Types of Disasters:-

Primarily disasters are triggered by natural hazards or human-induced, or result from a combination of both. In particular, human-induced factors can greatly aggravate the adverse impacts of a natural disaster. Even at a larger scale, globally, the UN Inter-Governmental Panel on Climate Change (IPCC) has shown that human-induced climate change has significantly increased both the frequency and intensity of extreme weather events. While heavy rains, cyclones, or earthquakes are all natural, the impacts may, and are usually, worsened by many factors related to human activity. The extensive industrialization and urbanization increases both the probability of human-induced disasters, and the extent of potential damage to life and property from both natural and human-induced disasters. The human society is also vulnerable to Chemical, Biological, Radiological, and Nuclear (CBRN) disasters.

1. Natural Disaster

Earthquake:- An earthquake is a phenomenon that occurs without warning and involves violent shaking of the ground and everything over it. It results from the release of accumulated stress of the moving lithospheric or crustal plates. The earth's crust is divided into seven major plates, that are about 50 miles thick, which move slowly and continuously over the earth's interior and several minor plates. Earthquakes are tectonic in origin; that is the moving plates are responsible for the occurrence of violent shakes. The occurrence of an earthquake in a populated area may cause numerous casualties and injuries as well as extensive damage to property.

Floods:- India is highly vulnerable to floods. Out of the total geographical area of 329 million hectares (mha), more than 40 mha is flood prone. Floods are a recurrent phenomenon, which cause huge loss of lives and damage to livelihood systems, property, infrastructure and public utilities. It is a cause for concern that flood related damages show an increasing trend. The average annual flood damage in the last 10 years period from 1996 to 2005 was Rs. 4745 crore as compared to Rs. 1805 crore, the corresponding average for the previous 53 years. This can be attributed to many reasons including a steep increase in population, rapid urbanization growing developmental and economic activities in flood plains coupled with global warming.

An average every year, 75 lakh hectares of land is affected, 1600 lives are lost and the damage caused to crops, houses and public utilities is Rs.1805 crores due to floods. The maximum number of lives (11,316) was lost in the year 1977. The frequency of major floods is more than once in five years.

Floods have also occurred in areas, which were earlier not considered flood prone. An effort has been made in these Guidelines to cover the entire gamut of Flood Management. Eighty per cent of the precipitation takes place in the monsoon months from June to September. The rivers a bring heavy sediment load from catchments. These, coupled with inadequate carrying capacity of rivers are responsible for causing floods, drainage congestion and erosion of river-banks. Cyclones, cyclonic circulations and cloud bursts cause flash floods and lead to huge losses. It is a fact that some of the rivers causing damage in India originate in neighboring countries; adding another complex dimension to the problem. Continuing and large-scale loss of lives and damage to public and private property due to floods indicate that we are still to develop an effective response to floods. NDMA's Executive Summary Guidelines have been prepared to enable the various implementing and stakeholder agencies to effectively address the critical areas for minimizing flood damage.

Urban Floods:- Urban flooding is significantly different from rural flooding as urbanization leads to developed catchments, which increases the flood peaks from 1.8 to 8 times and flood volumes by up to 6 times. Consequently, flooding occurs very quickly due to faster flow times (in a matter of minutes). Urban areas are densely populated and people living in vulnerable areas suffer due to flooding, sometimes resulting in loss of life. It is not only the event of flooding but the secondary effect of exposure to infection also has its toll in terms of human suffering, loss of livelihood and, in extreme cases, loss of life.

Urban areas are also centres of economic activities with vital infrastructure which needs to be protected 24x7. In most of the cities, damage to vital infrastructure has a bearing not only for the state and the country but it could even have global implications. Major cities in India have witnessed loss of life and property, disruption in transport and power and incidence of epidemics. Therefore, management of urban flooding has to be accorded top priority.

Increasing trend of urban flooding is a universal phenomenon and poses a great challenge to urban planners the world over. Problems associated with urban floods range from relatively localized incidents to major incidents, resulting in cities being inundated from hours to several days. Therefore, the impact can also be widespread, including temporary relocation of people, damage to civic amenities, deterioration of water quality and risk of epidemics.

