames ignited by the slightest spark. The Himalayan forests, particularly, Garhwali Himalayas have been burning regularly during the last few summers, with colossal loss of vegetation cover of that region. Forest fire causes imbalances in nature and endangers biodiversity by reducing faunal and floral wealth. Traditional methods of fire prevention are not proving effective and it is now essential to raise public awareness on the matter, particularly among those people who live close to or in forested areas.

Causes of Forest Fires:

- **Natural causes-** Many forest fires start from natural causes such as lightning which set trees on fire. However, rain extinguishes such fires without causing much damage. High atmospheric temperatures and dryness (low humidity) offer favorable circumstance for a fire to start.
- **Man made causes-** Fire is caused when a source of fire like naked flame, cigarette or bidi, electric spark or any source of ignition comes into contact with inflammable material.

Causes of forest fire can be categorized into two groups:

(i) Environmental causes(which are beyond control)
(ii) Human related causes (which are controllable)

Environmental causes: These are largely related to climatic conditions such as temperature, wind speed and direction, level of moisture in soil and atmosphere and duration of dry spells. Other natural causes are the friction of bamboos swaying due to high wind velocity and rolling stones that result in sparks setting off fires in highly inflammable leaf litter on the forest floor.

Human related causes: These result from human activity as well as methods of forest management. These can be intentional or unintentional, for example:

- graziers and gatherers of various forest products starting small fires to obtain good grazing grass as well as to facilitate gathering of minor forest produce like flowers of *Madhuca indica* and leaves of *Diospyros melanoxylon*
- the use of fires by villagers to ward off wild animals
- fires lit intentionally by people living around forests for recreation
- fires started accidentally by careless visitors to forests who discard cigarette butts.

The causes of forest fire have been increasing rapidly. The problem has been accentuated by the growing human and cattle population. People enter forests even more frequently to graze cattle, collect fuel wood, timber and other minor forest products. It has been estimated that 90% of forest fires in India are man-made.

Adverse Effects of Forest Fires:

Fires are a major cause of forest degradation and have wide ranging adverse ecological, economic and social impacts, including:

- Loss of valuable timber resources
- Degradation of catchment areas
- Loss of biodiversity and extinction of plants and animals
- Loss of wildlife habitat and depletion of wildlife
- Loss of natural regeneration and reduction in forest cover
- Global warming
- Loss of carbon sink resource and increase in percentage of CO_2 in atmosphere
- Change in the microclimate of the area with unhealthy living conditions
- Soil erosion affecting productivity of soils and production
- Ozone layer depletion
- Health problems leading to diseases
- Loss of livelihood for tribal people and the rural poor, as approximately 300 million people are directly dependent upon collection of non-timber forest products from forest areas for their livelihood.

The Need of Fire Management:

The incidence of forest fires in the country is on the increase and more area is burned each year. The major cause of this failure is the piecemeal approach to the problem. Both the national focus and the technical resources required for sustaining a systematic forest fire management programs are lacking in the country. Important forest fire management elements like strategic fire centres, coordination among Ministries, funding, human resource development, fire research, fire management, and extension programs are missing. Taking into consideration the serious nature of the problem, it is necessary to make some major improvements in the forest fire management strategy for the country. The Ministry of Environment and Forests, Government of India, has prepared a National Master Plan for Forest Fire Control. This plan proposes to introduce a well-coordinated and integrated fire-management program that includes the following components:

- Prevention of human-caused fires through education and environmental modification. It will include cultural activities, engineering works, people participation, and education and enforcement. It is proposed that more emphasis be given to people participation through Joint Forest Fire Management for fire prevention.
- Prompt detection of fires through a well coordinated network of observation points, efficient ground patrolling, and communication networks. Remote sensing technology is to be given due importance in fire detection. For successful fire management and administration, a National Fire Danger Rating System (NFDRS) and Fire Forecasting System are to be developed in the country.
- Fast initial attack measures.
- Vigorous follow up action.
- Introducing a forest fuel modification system at strategic points.
- Fire fighting resources.

Each of the above components plays an important role in the success of the entire system of fire management. Special emphasis is to be given to research, training, and development.

INDUSTRIAL HAZARDS

Definitions:

Industrial hazard may be defined as any condition produced by industries that may cause injury or death to personnel or loss of product or property.

