# DMMM Answer bank

| | 1 | 2 | 3 | 4 | 5 | 6 |
|---|---|---|---|---|---|---|
| 2025 May | 10 | 38 | 5 | 30 | 15 | 22 |
| 2024 Dec | 15 | 13 | 5 | 30 | 23 | 45 |
| 2024 May | 15 | 15 | 15 | 30 | 20 | 35 |
| 2023 Dec | 6 | 34 | 5 | 31 | 12 | 47 |
| 2023 May | 15 | 30 | 0 | 40 | 20 | 20 |
| 2022 Dec | 20 | 20 | 0 | 40 | 10 | 35 |
| **Est** | **15** | **30** | **5** | **30** | **20** | **35-45** |
| **Total** | 81 | 150 | 30 | 201 | 100 | 204 |

# PYQ Questions by Module

# (repeated questions not included. Same concept questions merged into single question)

Question's marks written in bracket, else 10-mark qn
# indicates 5-mark question

## 1. Introduction

1. Define the terms disaster, hazard, vulnerability and risk. #

2. Human repercussions of natural calamities. #

3. Evaluate the impact of disasters on infrastructure and their hindrance to developmental projects. [6]

4. Define vulnerability and its significance in disaster management. [4]

5. Define and differentiate between Risk and Vulnerability in the context of disaster management. #

6. Analyze the enduring impacts of disasters on affected communities, infrastructure, and socio-economic systems. #

7. Discuss Climate change, focusing on its underlying causes, ecological repercussions, and implications for disaster risk management. #

8. Discuss the Direct and indirect effects of disasters #

9. What is Disaster Scenario of India? #

# 2. Natural Disasters and Manmade disasters

1. What are droughts? State the mitigation measures taken in drought prone areas.

2. Explain natural and man-made disasters. Which disasters can be mitigated and how?

3. Discuss the role of growing population, industrialization, urbanization, and changing lifestyles in contributing to environmental degradation. What measures can be taken to mitigate their impact?

4. Write a note on Volcanic eruptions. [8]

5. Urban flooding: Implications for major cities. #

6. Delve into the paradox of industrialization: economic progress versus the threat of industrial mishaps. [8]

7. Provide an overview of various types of Manmade disasters, elucidating their causes, characteristics, and impacts. #

8. Classify different types of droughts and outline structural mitigation measures suitable for drought-prone regions.

9. Write a short note on Environmental hazard. #

10. Comment on radiation hazards. Also discuss possibilities of chemical spills in Mumbai. [6]

11. Discuss the various types of technological disasters and highlight the specific efforts to mitigate such disasters in India. [8]

12. Discuss various types of natural disasters in India and highlight their impacts on life. [6]

13. Is rapid depletion of ground water a type of disaster? To which category does this belong? What are the reasons for this problem? [5]

14. Identify and discuss the various hazards which are associated with volcanic eruptions. [4]

15. What are Man-made hazards? Also discuss possibilities of chemical spills. #

16. What are different types of flood? #

17. Explain disasters related to industries. Discuss the socioeconomic impact of industrial disasters with a case study.

18. Enlist and explain various terms and concepts with respect to earthquakes.

19. Explain the types of landslide and factors affecting them. Give a case study for the same.

## 3. Disaster Management, Policy and Administration

1. Explain PDCA cycle of disaster management. #
2. Evolving approaches to disaster management in India. #
3. Justify the significance of studying Disaster Management, highlighting its role in enhancing resilience, minimizing risks, and promoting sustainable development. #
4. Describe the Search and Rescue (SAR) procedure in disaster response, supported by a case study illustrating its implementation and effectiveness.
5. Write a short note on National Disaster Management Policy. #

## 4. Institutional Framework for Disaster Management in India

1. Write a short note on DM Act 2005.
2. Discuss the applications of remote sensing (GPS) and GIS in Disaster management process, highlighting its role in spatial analysis, risk assessment, and decision-making
3. What are the scope and responsibilities of NIDM and NDMA?
4. Leveraging technology for disaster preparedness. #
5. Outline the functions and duties of NIDM. [6]
6. Examine NDMA's directives for disaster preparedness in India. [6]
7. Assess the involvement of different stakeholders in mass casualty situations. [6]
8. Discuss the roles and functions of various government agencies in Disaster Management in India, emphasizing their coordination and collaboration efforts.
9. Write a short note on Function of NIDM. #
10. Discuss the framework for disaster management in India. [8]
11. Explain role of various software in disaster management.
12. Explain roles and responsibilities of NDMA in detail.
13. Describe the institutional mechanism setup in India.

## 5. Financing Relief Measures

1. What are the various methods of financial management during a disaster? Explain the government's fund-raising system for disaster response and recovery./ Evaluate various fundraising mechanisms for disaster management, considering their effectiveness, sustainability, and ethical implications.
2. Investigate the contributions of international aid agencies during extreme crises. [7]

3. Assess the contributions of various NGOs in Disaster Management, outlining their roles in emergency response, community engagement, and capacity-building initiatives. Additionally, list major NGOs operating globally in this field.

## 6. Preventive and Mitigation Measures

1. Explain disaster management for floods in urban areas. #

2. Explain the concept of Capacity building along with suitable example. #

3. Explain with examples structural and non-structural mitigation measures. [6]

4. What are the dos and don'ts in the event of a Covid-like pandemic? [6]

5. Guidelines for earthquake safety. #

6. Define early warning systems and illustrate their benefits through recent instances of flood, cyclone, and tsunami alerts. [8]

7. Explain Triage. Analyze the importance of initial response in disaster management. [8]

8. Describe non-structural measures for pandemic containment. [6]

9. Highlight the protective role of natural ecosystems against disasters, with examples. [6]

10. Define liquefaction and debate the merits of retrofitting versus relocation in landslide-prone areas. [6]

11. Enumerate preparedness measures for minimizing chemical disaster losses. [5]

12. Define Bio shield and explore its utility in disaster mitigation, particularly in addressing specific hazards such as floods, landslides, and coastal erosion. #

13. Outline structural mitigation measures suitable for drought-prone regions. #

14. Examine the multifaceted components of Disaster Management, including preparedness, response, recovery, and mitigation strategies.

15. Define Capacity Development and illustrate its application through a case study of Community-Based Disaster Management (CBDM), emphasizing community empowerment, resilience-building, and sustainable development. / What is Community Base Disaster Management (CBDM)? Discuss how it is useful in Indian scenario.

16. Enumerate essential Do’s and Don’ts for disaster preparedness and response, providing practical guidelines for individuals and communities to mitigate risks and ensure safety.

17. Write a short note on Capacity building. #

18. Write a short note on Sea walls, embankments and bio shields. #

19. Differentiate between structural and non-structural measures of flood mitigation and discuss the importance of forecasting, warning and monitoring system in India. [8]

20. Explain in detail the design concepts involved in as well as the construction materials used for the safe construction of facilities in case of earthquakes and cyclones. Also discuss the fire-resistant facilities that need to be essentially provided in a building/industry. [8]

21. Explain in detail, vulnerability, with reference to floods and cyclones. List down the preparatory measures for minimizing vulnerabilities related to Tsunami. [6]

22. Define the term Mitigation #

23. What are different mitigation measures for Tsunami and Cyclones?

24. Enlist structural mitigation measures for flood. #

25. Explain Bio shield and Sea wall in detail with schematic diagram.

26. What are Do's and Don'ts in Earthquake, Tsunami and Cyclone?

# 1. Introduction

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**1. Define the terms Disaster, Hazard, Vulnerability, and Risk.** ***(5 Marks)***

**Disaster:**

- A *sudden, catastrophic event* causing severe disruption to life, property, and environment.
- It *overwhelms the capacity* of the affected community to cope.
- Examples: Earthquake, flood, cyclone.

**Hazard:**

- A *potentially damaging physical or human activity* that may cause injury, property loss, or environmental harm.
- Becomes a **disaster** only when it interacts with vulnerable conditions.

**Vulnerability:**

- The *degree to which people or systems are likely to suffer damage* when exposed to a hazard.
- Factors: Poverty, poor infrastructure, lack of awareness.

**Risk:**

- The *likelihood of harmful consequences* resulting from hazard–vulnerability interaction.
- **Formula:**

$$\text{Risk} = \frac{\text{Hazard} \times \text{Vulnerability}}{\text{Capacity}}$$

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**2. Human Repercussions of Natural Calamities.** ***(5 Marks)***

**1. Direct Impacts:**

- **Loss of life and injuries.**
- **Destruction of property** and essential services (power, water, roads).
- **Mass displacement** of people from affected zones.

**2. Indirect Impacts:**

- **Economic loss** due to halted industries and damaged assets.
- **Health impacts** – epidemics, malnutrition, and poor sanitation.
- **Psychological trauma** among survivors.

**3. Long-Term Repercussions:**

- **Migration** and urban overcrowding.
- **Educational gaps** due to school closures.
- **Increased poverty and inequality.**

*Hence, disasters disrupt not only life and livelihood but also long-term social and economic stability.*

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**3. Evaluate the impact of disasters on infrastructure and their hindrance to developmental projects. *(6 Marks)***

**1. Impact on Infrastructure:**

- **Physical damage:** Collapse of roads, bridges, buildings, and utilities.
- **Communication breakdown:** Telecommunication and power failure.
- **Industrial loss:** Disruption in factories and supply chains.
- **Public institutions:** Hospitals and schools damaged, delaying recovery.