Landslide:- India has the highest mountain chain on earth, the Himalayas, which are formed due to collision of Indian and Eurasian plate, the northward movement of the Indian plate towards China causes continuous stress on the rocks rendering them friable, weak and prone to landslides and earthquakes. The slow motion of the Indian crust, about 5 cm/year accumulates stress to which natural disasters are attributed. Some landslides make unique, and unparalleled catastrophes. Landslides and avalanches are among the major hydro-geological hazards that affect large parts of India besides the Himalayas, the Northeastern hill ranges, the Western Ghats, the Nilgiris, the Eastern Ghats and the Vindhyans, in that order, covering about 15 % of the landmass. The Himalayas alone count for landslides of every fame, name and description-big and small, quick and creeping, ancient and new. The Northeastern region is badly affected by landslide problems of a bewildering variety. Landslides in the Darjeeling district of West Bengal as also those in Sikkim, Mizoram, Tripura, Meghalaya, Assam, Nagaland and Arunachal Pradesh pose chronic problems, causing recurring economic losses worth billions of rupees. A different variety of landslides, characterized by a lateritic cap, pose constant threat to the Western Ghats in the South, along the steep slopes overlooking the Konkan coast besides Nilgiris, which is highly landslide prone.

Some spectacular events of tragedies are reported as Varnavat landslide, Uttarkashi District, Malpha landslide Pithoragarh district, Okhimath landslide in Chamoli district, UK and Paglajhora in Darjeeling district as well as Sikkim, Aizawl sports complex, Mizoram.These are some of the more recent examples of landslides. The problem therefore needs to be tackled for mitigation and management for which hazard zones have to be identified and specific slides to be stabilized and managed in addition to monitoring and early warning systems to be placed at selected sites.

Cyclones:- Cyclones are caused by atmospheric disturbances around a low-pressure area distinguished by swift and often destructive air circulation. Cyclones are usually accompanied by violent storms and bad weather. The air circulates inward in an anticlockwise direction in the Northern hemisphere and clockwise in the Southern hemisphere. Cyclones are classified as: (i) extra tropical cyclones (also called temperate cyclones); and (ii) tropical cyclones. The word Cyclone is derived from the Greek word Cyclos meaning the coils of a snake. It was coined by Henry Peddington because the tropical storms in the Bay of Bengal and the Arabian Sea appear like coiled serpents of the sea.

Tsunami:- The Earth's lithosphere is broken up into a bunch of discrete pieces, called plates that move around the surface of the planet. There are seven or eight major plates (depending on how they are defined) and many minor plates. This motion is driven by the flow of the mantle rock beneath the plates and by the forces plates exert at their boundaries where they touch each other. Earthquakes happen when plates move with respect to each other because of the friction and stress at the edges of plates prevents them from slipping smoothly at their boundaries. **When one plate is forced to dive beneath another plate, there is no way to do it except with some component of vertical motion creating tsunami.**

Heat Wave:- A Heat Wave is a period of abnormally high temperatures, more than the normal maximum temperature that occurs during the summer season in the North-Western parts of India. Heat Waves typically occur between March and June, and in some rare cases even extend till July. The extreme temperatures and resultant atmospheric conditions adversely affect people living in these regions as they cause physiological stress, sometimes resulting in death.

The Indian Meteorological Department (IMD) has given the following criteria for Heat Waves :

- Heat Wave need not be considered till maximum temperature of a station reaches atleast 40*C for Plains and atleast 30*C for Hilly regions
- When normal maximum temperature of a station is less than or equal to 40*C Heat Wave Departure from normal is 5*C to 6*C Severe Heat Wave Departure from normal is 7*C or more
- When normal maximum temperature of a station is more than 40*C Heat Wave Departure from normal is 4*C to 5*C Severe Heat Wave Departure from normal is 6*C or more
- When actual maximum temperature remains 45*C or more irrespective of normal maximum temperature, heat waves should be declared.

Higher daily peak temperatures and longer, more intense heat waves are becomingly increasingly frequent globally due to climate change. India too is feeling the impact of climate change in terms of increased instances of heat waves which are more intense in nature with each passing year, and have a devastating impact on human health thereby increasing the number of heat wave casualties.

Health Impacts of Heat Waves:- The health impacts of Heat Waves typically involve dehydration, heat cramps, heat exhaustion and/or heat stroke. The signs and symptoms are as follows:

- Heat Cramps: Ederna (swelling) and Syncope (Fainting) generally accompanied by fever below 39*C i.e.102*F.
- Heat Exhaustion: Fatigue, weakness, dizziness, headache, nausea, vomiting, muscle cramps and sweating.
- Heat Stoke: Body temperatures of 40*C i.e. 104*F or more along with delirium, seizures or coma. This is a potential fatal condition

2. MAN MADE DISASTERS

Nuclear and Radiological Emergency:- The growth in the application of nuclear science and technology in the fields of power generation, medicine, industry, agriculture, research and defence has led to an increase in the risk of occurrence of Nuclear and Radiological emergencies. India has traditionally been vulnerable to natural disasters on account of its unique geo climatic conditions and it has, of late, like all other countries in the world, become equally vulnerable to various man-made disasters.