Types of Industrial hazards:

1. Mechanical hazards
2. Electrical hazards
3. Chemical hazards
4. Fire hazards
5. Dust hazards
6. Accident records

1. Mechanical Hazards:

A mechanical hazard is involving a machine or process. Motor vehicles and air bags pose mechanical hazards. Compressed gases or liquids can also be considered a mechanical hazard.

Causes of Mechanical Hazards:

- It occurs when a machine is malfunctioning.
- Machines may run either manually or automatically.
- A few machines are cutting, shearing, crushing, breaking.
- Most injuries occur when the machine needs human intervention repeatedly for its proper functioning.
- The machines are driven by a suitable power supply (electricity or steam).

Preventions of Mechanical Hazards:

- **Prevent contact:** The safeguard must prevent hands, arms, or any part of a worker's body from making contact with dangerous moving parts.
- **Secure:** Workers should not be able to easily remove with the safeguard. Guards and safety devices should be made of durable material that will withstand the conditions of normal use.
- **Protect from falling objects:** The safeguard should ensure that no objects can fall into moving parts. A small tool which is dropped into a cycling machine could easily become a projectile that could strike and injure someone.
- **Create no interference:** Proper safeguarding can actually enhance efficiency, since workers will not be afraid of injuries then.
- **Allow safe lubrication:** If possible, one should be able to lubricate the machine without removing the safeguards. Locating oil reservoirs outside of the guard, with a line leading to the lubrication point, will reduce the need for the operator or maintenance worker to enter the hazardous area.

2. Electrical Hazards:

Shock is one of the common electrical hazards. It occurs when the electric current passes through the body. This is possible when human is in contact with a conductor carrying a current and simultaneously in contact with the ground. This is referred to as SHORT CIRCUIT .

Causes of Electrical Hazards:

Different sources of electrical hazards are short circuit, electrostatic hazards and explosive materials.

A worker will receive a shock when he/she:

- Touches two wires at different voltages at the same time.
- Touches the phase standing on the ground
- Touches the phase having wet cloth and high humidity.
- Receive a shock from electrical components those are not grounded properly.
- Touching another person receiving an electrical shock.

Preventions of Electrical Hazards:

- Power equipment should be plugged into wall receptacles with power switches in the off position.
- Electrical equipment should be unplugged by grasping the plug and pulling. Never pull or jerk the cord to unplug the equipment.
- Frayed, cracked or exposed wiring on equipment cords must be corrected. Also check for defective cord clamps at locations where the power cord enters the equipment or the attachment plug.
- Temporary or permanent storage of materials must not be allowed within 3 feet of electrical equipment.
- Any electrical equipment causing shocks or which has high leakage potential must be tagged with a DANGER—DO NOT USE label or equivalent

3. Chemical Hazards:

Chemical hazards are systems where chemical accidents could occur under certain circumstances. Such events include fires, explosions, leakages or release of toxic or hazardous materials that can cause people illness, injury, or disability. Chemical accident means an accident involving a fortuitous, or sudden or unintended occurrence while handling any hazardous chemicals resulting in continuous, intermittent or repeated exposure to death, or injury to, any person or damage to any property but does not include an accident by reason only of war or radio-activity.

Causes of Chemical Hazards:

- Solvents used in extraction plants, purification of synthetic drugs and in chemical analysis may produce vapours.
  This vapours or gases may produce:
  - Breathing problem and suffocation to worker.
  - Irritation or burn to eye or skin of the worker.
  - Explosion in the work place.
  - General anaesthesia or death e.g. chloroforms and ether vapour

- Liquid chemicals if spilled on workers may produce
  - Dehydration by strong dehydrating agents e.g. concentrated sulphuric acid.
  - Burning by strong acid or alkalis.
  - Oxidation by strong oxidizing agents.

- Dusts of chemicals produced from different equipment may produce
  - Dermatitis or dust allergies to the workers.
  - Skin and eye irritations.
  - Resistance to certain antibiotics e.g. resistant to chloroform if the same worker is exposed to it regularly.
  - Some dusts may be carcinogenic (producing cancers).

Preventions of Chemical Hazards:

- Before starting work with a chemical a “chemical hazard pocket guide” should be consulted for necessary information about the chemical. It will give the type of reaction the chemical may produce, its in flammability, carcinogenicity, prevention and treatment procedures etc.
- No eating, drinking, or smoking where chemicals are used.
- Skin should be covered with protective clothing.
- Clothing should be removed immediately it gets wet or contaminated with a chemical.
- Eyes or skins should be washed with plenty of water after an accident
- Face mask may be used in toxic dust or gases.
- Workers working in antibiotic related products must be changed routinely so that an individual is not exposed to a certain antibiotic for a long period of time.
- Whenever a dust allergy or respiratory problem precipitates the worker should immediately be removed from the work place and put under proper healthcare.
- In case of inflammable gas or solvent leakage the exhaust fans should be started and all the source of fire should be extinguished.