**2. Hindrance to Development:**

- **Diversion of funds** from new development to repair work.
- **Delay in construction projects** due to unsafe conditions.
- **Reduced investments** and slowdown of regional economies.
- **Loss of human resources** due to deaths and migration.

**Conclusion:**
Disasters cause direct physical destruction and indirectly obstruct **economic growth and sustainable development** by forcing nations to rebuild instead of progress.

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**4. Define Vulnerability and its Significance in Disaster Management. *(4 Marks)***

**Definition:**

- Vulnerability is the *extent to which a community, system, or structure can be damaged* when exposed to a hazard.

**Significance:**

1. Helps in **identifying high-risk areas** and groups.
2. Aids in **risk assessment and planning** effective mitigation measures.
3. Guides **allocation of resources** and prioritization of relief.
4. Promotes **resilience-building** through education and preparedness.

*Hence, understanding vulnerability is vital to minimize disaster impact and improve recovery capacity.*

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**5. Define and Differentiate between Risk and Vulnerability in the Context of Disaster Management. *(5 Marks)***

**Risk:**

- The *probability of harmful consequences* arising when a hazard affects a vulnerable population.
- Quantifies potential loss (life, property, environment).
- **Formula:** Risk = Hazard × Vulnerability / Capacity

**Vulnerability:**

- The *degree of weakness or susceptibility* of a community or system to a hazard.
- Determined by factors such as poverty, poor infrastructure, and low preparedness.

**Difference:**

| **Basis** | **Risk** | **Vulnerability** |
|---|---|---|
| Meaning | Probability of loss or damage | Degree of weakness or exposure |
| Nature | Quantitative (measurable) | Qualitative (descriptive) |
| Depends On | Hazard, vulnerability, capacity | Social, economic, physical factors |
| Focus | Expected consequences | Root causes of damage |

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**6. Analyze the enduring impacts of disasters on affected communities, infrastructure, and socio-economic systems. *(5 Marks)***

**1. Impacts on Communities:**

- **Loss of lives** and injuries.
- **Displacement** of people, leading to overcrowded shelters.
- **Psychological trauma** such as stress and depression.
- **Breakdown of social networks** and community bonds.

**2. Impacts on Infrastructure:**

- **Destruction of roads, bridges, schools, hospitals, and power lines.**
- **Interruption of essential services** like water supply, transport, and communication.
- **Increased reconstruction costs** divert funds from development projects.

**3. Socio-Economic Impacts:**

- **Economic slowdown** due to damaged industries and halted trade.
- **Unemployment** and **loss of livelihoods.**

- **Decline in education and healthcare services.**
- **Widening inequality** as poor communities recover slower.

**Conclusion:**
The long-term impacts of disasters weaken the **social fabric, infrastructure base, and economic stability**, slowing sustainable development for years.

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**7. Discuss Climate Change, focusing on its underlying causes, ecological repercussions, and implications for disaster risk management. *(10 Marks)***

**Definition:**

- Climate change refers to the *long-term alteration in global weather patterns and temperature* due to natural and human activities.

**A. Underlying Causes:**

1. **Burning of fossil fuels** → releases $CO_2$, $CH_4$, and $N_2O$.
2. **Deforestation** → reduces $CO_2$ absorption capacity.
3. **Industrial emissions** → release greenhouse gases and pollutants.
4. **Agriculture & livestock** → emit methane and nitrous oxide.
5. **Urbanization & vehicle emissions** → increase the greenhouse effect.

**B. Ecological Repercussions:**

1. **Global temperature rise** → melting of glaciers and ice caps.
2. **Sea-level rise** → submergence of coastal areas.
3. **Extreme weather events** → frequent floods, droughts, and cyclones.
4. **Loss of biodiversity** → extinction of flora and fauna.
5. **Ocean acidification** → destruction of coral reefs and marine life.

**C. Implications for Disaster Risk Management:**

1. **Increased disaster frequency** – intensified natural hazards.
2. **Need for adaptation** – climate-resilient crops, infrastructure, and early warning systems.
3. **Policy integration** – linking climate policies with national disaster management plans.
4. **Awareness & capacity building** – educating communities about risks.
5. **International cooperation** – through frameworks like the **Paris Agreement (2015)**.

**Conclusion:**
Climate change amplifies disaster risks by disturbing ecological balance. Effective risk management requires **sustainability, mitigation, and global collaboration**.

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**8. Discuss the Direct and Indirect Effects of Disasters. *(10 Marks)***

**A. Direct Effects:**

1. **Human casualties** – deaths, injuries, and disabilities.
2. **Property destruction** – buildings, bridges, and infrastructure collapse.
3. **Displacement of population** – forced migration and homelessness.
4. **Interruption of services** – water, electricity, transport, and communication failure.

**B. Indirect Effects:**

1. **Economic loss** – industries shut down, loss of jobs and income.
2. **Psychological trauma** – mental stress and fear among survivors.
3. **Health issues** – epidemics due to poor sanitation and polluted water.
4. **Environmental degradation** – deforestation, pollution, and habitat loss.

**C. Long-Term Effects:**

- **Reduced economic growth** and foreign investment.
- **Loss of education and healthcare access.**
- **Increased inequality** and vulnerability among poor communities.

**Conclusion:**
Direct effects cause *immediate damage*, while indirect and long-term effects *delay recovery and hinder sustainable development*.

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**9. What is Disaster Scenario of India? *(5 Marks)***

**Overview:**

- India is among the **most disaster-prone countries** in the world due to its **geographical diversity and climatic variations.**

**Major Hazards:**

1. **Earthquakes:** 60% of landmass prone (Zones IV & V).
2. **Floods:** 40 million hectares affected annually.
3. **Cyclones:** 8% of coastline highly vulnerable.
4. **Droughts:** 70% of cultivated land exposed to rainfall variation.

5. **Landslides & Forest Fires:** Frequent in Himalayan and forest regions.

**Recent Disasters:**

- 2001 Gujarat Earthquake
- 2004 Indian Ocean Tsunami
- 2013 Uttarakhand Floods
- 2020 Amphan Cyclone

**Government Measures:**

- **Disaster Management Act, 2005**
- Formation of **NDMA**, **NIDM**, and **SDMAs**
- Implementation of **National Disaster Management Plan (NDMP)**

**Conclusion:**
India's disaster scenario emphasizes the need for **risk mapping, early warning systems, resilient infrastructure, and public awareness** to reduce vulnerability.

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# 2. Natural Disasters and Manmade disasters

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**1. What are Droughts? State the Mitigation Measures Taken in Drought-Prone Areas. *(10 Marks)***

**Definition:**

- A **drought** is a *prolonged period of deficient rainfall* that leads to **water scarcity**, affecting agriculture, environment, and livelihoods.
- It is a **slow-onset disaster** that develops gradually and lasts for months or years.

**Types of Droughts:**

1. **Meteorological Drought:** Less rainfall than average.
2. **Agricultural Drought:** Insufficient soil moisture for crops.
3. **Hydrological Drought:** Depletion of surface and groundwater resources.
4. **Socio-economic Drought:** Water shortage affecting human and economic activities.

**Causes:**

- Irregular monsoon, deforestation, poor irrigation management, overgrazing, and climate change.

**Mitigation Measures:**

1. **Water Management:**
    - Rainwater harvesting, check dams, percolation tanks.
2. **Soil Conservation:**
    - Afforestation, contour ploughing, and controlled grazing.
3. **Drought-Resistant Crops:**
    - Use of hardy varieties (e.g., millet, pulses).
4. **Efficient Irrigation:**
    - Drip and sprinkler systems to reduce wastage.
5. **Awareness & Planning:**
    - Drought forecasting, early warning systems, and community training.
6. **Government Initiatives:**
    - **Integrated Watershed Management Program (IWMP)** and **National Drought Policy**.

**Conclusion:**
Effective drought mitigation requires **sustainable water use, soil conservation, and community participation** to ensure resilience against rainfall failures.

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**2. Explain Natural and Man-Made Disasters. Which Disasters Can Be Mitigated and How? *(10 Marks)***

**A. Natural Disasters:**

- Caused by natural phenomena beyond human control.
- **Examples:** Earthquakes, floods, cyclones, droughts, landslides, volcanic eruptions.

**B. Man-Made Disasters:**

- Result from human negligence or technological failure.
- **Examples:** Industrial accidents, oil spills, nuclear leaks, deforestation, pollution, war.

**Mitigable Disasters & Methods:**

| Type | Example | Mitigation Measures |
|---|---|---|
| **Floods** | Heavy rainfall, river overflow | Construction of embankments, proper drainage, flood zoning |
| **Earthquakes** | Tectonic movement | Earthquake-resistant buildings, land-use planning |
| **Cyclones** | Oceanic disturbances | Early warning systems, cyclone shelters |
| **Droughts** | Rainfall deficiency | Water conservation, crop planning |
| **Industrial accidents** | Chemical leakage | Safety audits, strict industrial norms |
| **Urban fires** | Overcrowded settlements | Fire safety codes, emergency response teams |

**Conclusion:**
While **natural disasters cannot be prevented**, their **impacts can be minimized** through **preparedness, resilience planning, and sustainable development**.