Nuclear and Radiological Emergency can arise in a nuclear facility at plant level leading to plant/ site or offsite emergency depending upon the extent of its impact on the surroundings. It can also take place while using radiation sources, either at Hospitals, Industries, Agriculture or Research Institutions due to loss or misplacement or due to faulty handling. The other events that can lead to Nuclear or Radiological Emergency in the public domain, include, accident of a vehicle carrying radioactive/nuclear material, due of an orphan source i.e. the source which is not under regulatory control or due to usage of radiation source/radioactive material in Malevolant activities.

Any radiation incident resulting in or having a potential to result in exposure and/or contamination of the workers or the public in excess of the respective permissible limits can lead to a nuclear/radiological emergency.

Biological disasters are causative of process or phenomenon of organic origin or conveyed by biological vectors, including exposure to pathogenic micro-organisms, toxins and bioactive substances that may cause loss of life, injury, illness or other health impacts, property damage, loss of livelihoods and services, social and economic disruption, or environmental damage. Examples of biological disasters include outbreaks of epidemic diseases, plant or animal contagion, insect or other animal plagues and infestation. Biological disasters may be in the form of:-

Epidemic affecting a disproportionately large number of individuals within a population, community, or region at the same time, examples being Cholera, Plague, Japanese Encephalitis (JE)/Acute Encephalitis Syndrome (AES); or,

Pandemic is an epidemic that spreads across a large region, that is, a continent, or even worldwide of existing, emerging or reemerging diseases and pestilences, example being Influenza H1N1 (Swine Flu).

Chemical Disaster:- Chemical, being at the core of modern industrial systems, has attained a very serious concern for disaster management within government, private sector and community at large. Chemical disasters may be traumatic in their impacts on human beings and have resulted in the casualties and also damages nature and property. The elements which are at highest risks due to chemical disaster primarily include the industrial plant, its employees & workers, hazardous chemicals vehicles, the residents of nearby settlements, adjacent buildings, occupants and surrounding community. Chemical disasters may arise in number of ways, such as:-

1. Process and safety systems failures

   -Human errors

   -Technical errors

   -Management errors

2. Induced effect of natural calamities
3. Accidents during the transportation
4. Hazardous waste processing/ disposal
5. Terrorist attack/ unrest leading to sabotage

Status of Chemical Disaster Risk in India

India has witnessed the world's worst chemical (industrial) disaster "Bhopal Gas Tragedy" in the year 1984. The Bhopal Gas tragedy was most devastating chemical accident in history, where over thousands of people died due to accidental release of toxic gas Methyl Iso Cyanate (MIC). Such accidents are significant in terms of injuries, pain, suffering, loss of lives, damage to property and environment. India continued to witness a series of chemical accidents even after Bhopal had demonstrated the vulnerability of the country. Only in last decade, 130 significant chemical accidents reported in India, which resulted into 259 deaths and 563 number of major injured. There are about 1861 Major Accident Hazard (MAH) units, spread across 301 districts and 25 states & 3 Union Territories, in all zones of country. Besides, there are thousands of registered and hazardous factories (below MAH criteria) and un-organized sectors dealing with numerous range of hazardous material posing serious and complex levels of disaster risks.

Safety initiatives taken in India to address chemical risk

The comprehensive legal/ institutional framework exists in our country. A number of regulations covering the safety in transportation, liability, insurance and compensations have been enacted.
Following are the relevant provisions on chemical disaster management, prevailing in country:-

1. Explosives Act 1884 - Petroleum Act 1934
2. Factories Act 1948 - Insecticides Act 1968
3. Environment Protection Act 1986 - Motor Vehicles Act 1988
4. Public Liability Insurance Act 1991 - Disaster Management Act 2005

Government of India has further reinforced the legal framework on chemical safety and management of chemical accidents by enacting new rules such as MSIHC Rules, EPPR Rules, SMPV Rules, CMV Rules, Gas Cylinder Rules, Hazardous Waste Rules, Dock Workers Rules and by way of amendments to them.

The National Disaster Management Authority (NDMA) of India had come out with very specific guidelines on Chemical Disaster Management. The guidelines have been prepared to provide the directions to ministries, departments and state authorities for the preparation of their detailed disaster management plans. These guidelines call for a proactive, participatory, multi-disciplinary and multi-sectoral approach at various levels for chemical disaster preparedness and response.

Further, NDMA has provided specific inputs to the GOM for avoidance of future chemical disasters in the country, along with suggested amendments on the existing framework. NDMA is also working on revamping of CIFs (Chief Inspectorate of Factories) to strengthen chemical safety in India. In addition, the National Action Plan on Chemical Industrial Disaster Management (NAP-CIDM), has been finalized which will act as the roadmap for chemical disaster management in India.