4. Fire Hazards:

Fire hazards are the workplace hazards that involve the presence of flame or risk of an uncontrolled fire.

Causes of Fire Hazards:

- Class A Fires: These are fires in ordinary combustible materials such as wood, cloth, paper etc. those produce glowing ember.
- Class B Fires: These are fires of flammable petroleum products, liquids, gases and greases etc.
- Class C Fires: These fires involve energized electrical equipment.
- Class D Fires: These are fires in combustible metals.

Preventions of Fire Hazards:

- **Fire Extinguishers:** Fire extinguishing agents work by:
  - removal of fuel e.g. blanketing with foam or interposing a layer of gas between the fuel and the flames .
  - by removal of oxygen e.g. by dilution with inert gases or vapours .
  - by removal of heat by cooling with water or other extinguishing agents

- **Water based fire extinguishers:** They produce CO_2 by reaction with acid and carbonates, or CO_2 is kept under pressure. E.g. Portable fire extinguisher, Soda-Ash Extinguisher, Antifreeze Extinguisher.

- **Water based foams:** Two types of foams are available. Chemical foams and Mechanical foams. Chemical foams are bubbles filled with CO_2 produced by chemical reaction in an aqueous solution mixed with a foaming agent. The reacting chemicals are usually of sodium carbonate and ammonium sulphate. Mechanical foams are bubbles filled with air. Foams forms barrier and prevents contact between fuel and air.

- **Dry chemicals:** These are finely divided solid particles usually discharged through a hose pipe. Usually they contain sodium bicarbonate, potassium bicarbonate and ammonium sulphate.

5. Dust Hazards:

Combustible dust is defined as a solid material composed of distinct particles or pieces, regardless of size, shape, or chemical composition, which presents a fire or deflagration hazard when suspended in air or some other oxidizing medium over a range of concentrations.

Causes of Dust Hazards:

- Grinding or milling of drugs, excipients, or herbal products.
- During weighing dusts may float on air.
- During powder mixing dusts may be generated. During coating operation dusts are generated.
- During capsule filling and tablet punching operation dusts may be generated.

Preventions of Dust Hazards:

- **Filtration:** Air is sucked through a suitable filter medium (like paper, wool, cotton-wool and nylon). Filter bags can be attached with machines where dust is produced.

- **Inertial separator:** In cyclone separator the air is circulated at high speed in a spiral manner. Due to centrifugal force the dust particles are thrown outward and the particles are collected at the bottom and the clean air comes out through the top.

- **Electrostatic separator:** It consists of metal tubes though which a conductor wire is passed. Several thousand volts of DC current is applied on the metal wire. When air is passed through the pipes the dust particles becomes charged and precipitates on the inner wall of the tube and clean air passes out. Periodically the dust is collected.

EPIDEMICS

Definition:

An **epidemic** is the rapid spread of infectious disease to a large number of people in a given population within a short period of time, usually two weeks or less.

An epidemic may be restricted to one location; however, if it spreads to other countries or continents and affects a substantial number of people, it may be termed a pandemic.

Causes of Epidemics:

- Epidemics relating to the spread of infectious diseases are caused by the lack of knowledge on specific ways a germ is transmitted and the ability for treatments to be effective in controlling the spread of the disease. There are viruses, bacteria, fungi, and protozoa, classifications of disease organisms. Each strain can mutate when exposed in the human body or other living organisms and form new strains of that disease. It is very difficult for scientists and doctors to keep up with this as many environmental factors can influence mutations also. So because of this, until new sanitation preventive measures and treatments are discovered, many diseases spread quickly resulting in an epidemic.
- The conditions which govern the outbreak of epidemics include infected food supplies such as contaminated drinking water and the migration of populations of certain animals, such as rats or mosquitoes, which can act as disease vectors. Certain epidemics occur at certain seasons.
- For example, whooping-cough occurs in spring, whereas measles produces two epidemics, one in winter and one in March. Influenza, the common cold, and other infections of the upper respiratory tract, such as sore throat, occur predominantly in the winter. There is another variation, both as regards the number of people affected and the number who die in successive epidemics: the severity of successive epidemics rises and falls over periods of five or ten years.