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**3. Discuss the Role of Growing Population, Industrialization, Urbanization, and Changing Lifestyles in Contributing to Environmental Degradation. What Measures Can Be Taken to Mitigate Their Impact? *(10 Marks)***

**A. Causes of Environmental Degradation:**

1. **Population Growth:**
    - Increased demand for land, food, and energy.
    - Deforestation and resource overexploitation.
2. **Industrialization:**
    - Emission of pollutants, waste disposal issues, and chemical contamination.
    - Example: Air and water pollution near industrial belts.

3. **Urbanization:**
    - Encroachment on green areas, poor waste management, and urban heat islands.
    - Overburdened infrastructure and traffic pollution.
4. **Changing Lifestyles:**
    - Overconsumption and waste generation.
    - Use of plastic, packaged foods, and energy-intensive gadgets.

**B. Mitigation Measures:**

1. **Population Control:**
    - Family planning, education, and awareness programs.
2. **Eco-friendly Industrial Practices:**
    - Adoption of **clean technologies**, emission control, and waste recycling.
3. **Urban Planning:**
    - Creation of green belts, proper sewage and waste systems.
4. **Sustainable Lifestyles:**
    - Reduce–Reuse–Recycle, using public transport, and conserving energy.
5. **Legislation:**
    - Enforcement of **Environmental Protection Act (1986)** and **Pollution Control Boards**.

**Conclusion:**
Balancing growth with environmental care through **sustainable development policies** is the only way to ensure a healthy ecosystem for future generations.

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**4. Write a Note on Volcanic Eruptions.** ***(8 Marks)***

**Definition:**

- A **volcanic eruption** occurs when **magma, gases, and ash** are expelled from beneath the Earth's crust through an opening or vent.

**Types of Volcanoes:**

1. **Active Volcanoes:** Frequently erupt (e.g., Mount Etna).
2. **Dormant Volcanoes:** Inactive for years but may erupt (e.g., Mount Fuji).
3. **Extinct Volcanoes:** No longer expected to erupt (e.g., Deccan Traps).

**Causes:**

- Movement of **tectonic plates** and **pressure buildup** in magma chambers.

**Effects:**

1. **Destruction of life and property** due to lava and ash flow.
2. **Air pollution** and **acid rain** formation.
3. **Climate alteration** – ash clouds block sunlight, lowering temperature.
4. **Soil enrichment** – long-term fertility due to volcanic minerals.

**Mitigation Measures:**

- Volcanic monitoring using sensors and satellite data.
- Hazard mapping and **zoning of high-risk areas**.
- Public awareness and **evacuation plans**.

**Conclusion:**
Though uncontrollable, volcanic risks can be **minimized by scientific forecasting, preparedness, and proper land-use planning.**

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**5. Urban Flooding: Implications for Major Cities.** ***(5 Marks)***

**Definition:**

- Urban flooding occurs when **rainwater accumulation exceeds drainage capacity** in cities, often due to unplanned urbanization.

**Causes:**

- Encroachment on natural drainage systems.
- Blocked stormwater drains.
- Reduced permeable surfaces due to concrete structures.
- Climate change and intense rainfall.

**Implications:**

1. **Traffic paralysis** and infrastructure damage.
2. **Water contamination** leading to health hazards.
3. **Power and communication failures.**
4. **Economic loss** due to halted business and property damage.
5. **Increased urban poverty** and displacement.

**Examples:**

- **Mumbai Floods (2005)**, **Chennai Floods (2015)**.

**Mitigation Measures:**

- Proper drainage design and regular maintenance.

- Rainwater harvesting and green spaces.
- Urban flood zoning and early warning systems.

**Conclusion:**
Urban flooding highlights the need for **sustainable city planning** and **integration of natural water systems** into urban infrastructure.

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**6. Delve into the Paradox of Industrialization: Economic Progress versus the Threat of Industrial Mishaps.** ***(8 Marks)***

**Introduction:**

- **Industrialization** is a key driver of economic growth, employment, and technological advancement.
- However, it also brings **risks of industrial accidents**, pollution, and resource depletion — creating a paradox of progress vs. peril.

**Economic Progress:**

1. Increases **national income** and employment.
2. Promotes **urban development** and infrastructure growth.
3. Enhances **technological innovation** and productivity.
4. Leads to **improved living standards** and exports.

**Threat of Industrial Mishaps:**

1. **Chemical leaks and explosions** – e.g., *Bhopal Gas Tragedy (1984)*.
2. **Fire and toxic releases** in industrial zones.
3. **Occupational hazards** for workers (toxic exposure, accidents).
4. **Air and water pollution** causing ecological damage.
5. **Public health risks** and contamination of nearby communities.

**Mitigation Measures:**

- Strict **industrial safety norms** and **regular audits**.
- Adoption of **clean and green technologies**.
- **Emergency response plans** and mock drills.
- Enforcement of **Environmental Protection Act (1986)** and **Factories Act (1948)**.

**Conclusion:**
Industrialization must balance economic progress with **safety, sustainability, and accountability**, ensuring growth that doesn't endanger people or the environment.

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**7. Provide an Overview of Various Types of Man-Made Disasters, Elucidating Their Causes, Characteristics, and Impacts.** ***(5 Marks)***

**Definition:**

- Man-made disasters are **events caused by human negligence, technological failure, or deliberate actions** leading to loss of life, property, and environment.

**Types, Causes, and Impacts:**

| Type | Causes | Impacts |
|---|---|---|
| **Industrial Accidents** | Chemical leaks, explosions | Pollution, health hazards, deaths (e.g., Bhopal Gas Leak) |
| **Nuclear Disasters** | Reactor failure, radiation leaks | Long-term radiation sickness (e.g., Chernobyl, Fukushima) |
| **Transport Accidents** | Human error, mechanical failure | Loss of life, property damage |
| **Terrorist Attacks** | Political or ideological motives | Casualties, fear, infrastructure loss |
| **Oil Spills** | Leakage from tankers | Marine pollution, biodiversity loss |
| **Fires and Explosions** | Electrical faults, poor safety | Property loss, environmental damage |

**Conclusion:**
Most man-made disasters are **preventable** through **strict safety regulations, awareness, and preparedness** at all levels.

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**8. Classify Different Types of Droughts and Outline Structural Mitigation Measures Suitable for Drought-Prone Regions.** ***(10 Marks)***

**A. Types of Droughts:**

1. **Meteorological Drought:**
    - Caused by below-normal rainfall compared to long-term averages.
2. **Agricultural Drought:**
    - Insufficient soil moisture affecting crop productivity.
3. **Hydrological Drought:**
    - Decline in surface water and groundwater levels.
4. **Socio-Economic Drought:**
    - Water scarcity impacts livelihood, economy, and social stability.

**B. Structural Mitigation Measures:**

1. **Water Harvesting Structures:**
    - Construction of check dams, percolation tanks, and farm ponds.
2. **Watershed Management:**
    - Integrated land and water conservation practices.
3. **Irrigation Improvements:**
    - Use of drip and sprinkler systems for efficient water use.
4. **Groundwater Recharge:**
    - Artificial recharge wells and infiltration trenches.
5. **Afforestation:**
    - Planting drought-resistant trees to improve soil moisture.
6. **Storage Reservoirs:**
    - Multipurpose dams for irrigation and water supply.

**Conclusion:**
Structural measures must be supported by **community participation, policy support, and scientific planning** to ensure drought resilience.

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**9. Write a Short Note on Environmental Hazard. *(5 Marks)***

**Definition:**

- An **environmental hazard** is a *natural or human-induced process* that may harm ecosystems, human health, or the environment.

**Types:**

1. **Physical Hazards:** Floods, earthquakes, radiation.
2. **Chemical Hazards:** Industrial emissions, pesticides, and oil spills.
3. **Biological Hazards:** Pathogens, viruses, and invasive species.
4. **Cultural/Social Hazards:** Unsafe settlements, poor sanitation.

**Impacts:**

- Pollution of air, water, and soil.
- Habitat destruction and loss of biodiversity.
- Health issues like respiratory diseases and poisoning.

**Mitigation:**

- Pollution control, waste management, environmental education, and strict enforcement of environmental laws.

**Conclusion:**
Environmental hazards demand a balance between **development and ecological preservation** through **sustainable practices**.

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**10. Comment on Radiation Hazards. Also Discuss Possibilities of Chemical Spills in Mumbai.** ***(6 Marks)***

**Radiation Hazards:**

- Caused by exposure to **ionizing radiation** from nuclear plants, medical sources, or accidents.

**Effects:**

- **Health:** Cancer, genetic mutations, burns, and radiation sickness.
- **Environmental:** Soil and water contamination, biodiversity loss.
- **Examples:** Chernobyl (1986), Fukushima (2011).

**Safety Measures:**

- Proper shielding, regular monitoring, and safe disposal of radioactive waste.
- Implementation of **Atomic Energy Regulatory Board (AERB)** guidelines.

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**Chemical Spills in Mumbai – Possibilities:**

- Mumbai houses **large petrochemical, pharmaceutical, and fertilizer industries**, making it prone to **chemical leaks** or **toxic releases**.
- **Causes:**
    - Pipeline ruptures or tanker accidents.
    - Improper waste disposal.
    - Accidents during transport or storage.

**Mitigation Measures:**

1. Strict enforcement of **Hazardous Waste Management Rules**.
2. Regular **safety audits and emergency drills**.
3. Establishment of **chemical disaster management cells** in industrial zones.
4. **Training local communities** for rapid response and evacuation.

**Conclusion:**
Both radiation and chemical hazards underline the need for **proactive regulation, monitoring, and industrial preparedness** to safeguard urban populations.

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**11. Discuss the Various Types of Technological Disasters and Highlight the Specific Efforts to Mitigate Such Disasters in India.** ***(8 Marks)***

**Definition:**

- **Technological disasters** are *accidents resulting from human error, equipment failure, or mismanagement of technology* causing large-scale damage to life and environment.

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**Types of Technological Disasters:**

1. **Industrial Accidents:**
    - Chemical leaks, explosions, and toxic emissions (e.g., *Bhopal Gas Tragedy, 1984*).
2. **Nuclear Accidents:**
    - Radiation exposure due to malfunction or safety lapses (e.g., *Tarapur Atomic Plant incidents*).
3. **Transport Accidents:**
    - Air crashes, train derailments, and ship collisions causing loss of life.
4. **Structural Failures:**
    - Collapse of bridges, dams, or buildings due to design or maintenance faults.
5. **Cyber Disasters:**
    - Cyber-attacks on critical infrastructure, data theft, and system breakdowns.

**Mitigation Efforts in India:**

1. **Legislative Measures:**
    - *Factories Act (1948)* and *Environment (Protection) Act (1986)* ensure safety and pollution control.
2. **Disaster Management Framework:**
    - *NDMA guidelines* for chemical, nuclear, and biological disaster management.
3. **On-site & Off-site Emergency Plans:**
    - Mandatory for hazardous industries.
4. **Technology Upgradation:**
    - Use of sensors, alarms, and automation to prevent leaks or failures.
5. **Training & Mock Drills:**
    - Regular safety drills and worker awareness programs.
6. **Monitoring Bodies:**

- *Atomic Energy Regulatory Board (AERB)*, *Central Pollution Control Board (CPCB)*.

**Conclusion:**
Technological disasters are preventable with **strict regulation, modern safety technology, and industrial accountability.**

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**12. Discuss Various Types of Natural Disasters in India and Highlight Their Impacts on Life. *(6 Marks)***

**Types of Natural Disasters:**

1. **Earthquakes:**
   - Caused by tectonic movement (e.g., *Gujarat, 2001*).
   - *Impact:* Loss of lives, building collapse, and infrastructure damage.
2. **Floods:**
   - Heavy rainfall and river overflow (e.g., *Assam and Bihar floods*).
   - *Impact:* Displacement, waterborne diseases, crop loss.
3. **Cyclones:**
   - Formed over warm seas (e.g., *Cyclone Amphan, 2020*).
   - *Impact:* Coastal damage, power failure, casualties.
4. **Droughts:**
   - Long dry spells and monsoon failure.
   - *Impact:* Famine, water scarcity, livestock deaths.
5. **Landslides:**
   - Slope instability due to deforestation or rain (e.g., *Uttarakhand*).
   - *Impact:* Destruction of roads, villages, and agriculture.
6. **Forest Fires:**
   - Caused by human negligence or high temperatures.
   - *Impact:* Air pollution, habitat loss, reduced biodiversity.

**Conclusion:**
India's diverse geography exposes it to multiple hazards, causing severe **human, economic, and environmental losses**, demanding strong mitigation strategies.

---

**13. Is Rapid Depletion of Groundwater a Type of Disaster? To Which Category Does This Belong? What Are the Reasons for This Problem? *(5 Marks)***

**Yes,** rapid groundwater depletion is a **slow-onset environmental disaster**.

**Category:**

- It belongs to the category of **Environmental and Hydrological Disasters.**

**Reasons:**

1. **Over-extraction:** Excessive use for irrigation and domestic purposes.
2. **Deforestation:** Reduced groundwater recharge.
3. **Urbanization:** Concrete surfaces block percolation.
4. **Lack of Rainwater Harvesting:** Reduced replenishment of aquifers.
5. **Climate Change:** Altered rainfall patterns.

**Impacts:**

- Drying of wells, land subsidence, declining crop yield, and water scarcity.

**Mitigation:**

- Rainwater harvesting, groundwater recharge, and sustainable water management.

---

**14. Identify and Discuss the Various Hazards Which Are Associated with Volcanic Eruptions. *(4 Marks)***

**Hazards Associated with Volcanic Eruptions:**

1. **Lava Flow:** Destroys property, vegetation, and settlements.
2. **Ash Fall:** Causes respiratory issues, pollutes water, and reduces sunlight.
3. **Pyroclastic Flows:** Hot gas and ash clouds travel at high speeds, devastating everything in their path.
4. **Lahars (Mudflows):** Mix of ash and rainwater leading to flooding and soil erosion.
5. **Gas Emissions:** Release of $CO_2$, $SO_2$, and other toxic gases causing acid rain and climate effects.

**Conclusion:**
Volcanic hazards cause *widespread destruction and health risks*, but monitoring systems and evacuation planning can reduce their impact.

---

**15. What Are Man-Made Hazards? Also Discuss Possibilities of Chemical Spills. *(5 Marks)***

**Man-Made Hazards:**

- Disasters caused by *human negligence, technological errors, or unsafe industrial practices*.
- **Examples:** Industrial explosions, oil spills, nuclear accidents, fires, pollution, terrorism.

**Causes:**

- Rapid industrialization without safety measures.
- Poor waste management and storage.
- Human error or mechanical failure.

**Possibilities of Chemical Spills:**

- **Cities like Mumbai** with dense industrial zones (e.g., *Chembur, Thane-Belapur belt*) are vulnerable.
- **Causes:**
    - Pipeline ruptures, tanker leaks, or factory accidents.
    - Improper chemical storage and transport.

**Impacts:**

- Air and water pollution, health hazards, and marine ecosystem damage.

**Preventive Measures:**

1. Strict enforcement of **Hazardous Waste Management Rules (2016)**.
2. **Emergency response units** and public evacuation plans.
3. **Regular safety inspections** and spill response training.

**Conclusion:**
Man-made hazards, particularly chemical spills, can be **prevented through strong regulation, industrial discipline, and community preparedness.**

---

**16. What Are Different Types of Flood? *(5 Marks)***

**Definition:**

- A **flood** is an overflow of water that submerges land which is usually dry.
- It is one of the most frequent and destructive natural disasters in India.

**Types of Floods:**

1. **River Floods:**
    - Caused by heavy rainfall or snowmelt leading to river overflow.
    - *Example:* Ganga and Brahmaputra floods.
2. **Flash Floods:**
    - Sudden and intense flooding due to heavy rainfall or dam break.
    - *Example:* Kedarnath Floods (2013).
3. **Urban Floods:**
    - Waterlogging in cities due to poor drainage and encroachment.

- *Example:* Mumbai Floods (2005).

4. **Coastal Floods:**
    - Caused by high tides, cyclones, and storm surges in coastal areas.
5. **Pluvial (Surface Water) Floods:**
    - Occur when rainfall exceeds ground absorption capacity, even without river overflow.

**Conclusion:**
Different floods demand **region-specific mitigation**, such as embankments, proper drainage, and early warning systems.

---

**17. Explain Disasters Related to Industries. Discuss the Socioeconomic Impact of Industrial Disasters with a Case Study. *(10 Marks)***

**Definition:**

- Industrial disasters occur due to **chemical leaks, explosions, or unsafe industrial operations** that harm life and environment.

**Examples of Industrial Disasters:**

- *Bhopal Gas Tragedy (1984)*
- *Visakhapatnam Gas Leak (2020)*
- *Oil refinery fires, factory explosions.*

**Causes:**

1. Human negligence or operational failure.
2. Lack of safety audits and equipment maintenance.
3. Inadequate emergency planning.
4. Poor urban–industrial zoning.

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**Socioeconomic Impacts:**

1. **Loss of Life and Health:** Deaths, chronic diseases, and disabilities.
2. **Economic Loss:** Factory damage, unemployment, and reduced productivity.
3. **Environmental Pollution:** Soil and groundwater contamination.
4. **Migration:** Displacement of affected populations.
5. **Social Impact:** Public panic, psychological trauma, and long-term mistrust of industries.

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**Case Study – Bhopal Gas Tragedy (1984):**

- **Incident:** Leakage of *Methyl Isocyanate (MIC)* gas from Union Carbide India Ltd. in Bhopal, Madhya Pradesh.
- **Impact:**
    - Over **2,000 immediate deaths**, and thousands suffered respiratory and neurological issues.
    - Contamination of groundwater and soil.
    - Long-term health disorders and birth defects.
- **Outcome:**
    - Led to creation of **Environment (Protection) Act, 1986**.
    - Established **NDMA guidelines** for chemical disaster prevention.

**Conclusion:**
Industrial disasters highlight the urgent need for **strict safety laws, periodic inspections, and effective emergency response systems.**

---

**18. Enlist and Explain Various Terms and Concepts with Respect to Earthquakes. *(10 Marks)***

**Definition:**

- An **earthquake** is a sudden release of energy in the Earth's crust, creating seismic waves that shake the ground.