Typical Adverse Effects of Epidemics:

Direct Effects of Epidemics:

- Epidemics usually affect large number of individuals and can lead to complications including disabilities and death.
- There is always a possibility of existence of sufficient number of disease carriers who may favour the resurgence and spread of disease.
- On seeing the suffering and deaths especially within close relatives, psychological effects are also common during epidemics.

Indirect Effects of Epidemics:

- Social and political disruption due to tension and law and order problems.
- Economic loss arising from lack of strength of cultivates.
- Economic loss arising from lack of strength of cultivates.
- Scarcity of clean food and water leading to malnutrition and starvation.

Mitigation measures:

- Investment in improved sanitation, provision of clean water and better urban infrastructure can reduce the frequency of human contact with pathogenic agents.
- Building strong health systems and supporting proper nutrition will help ensure good baseline levels of health, making people less susceptible to infectious diseases.
- Investment in reliable disease surveillance in both human and animal populations will help in reducing epidemics.
- Technological solutions can help minimize the burden of sizable outbreaks and epidemics.
- Better and less costly treatments including novel antibiotics and antiviral to counter resistant diseases, are sorely needed. New and improved vaccines are even more important.

HEAT WAVES

Definition:

Heat-wave is a condition of atmospheric temperature that leads to physiological stress, which sometimes can claim human life.

- Heat-wave is defined as the condition where maximum temperature at a grid point is 3˚C or more than the normal temperature, consecutively for 3 days or more.
- World Meteorological Organization defines a heat wave as five or more consecutive days during which the daily maximum temperature exceeds the average maximum temperature by five degrees Celsius.
- If the maximum temperature of any place continues to be more than **45° C** consecutively for two days, it is called a heat wave condition.

There will be no harm to the human body if the environmental temperature remains at 37° C. Whenever the environmental temperature increases above 37° C, the human body starts gaining heat from the atmosphere. If humidity is high, a person can suffer from heat stress disorders even with the temperature at 37°C or 38°C.

Causes of Heat waves:

A heat wave occurs when a system of high atmospheric pressure moves into an area. In such a high-pressure system, air from upper levels of our atmosphere is pulled toward the ground, where it becomes compressed and increases in temperature. This high concentration of pressure makes it difficult for other weather systems to move into the area, which is why a heat wave can last for several days or weeks. The longer the system stays in an area, the hotter the area becomes. The high-pressure inhibits winds, making them faint-to-nonexistent. Because the high-pressure system also prevents clouds from entering the region, sunlight can become punishing, heating up the system even more. The combination of all of these factors come together to create the exceptionally hot temperatures we call a heat wave.

Adverse Effects of Heat waves:

- Heat waves causes serious health risks like dehydration, heat rash, heat cramps, sunburn, heat exhaustion, heat stroke etc.
- Excessive heat causes psychological stress
- Abnormally hot temperatures cause electricity demand to increase during the peak summertime hours which leads to electricity spikes due to increased air conditioning use, which can create power outages. As a result, available electricity supplies are challenged during a higher, wider, peak electricity consumption period.
- If a heat wave occurs during a drought, which dries out vegetation, it can contribute to bushfires and wildfires.
- Heat waves can cause roads and highways to buckle and melt water lines to burst, and power transformers to detonate, causing fires.

Mitigation measures:

- **Establish Early Warning System and Inter-Agency Coordination** to alert residents on predicted high and extreme temperatures. Who will do what, when, and how is made clear to individuals and units of key departments, especially for health.

- **Capacity building / training programme** for health care professionals at local level to recognize and respond to heat-related illnesses, particularly during extreme heat events. These training programs should focus on medical officers, paramedical staff and community health staff to reduce mortality and morbidity.

- **Public Awareness and community outreach** Disseminating public awareness messages on how to protect against the extreme heat-wave through print, electronic and social media and Information, Education and Communication (IEC) materials such as pamphlets, posters and advertisements and Television Commercials (TVCs) on Do's and Don'ts and treatment measures for heat related illnesses.

- **Collaboration with non government and civil society:** Collaboration with non-governmental organizations and civil society organizations to improve bus stands, building temporary shelters, wherever necessary, improved water delivery systems in public areas and other innovative measures to tackle Heat wave conditions.