**Key Terms and Concepts:**

1. **Focus (Hypocenter):**
    - The point inside the Earth where the earthquake originates.
2. **Epicenter:**
    - The surface point directly above the focus where shaking is strongest.
3. **Seismic Waves:**
    - Energy waves generated by an earthquake.
    - **P-Waves (Primary):** Fastest, travel through solids and liquids.
    - **S-Waves (Secondary):** Slower, travel only through solids.
    - **Surface Waves:** Cause the most destruction.
4. **Magnitude:**
    - Amount of energy released, measured by **Richter Scale**.
5. **Intensity:**
    - Observed effects of an earthquake, measured by **Mercalli Scale**.

6. **Faults:**
    - Fractures in the Earth's crust where movement occurs.
    - Example: Himalayan Fault Zone.
7. **Aftershocks:**
    - Smaller tremors following the main earthquake.
8. **Liquefaction:**
    - Soil loses strength due to shaking, causing structures to sink.

**Conclusion:**
Understanding these terms helps in **earthquake prediction, zoning, and disaster preparedness.**

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**19. Explain the Types of Landslide and Factors Affecting Them. Give a Case Study for the Same.** ***(10 Marks)***

**Definition:**

- A **landslide** is the *downward movement of rock, soil, or debris* due to gravity, often triggered by rainfall, earthquakes, or human activities.

**Types of Landslides:**

1. **Falling:**
    - Sudden free fall of rock fragments from steep slopes.
2. **Toppling:**
    - Forward rotation of rock blocks on a slope.
3. **Sliding:**
    - Movement of rock or soil along a plane of weakness.
4. **Spreading:**
    - Horizontal displacement due to liquefaction of underlying material.
5. **Flowing:**
    - Rapid flow of saturated soil and debris (e.g., mudflow).

**Factors Affecting Landslides:**

1. **Natural Factors:**
    - Intense rainfall, earthquakes, slope angle, and soil type.
2. **Human-Induced Factors:**
    - Deforestation, unplanned construction, mining, and road cutting.

3. **Geological Factors:**
    - Weak rock structures and weathered material.

**Case Study – Malin Landslide, Maharashtra (2014):**

- Heavy rainfall caused a massive landslide in Pune district.
- **Impact:**
    - Entire village buried; over **150 people killed.**
    - Loss of farmland and property.
- **Cause:**
    - Deforestation and slope instability.
- **Response:**
    - National Disaster Response Force (NDRF) carried out rescue operations.

**Conclusion:**
Landslides can be reduced through **afforestation, slope stabilization, proper drainage, and regulated hill development.**

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# 3. Disaster Management, Policy and Administration

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**1. Explain PDCA Cycle of Disaster Management.** ***(5 Marks)***

**Definition:**

- The **PDCA Cycle (Plan–Do–Check–Act)** is a **continuous improvement model** used in disaster management to ensure effective planning, implementation, monitoring, and updating of strategies.

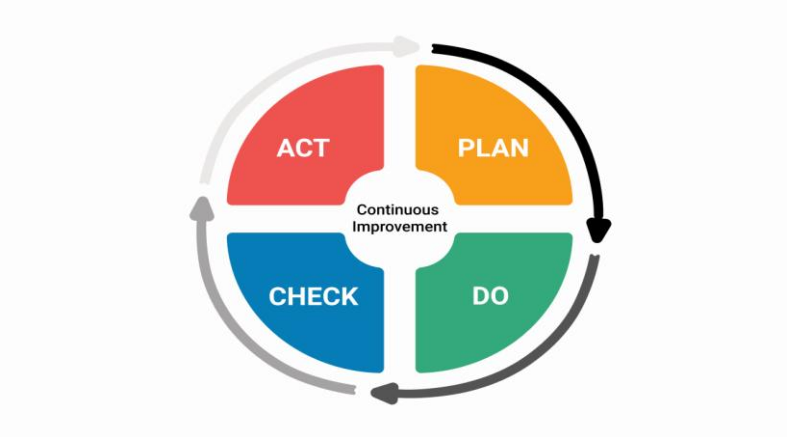
**Phases:**

1. **Plan:**
    - Identify risks, vulnerabilities, and resources.
    - Formulate disaster management and mitigation plans.
2. **Do:**
    - Implement the planned actions — training, awareness, drills, and preventive measures.
3. **Check:**
    - Evaluate performance through audits, mock drills, and data analysis.
    - Identify strengths and weaknesses.
4. **Act:**
    - Modify or improve the disaster management plan based on feedback and evaluation results.

**Application:**

- Used by **NDMA and State Disaster Management Authorities** for continuous improvement of disaster preparedness and response systems.

**Conclusion:**
The PDCA cycle promotes **systematic, flexible, and adaptive disaster management**, ensuring preparedness and resilience.

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**2. Evolving Approaches to Disaster Management in India.** ***(5 Marks)***

**Traditional Approach:**

- Focused mainly on **relief and response** after a disaster occurred.
- Reactive in nature, lacking prevention and long-term planning.

**Modern Approach (Post-2005):**

- Shift from **response-based** to **proactive, prevention-oriented** disaster management.
- Integration of **risk reduction, mitigation, preparedness, and resilience**.

**Key Developments:**

1. **Disaster Management Act, 2005** – established **NDMA, SDMA, and NDRF**.
2. **National Policy on Disaster Management (2009)** – emphasized holistic risk reduction.
3. **Integration with Development Plans** – mainstreaming DRR in all sectors.
4. **Community-Based Approach** – local participation in preparedness and response.
5. **Use of Technology** – GIS mapping, early warning systems, and satellite monitoring.

**Conclusion:**
India's approach evolved from **reactive relief** to a **multi-dimensional risk management framework**, aligning with global frameworks like the **Sendai Framework (2015–2030)**.

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**3. Justify the Significance of Studying Disaster Management, Highlighting Its Role in Enhancing Resilience, Minimizing Risks, and Promoting Sustainable Development.** ***(10 Marks)***

**Introduction:**

- Disaster Management is the **systematic process of planning, organizing, coordinating, and implementing** measures to prevent and mitigate disaster impacts.

**Significance:**

1. **Enhancing Resilience:**
    - Builds the capacity of communities to **prepare, withstand, and recover** from disasters.
    - Promotes early warning systems and safe infrastructure.
2. **Minimizing Risks:**
    - Identifies vulnerable areas and populations.
    - Helps in planning **risk reduction and mitigation strategies**.
    - Promotes insurance and financial risk-sharing mechanisms.
3. **Promoting Sustainable Development:**

- Integrates disaster management with **environmental protection** and resource conservation.
- Ensures that development is **risk-informed** and **climate-resilient**.

4. **Policy & Governance:**
   - Provides a framework for **legislation, planning, and community participation**.
5. **Capacity Building & Awareness:**
   - Educates people about disaster prevention, preparedness, and response.

**Conclusion:**
Studying disaster management fosters **resilient societies, reduces economic losses, and ensures sustainable growth**, making it vital for engineers, policymakers, and citizens alike.

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**4. Describe the Search and Rescue (SAR) Procedure in Disaster Response, Supported by a Case Study Illustrating Its Implementation and Effectiveness. *(10 Marks)***

**Definition:**

- **Search and Rescue (SAR)** is the process of **locating, assisting, and evacuating** victims trapped or injured during a disaster.

**Procedure:**

1. **Assessment:**
   - Evaluate the situation and identify affected zones.
2. **Planning:**
   - Allocate teams, equipment, and communication networks.
3. **Search Operation:**
   - Use trained personnel and technology (drones, thermal sensors, sniffer dogs) to locate victims.
4. **Rescue Operation:**
   - Provide first aid, evacuate victims to safety, and ensure medical care.
5. **Coordination:**
   - Collaboration between **NDRF, SDRF, Armed Forces, and local authorities**.
6. **Post-Rescue:**
   - Documentation, debriefing, and psychological support to victims.

**Case Study – Uttarakhand Floods (2013):**

- Massive floods and landslides affected Kedarnath and nearby regions.

- **NDRF and Indian Air Force** conducted large-scale SAR operations.
- Over **100,000 pilgrims and locals** were rescued via helicopters and ground teams.
- **Technologies Used:** GPS tracking, GIS mapping, and satellite communication.

**Effectiveness:**

- Rapid coordination saved thousands of lives.
- Led to improvements in **early warning systems** and **inter-agency collaboration**.

**Conclusion:**
SAR operations are vital in **reducing casualties and strengthening disaster response efficiency.**

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**5. Write a Short Note on National Disaster Management Policy.** ***(5 Marks)***

**Introduction:**

- The **National Policy on Disaster Management (NPDM), 2009** provides a **comprehensive framework** for disaster prevention, mitigation, preparedness, and response in India.

**Objectives:**

1. Promote a **culture of prevention and preparedness**.
2. Strengthen institutional mechanisms at national, state, and local levels.
3. Integrate **Disaster Risk Reduction (DRR)** into development planning.
4. Encourage **community participation** and **capacity building**.

**Key Features:**

- Based on **Disaster Management Act, 2005**.
- Defines roles of **NDMA, SDMAs, DDMAs, and NDRF**.
- Focuses on **multi-hazard approach** including natural and man-made disasters.
- Supports **public–private partnerships** and **scientific research** for resilience.

**Conclusion:**
The NPDM serves as a cornerstone for India's **risk management strategy**, ensuring a shift from reactive relief to **proactive disaster preparedness and sustainable development.**

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# 4. Institutional Framework for Disaster Management in India

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**1. Write a Short Note on Disaster Management Act, 2005. *(10 Marks)***

**Introduction:**

- The **Disaster Management Act, 2005** is a comprehensive legislation enacted by the **Government of India** to ensure effective disaster prevention, mitigation, preparedness, and response.
- It came into force on **23rd December 2005**.

**Objectives:**

1. Establish institutional mechanisms for disaster management at all levels.
2. Define powers, functions, and responsibilities of authorities.
3. Promote a holistic approach covering all disaster phases.

**Key Provisions:**

1. **National Disaster Management Authority (NDMA):** Headed by the Prime Minister; formulates national policies and plans.
2. **State Disaster Management Authorities (SDMA):** Headed by Chief Ministers; implement policies at the state level.
3. **District Disaster Management Authorities (DDMA):** Coordinate local-level activities.
4. **National Executive Committee (NEC):** Assists NDMA in policy implementation.
5. **National Institute of Disaster Management (NIDM):** Responsible for research, training, and capacity building.
6. **National Disaster Response Force (NDRF):** Specialized force for rescue and relief operations.

**Significance:**

- Ensures **coordinated response**, **legal backing**, and **accountability** in disaster management.

**Conclusion:**
The DM Act 2005 marked a paradigm shift from **reactive relief to proactive risk reduction**, strengthening India's disaster governance structure.

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**2. Discuss the Applications of Remote Sensing (GPS) and GIS in Disaster Management Process, Highlighting Its Role in Spatial Analysis, Risk Assessment, and Decision-Making. *(10 Marks)***

**Introduction:**

- **Remote Sensing (RS)** and **Geographical Information System (GIS)** are essential tools for collecting, analyzing, and visualizing spatial data related to disasters.

**Applications:**

1. **Disaster Monitoring:**
    - Satellite imagery helps track cyclones, floods, and forest fires in real time.
2. **Hazard Mapping:**
    - GIS generates hazard zonation maps for earthquakes, floods, and landslides.
3. **Risk Assessment:**
    - Combines data on hazard exposure, population density, and vulnerability to identify high-risk zones.
4. **Early Warning Systems:**
    - GPS and satellite data predict the path of cyclones or weather disturbances.
5. **Damage Assessment:**
    - Post-disaster mapping to estimate affected area, infrastructure loss, and recovery needs.
6. **Resource Allocation:**
    - Supports decision-making for deployment of relief materials and personnel.
7. **Urban Planning:**
    - GIS supports floodplain zoning, drainage mapping, and sustainable urban layouts.

**Example:**

- **ISRO** and **National Remote Sensing Centre (NRSC)** provide real-time data for flood and drought monitoring in India.

**Conclusion:**
RS and GIS technologies enable **data-driven, precise, and proactive disaster management**, improving response efficiency and risk mitigation.

**3. What Are the Scope and Responsibilities of NIDM and NDMA? *(10 Marks)***

**A. National Institute of Disaster Management (NIDM):**

**Scope:**

- Acts as the **apex training and research institute** under the DM Act 2005.

**Responsibilities:**

1. **Training & Capacity Building:** Conducts courses for officials, NGOs, and community leaders.
2. **Research & Documentation:** Publishes disaster studies and best practices.
3. **Policy Support:** Assists NDMA and SDMAs in policy formulation.
4. **Awareness Programs:** Organizes workshops and simulation exercises.
5. **International Collaboration:** Works with UNDP, SAARC, and other agencies for knowledge exchange.

**B. National Disaster Management Authority (NDMA):**

**Scope:**

- Apex policy-making body chaired by the **Prime Minister of India**.

**Responsibilities:**

1. Formulates **National Disaster Management Policy** and guidelines.
2. Approves **National Disaster Management Plan (NDMP)**.
3. Coordinates disaster response and relief across ministries.
4. Promotes **multi-hazard mitigation** and **early warning systems**.
5. Supervises **NDRF and NEC** operations.
6. Encourages **research, technology use, and community resilience.**

**Conclusion:**
NIDM focuses on **capacity building**, while NDMA leads **policy, planning, and coordination**, together ensuring comprehensive disaster management in India.

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**4. Leveraging Technology for Disaster Preparedness. *(5 Marks)***

**Introduction:**

- Technology enhances disaster preparedness by providing **early warnings, communication, and data-driven decision-making.**

**Technological Tools:**

1. **Remote Sensing & GIS:** Real-time hazard monitoring and mapping.

2. **Early Warning Systems:** Weather forecasting and alerts (IMD, ISRO).
3. **Communication Technology:** Satellite and mobile networks for rapid response.
4. **AI & Machine Learning:** Predictive modeling for floods, cyclones, and earthquakes.
5. **Drones & Robotics:** Used for surveillance, rescue, and damage assessment.
6. **Mobile Applications:** Apps like *Sachet* and *Damini* for lightning and disaster alerts.

**Conclusion:**
Technology empowers disaster managers to **anticipate, prepare, and respond effectively**, minimizing loss and improving resilience.

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**5. Outline the Functions and Duties of NIDM.** ***(6 Marks)***

**Functions of NIDM:**

1. **Training and Education:** Conduct training programs and certification courses.
2. **Research and Innovation:** Develop scientific studies and disaster management modules.
3. **Documentation:** Maintain databases, case studies, and manuals on disasters.
4. **Policy Support:** Provide technical advice to NDMA and State Authorities.
5. **Networking:** Collaborate with universities, NGOs, and international organizations.
6. **Awareness Generation:** Conduct public awareness campaigns and capacity-building workshops.

**Conclusion:**
NIDM plays a vital role in developing **skilled human resources and knowledge frameworks** for efficient disaster management.

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**6. Examine NDMA's Directives for Disaster Preparedness in India.** ***(6 Marks)***

**Key Directives:**

1. **Comprehensive Preparedness Plans:** Develop multi-hazard preparedness frameworks.
2. **Early Warning Systems:** Strengthen real-time monitoring via IMD, ISRO, and CWC.
3. **Community-Based Preparedness:** Encourage local participation and mock drills.
4. **Capacity Building:** Training programs for NDRF, SDRF, and local volunteers.
5. **Infrastructure Safety:** Enforce building codes and retrofitting of critical facilities.
6. **Information Dissemination:** Use of media, mobile alerts, and educational campaigns.

**Conclusion:**
NDMA's directives aim at creating a **culture of readiness and resilience** through coordinated planning, technology, and public awareness.

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**7. Assess the Involvement of Different Stakeholders in Mass Casualty Situations.** ***(6 Marks)***

**Stakeholders and Their Roles:**

1. **Government Agencies:**
    - NDMA, SDMA, NDRF, and police handle coordination, rescue, and resource mobilization.
2. **Health Sector:**
    - Hospitals and paramedics provide medical aid, triage, and emergency care.
3. **Community and NGOs:**
    - Provide immediate assistance, shelters, and psychological support.
4. **Armed Forces:**
    - Conduct rescue, evacuation, and logistics support.
5. **Media:**
    - Disseminates verified information and public advisories.
6. **Private Sector:**
    - Supports with funds, logistics, and corporate social responsibility (CSR) initiatives.
7. **Volunteers:**
    - Help in distributing relief materials and crowd management.

**Conclusion:**
Effective mass casualty management requires **coordination among all stakeholders**, ensuring rapid response, efficient resource use, and minimized fatalities.

---

**8. Discuss the Roles and Functions of Various Government Agencies in Disaster Management in India, Emphasizing Their Coordination and Collaboration Efforts.** ***(10 Marks)***

**Introduction:**
Disaster management in India operates through a **multi-tiered structure** involving national, state, and district-level agencies working in coordination.

**A. Key Government Agencies and Their Roles:**

1. **National Disaster Management Authority (NDMA):**
    - Apex body chaired by the Prime Minister.
    - Formulates national policies, plans, and guidelines.
    - Coordinates with ministries and state governments.
2. **National Executive Committee (NEC):**

- Implements NDMA policies and ensures inter-ministerial coordination.

3. **National Institute of Disaster Management (NIDM):**
   - Conducts training, research, and documentation.
   - Builds professional and community capacity.
4. **National Disaster Response Force (NDRF):**
   - Specialized force for rescue and relief operations.
   - Conducts mock drills and capacity-building activities.
5. **State Disaster Management Authorities (SDMAs):**
   - Headed by Chief Ministers.
   - Implement policies and prepare state disaster plans.
6. **District Disaster Management Authorities (DDMAs):**
   - Coordinate local-level disaster response and mitigation.
7. **Line Ministries & Departments:**
   - Each ministry acts as a nodal agency (e.g., Ministry of Health for epidemics, Ministry of Agriculture for droughts).
8. **Armed Forces & Central Armed Police Forces:**
   - Support large-scale rescue, relief, and logistics.

**B. Coordination and Collaboration Efforts:**

1. **National Disaster Management Framework (NDMF):** Integrates efforts across ministries.
2. **Information Sharing:** Use of GIS, IMD alerts, and NDMA data portals.
3. **Joint Training & Exercises:** Inter-agency mock drills and simulations.
4. **Public–Private Partnerships (PPP):** Collaboration with NGOs and industries.

**Conclusion:**
Effective disaster management in India relies on **synergized coordination** between agencies at all levels, ensuring timely action and resource optimization.

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**9. Write a Short Note on Function of NIDM.** ***(5 Marks)***

**Functions of the National Institute of Disaster Management (NIDM):**

1. **Training & Education:** Conducts training programs for officials, volunteers, and communities.
2. **Research & Documentation:** Develops models and maintains a database on disaster case studies.

3. **Policy Support:** Provides scientific inputs for national and state policies.
4. **Awareness Generation:** Organizes workshops and seminars for public awareness.
5. **Capacity Building:** Strengthens institutional and community resilience.
6. **Networking:** Collaborates with UNDP, SAARC, and international institutions for knowledge exchange.

**Conclusion:**
NIDM serves as India's **knowledge and training hub**, enhancing preparedness and professional capacity in disaster management.

---

**10. Discuss the Framework for Disaster Management in India.** ***(8 Marks)***

**1. Legal Framework:**

- Based on the **Disaster Management Act, 2005** which provides the legal foundation for DM governance.

**2. Institutional Framework:**

- **NDMA (National):** Policy formulation and coordination.
- **SDMA (State):** Implementation of plans at state level.
- **DDMA (District):** Local-level planning and response.

**3. Planning Framework:**

- **National Disaster Management Plan (NDMP):** Integrates prevention, mitigation, preparedness, response, and recovery.
- **State and District Plans:** Align with NDMP goals.

**4. Financial Mechanism:**

- **National Disaster Response Fund (NDRF)** and **State Disaster Response Fund (SDRF)** for relief and rehabilitation.

**5. Technological Framework:**

- Use of **GIS, RS, and IMD warning systems** for early detection and response.

**6. Community Participation:**

- Encouraging local self-governance and NGOs in disaster preparedness.

**Conclusion:**
India's framework integrates **policy, planning, finance, and community participation**, ensuring a **holistic, multi-hazard approach** to disaster management.

---

**11. Explain Role of Various Software in Disaster Management.** ***(10 Marks)***

**Introduction:**
Software tools play a crucial role in **data analysis, modeling, communication, and visualization** during all disaster phases.

**Major Software and Their Roles:**

| Software | Function | Use Case |
|---|---|---|
| **GIS (Geographic Information System)** | Spatial data analysis & mapping | Hazard zonation, risk mapping |
| **Remote Sensing Tools (ERDAS, ENVI)** | Satellite imagery analysis | Flood & drought monitoring |
| **HYSPLIT Model** | Air pollution dispersion modeling | Tracking chemical or nuclear leaks |
| **DSS (Decision Support System)** | Data integration for decision-making | Emergency planning |
| **HEC-RAS** | River and flood flow modeling | Flood forecasting |
| **CAP (Common Alerting Protocol)** | Unified communication system | Early warning dissemination |
| **Google Earth Pro** | Visualization of disaster zones | Pre- and post-disaster imagery |
| **INDRA & Bhuvan (ISRO)** | Indian GIS portals for real-time data | Mapping and emergency planning |

**Conclusion:**
Software applications enhance **accuracy, speed, and coordination** in disaster management through real-time information and predictive modeling.

---

**12. Explain Roles and Responsibilities of NDMA in Detail.** ***(10 Marks)***

**Introduction:**
The **National Disaster Management Authority (NDMA)**, established under the **DM Act, 2005**, is India's apex body for policy and coordination in disaster management.

**Roles and Responsibilities:**

1. **Policy Formulation:** Develops national policies and guidelines for disaster management.
2. **Planning:** Prepares the **National Disaster Management Plan (NDMP)** covering all hazards.
3. **Coordination:** Ensures inter-ministerial, state, and district-level coordination.
4. **Preparedness & Mitigation:** Promotes hazard-resistant construction, retrofitting, and awareness.
5. **Response Management:** Supervises **NDRF** operations during disasters.

6. **Capacity Building:** Supports training, simulation, and community programs.
7. **Use of Technology:** Promotes GIS, remote sensing, and digital communication tools.
8. **Research & Documentation:** Encourages scientific studies and dissemination of best practices.
9. **International Collaboration:** Coordinates with UN, SAARC, and global frameworks like **Sendai Framework**.
10. **Monitoring & Evaluation:** Reviews disaster preparedness levels across states.

**Conclusion:**
NDMA ensures a **comprehensive, coordinated, and technology-driven approach** to disaster risk reduction in India.

---

**13. Describe the Institutional Mechanism Setup in India. *(10 Marks)***

**Introduction:**
India's institutional mechanism for disaster management follows a **multi-level governance structure** established under the DM Act, 2005.

**1. National Level:**

- **NDMA:** Apex authority led by the Prime Minister.
- **NEC (National Executive Committee):** Implements NDMA policies.
- **NIDM:** Training and research institution.
- **NDRF:** Specialized response force.

**2. State Level:**

- **SDMA:** Headed by Chief Minister; prepares state DM plans.
- **SEC (State Executive Committee):** Executes SDMA directives.

**3. District Level:**

- **DDMA:** Headed by District Collector; manages local disaster response.
- **District Control Rooms:** Monitor and coordinate relief work.

**4. Local Level:**

- **Urban Local Bodies and Panchayats:** Community preparedness and early warning dissemination.
- **NGOs & Civil Societies:** Act as partners in relief and recovery.

**Coordination Mechanism:**

- Regular meetings between NDMA, SDMAs, and DDMAs.
- Joint operations between NDRF, SDRF, and armed forces.

- Information sharing via GIS and early warning networks.

**Conclusion:**
India's institutional setup ensures **decentralized disaster management**, integrating national leadership with **grassroot-level execution** for effective preparedness and response.

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# 5. Financing Relief Measures

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**1. Various methods of financial management during a disaster. Explain the government's fund-raising system for disaster response and recovery. / Evaluate various fundraising mechanisms for disaster management, considering their effectiveness, sustainability, and ethical implications.** ***(10 Marks — combined answer)***

**A. Methods of financial management during a disaster**

1. **Immediate Relief Funds**
    - Use of pre-existing contingency funds (National Disaster Response Fund — NDRF; State Disaster Response Fund — SDRF).
    - Quick disbursal for food, shelter, medical aid and search & rescue.
2. **Budget Reappropriation**
    - Reallocation of regular budget lines (development funds) to urgent relief and reconstruction.
3. **Insurance & Risk-Transfer Instruments**
    - Crop insurance, property insurance, parametric insurance (payouts triggered by measurable events).
    - Sovereign risk pools (regional catastrophe risk pools).
4. **Public–Private Partnerships (PPP)**
    - Mobilize corporate funding, logistics, and technical assistance under CSR or MOUs.
5. **Donations & Crowdfunding**
    - Voluntary contributions from citizens, diaspora remittances, online crowdfunding platforms.
6. **International Aid & Grants/Loans**
    - Bilateral aid, multilateral grants (UN, World Bank emergency loans/grants), and specialized funds.
7. **Microfinance & Livelihood Support**
    - Immediate low-interest loans, cash-for-work, and grants to restore livelihoods.
8. **Contingency Credit Lines**
    - Pre-approved credit facilities from national banks or development banks for rapid liquidity.

**B. Government's Fund-Raising System (typical structure & steps)**

1. **Pre-positioned Funds:** NDRF (central) and SDRF (state) for immediate response.

2. **Assessment & Demand:** Post-impact damage assessment by local/state authorities → formal request to central government for additional funds.
3. **Central Assistance Mechanisms:** Calamity Relief Fund (CRF), NDRF allocations, special budgetary packages.
4. **External Aid Approval:** Government-to-government or multilateral aid routed via MEA and Ministry of Finance with NDMA coordination.
5. **Disbursement & Audit:** Funds released to state/local agencies with prescribed utilization certificates and audits for transparency.

**C. Evaluation of Fundraising Mechanisms (Effectiveness, Sustainability, Ethics)**

| Mechanism | Effectiveness | Sustainability | Ethical Considerations |
|---|---|---|---|
| **Pre-positioned Funds (NDRF/SDRF)** | Very effective for immediate needs | Moderately sustainable if replenished | Transparent allocation required to avoid misuse |
| **Insurance / Parametric instruments** | Fast payouts; reduces fiscal burden | Sustainable if premiums subsidized sensibly | Must ensure equitable access for poor/vulnerable |
| **International Aid** | Highly effective for large disasters | Not always sustainable (donor fatigue) | Conditionalities, sovereignty and dependency issues |
| **Crowdfunding / Donations** | Rapid mobilization; good for targeted needs | Not reliable long-term | Risk of fraud; requires accountability |
| **Budget Reallocation** | Fast and flexible | May harm long-term development if overused | Equity issues if cuts hit poor communities |
| **Public–Private (CSR)** | Brings resources & expertise | Sustainable if institutionalized | Risk of favoring visible areas over vulnerable ones |
| **Contingency Credit** | Provides liquidity quickly | Increases debt if overused | Burden on future budgets; ethical if used prudently |

**D. Key Recommendations**

- Maintain robust **pre-funding** (NDRF/SDRF) + contingency credit lines.
- Scale up **parametric insurance** for rapid, predictable payouts.
- Strengthen **transparency & audit** mechanisms for donations and external aid.
- Ensure **inclusion**—safeguards so the poorest get access to insurance/assistance.

**Conclusion:** A mixed financing strategy (pre-funds + insurance + donor & private support) with strict transparency and equity safeguards offers the best balance of effectiveness, sustainability, and ethical soundness.

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**2. Investigate the contributions of international aid agencies during extreme crises.** ***(7 Marks)***

**Role & Contribution Areas**

1. **Immediate Relief & Humanitarian Assistance**
    - Provide food, water, shelter, medical aid, and emergency logistics through agencies like **UN OCHA, WFP, UNICEF, ICRC/Red Cross**.
2. **Technical Expertise & Capacity Building**
    - Offer specialists (logistics, health, water & sanitation, camp management) and training to local responders.
3. **Large-scale Funding & Pooled Mechanisms**
    - Mobilize funds quickly via the **UN Flash Appeals**, CERF (Central Emergency Response Fund), and humanitarian pooled funds.
4. **Coordination & Information Sharing**
    - Lead cluster coordination (health, shelter, WASH, protection) and situational reporting to prevent duplication.
5. **Reconstruction & Recovery Support**
    - Provide grants/loans, livelihoods programs, and technical assistance for "build back better" reconstruction (e.g., World Bank/ADB).
6. **Advocacy & Standards**
    - Promote humanitarian principles, accountability (CHS), and safeguard standards (protection, gender).
7. **Long-term Resilience & DRR Funding**
    - Support disaster risk reduction programs, climate adaptation funds (Green Climate Fund), and capacity building.

**Limitations / Challenges**

- Coordination complexity; risk of parallel systems.
- Conditionalities & donor priorities may not align with local needs.
- Logistical constraints in insecure or remote areas.

**Conclusion:** International agencies play an essential catalytic role—providing funds, expertise, coordination, and standards—especially where local capacity or resources are overwhelmed.

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**3. Assess the contributions of various NGOs in Disaster Management, outlining their roles in emergency response, community engagement, and capacity-building initiatives. Additionally, list major NGOs operating globally in this field.** ***(10 Marks)***

**A. Roles & Contributions of NGOs**

1. **Immediate Response & Relief Delivery**
    - Rapid on-ground distribution of food, water, shelter, medical relief (often faster due to local presence and flexibility).
2. **Community Engagement & Local Knowledge**
    - Work with local communities to design culturally appropriate responses; mobilize volunteers and local leaders.
3. **Capacity Building & Preparedness**
    - Train community first responders, run early warning awareness, conduct drills and preparedness programs.
4. **Recovery & Livelihood Restoration**
    - Support rebuilding homes, restoring livelihoods (cash transfers, skill training), and psychosocial support.
5. **Advocacy & Policy Influence**
    - Advocate for vulnerable groups, push for inclusive policies, and hold authorities accountable.
6. **Specialized Services**
    - Health (MSF), shelter (ShelterBox), WASH (WaterAid), child protection (Save the Children).
7. **Innovation & Partnerships**
    - Pilot scalable solutions (cash transfers, community insurance) and partner with governments/UN for broader impact.

**B. Effectiveness Factors**

- Local presence and community trust → speed and appropriateness.
- Partnerships with governments and UN clusters → improved coordination.
- Transparent reporting and accountability → donor confidence and sustained support.

**C. Major International NGOs in Disaster Management (examples)**

- **International Federation of Red Cross and Red Crescent Societies (IFRC)** / National Red Cross Societies
- **Médecins Sans Frontières (MSF / Doctors Without Borders)**
- **Oxfam International**

- **Save the Children**
- **CARE International**
- **World Vision**
- **Mercy Corps**
- **ShelterBox** (shelter solutions)
- **International Rescue Committee (IRC)**
- **ActionAid**
- **Plan International**
- **WaterAid** (WASH specialist)

**D. Recommendations for NGO Impact**

- Strengthen **localization** (funding and leadership to local NGOs).
- Improve **coordination with state agencies** to avoid duplication.
- Emphasize **transparency, accountability, and safeguarding** in operations.

**Conclusion:** NGOs are indispensable at all stages—rapid response, community engagement, recovery and capacity building. When coordinated with governments and international agencies, their impact multiplies.

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# 6. Preventive and Mitigation Measures

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**1. Explain Disaster Management for Floods in Urban Areas.** ***(5 Marks)***

**Introduction:**
Urban floods occur when natural drainage systems are overwhelmed by intense rainfall, blocked drains, or poor urban planning.

**Causes:**

- Encroachment on water bodies
- Inadequate drainage systems
- Climate change and excessive rainfall
- Improper solid waste disposal blocking storm drains

**Management Measures:**

**a) Structural Measures:**

1. Construction of **stormwater drains and retention basins**.
2. **Rainwater harvesting** and **permeable pavements**.
3. **Desilting** and cleaning of existing drains before monsoons.

**b) Non-Structural Measures:**

1. Flood forecasting and **early warning systems** using IMD & GIS.
2. Urban zoning and land-use planning (avoid low-lying construction).
3. Public awareness campaigns and community drills.

**Example:**

- The **Mumbai Floods (2005)** led to reforms like stormwater project "**BRIMSTOWAD**" for improving city drainage.

**Conclusion:**
An integrated approach combining **engineering solutions, urban planning, and community awareness** is key for sustainable flood management in cities.

---

**2. Explain the Concept of Capacity Building along with a Suitable Example.** ***(5 Marks)***

**Definition:**
Capacity building refers to the process of **enhancing the abilities, knowledge, and resources** of individuals, communities, and organizations to effectively prepare for and respond to disasters.

**Components:**

1. **Training & Education:** Skill-building for rescue, first aid, and emergency response.

2. **Institutional Strengthening:** Empowering disaster management authorities and local bodies.
3. **Resource Mobilization:** Ensuring availability of equipment, funds, and communication systems.
4. **Community Empowerment:** Involving local people in planning and drills.

**Example:**

- The **National Institute of Disaster Management (NIDM)** conducts capacity-building programs for officials and communities through simulations and workshops.

**Conclusion:**
Capacity building transforms vulnerable communities into **resilient, self-reliant units** capable of effective disaster management.

---

**3. Explain with Examples Structural and Non-Structural Mitigation Measures.** ***(6 Marks)***

**Structural Mitigation Measures:**
These involve **physical constructions** to reduce disaster impacts.

**Examples:**

1. **Flood levees and embankments** – prevent river overflow.
2. **Earthquake-resistant buildings** – base isolation, flexible frames.
3. **Cyclone shelters** and coastal embankments.
4. **Retrofitting of bridges and public buildings.**

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**Non-Structural Mitigation Measures:**
These involve **policies, laws, and awareness** to minimize risks.

**Examples:**

1. **Land-use planning** – avoid construction in flood-prone areas.
2. **Early warning systems** – IMD cyclone alerts.
3. **Building codes** and enforcement.
4. **Public education and community preparedness.**

**Conclusion:**
Both structural and non-structural measures complement each other to achieve **comprehensive disaster risk reduction.**

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**4. What Are the Dos and Don'ts in the Event of a Covid-like Pandemic?** ***(6 Marks)***

**Do's:**

1. Wear **masks** and maintain **social distancing**.

2. Wash hands regularly or use sanitizer.
3. Get **vaccinated** and follow health advisories.
4. Stay home during lockdowns and **report symptoms** immediately.
5. Maintain mental well-being through healthy routines.

**Don’ts:**

1. Avoid **crowded places** and unnecessary travel.
2. Do not **spread misinformation** or rumors.
3. Avoid **self-medication** without medical advice.
4. Do not **ignore hygiene** or neglect vulnerable groups.

**Conclusion:**
Following preventive protocols ensures **personal safety and collective control** during pandemic situations.

---

**5. Guidelines for Earthquake Safety.** ***(5 Marks)***

**Before an Earthquake:**

1. Identify safe spots (under sturdy tables, open spaces).
2. Secure heavy furniture and appliances.
3. Prepare an emergency kit and evacuation plan.

**During an Earthquake:**

1. **Drop, Cover, and Hold On** until shaking stops.
2. Stay away from windows, glass, and tall furniture.
3. Do not use elevators.

**After an Earthquake:**

1. Check for injuries and provide first aid.
2. Switch off gas and electricity if damaged.
3. Listen to official updates and avoid panic.

**Conclusion:**
Adherence to safety guidelines minimizes injury and ensures quick evacuation during seismic events.

---

**6. Define Early Warning Systems and Illustrate Their Benefits through Recent Instances of Flood, Cyclone, and Tsunami Alerts.** ***(8 Marks)***

**Definition:**
An **Early Warning System (EWS)** is a coordinated set of tools, communication methods, and institutions that **detect, forecast, and alert** populations before hazards strike.

**Components:**

1. **Risk Knowledge** – Identify hazards and vulnerable areas.
2. **Monitoring & Forecasting** – Using satellite and meteorological data.
3. **Communication** – Rapid dissemination of alerts.
4. **Response Capability** – Community action and evacuation.

**Benefits (with examples):**

1. **Floods (Assam, 2022):**
    - IMD and CWC issued flood forecasts 48 hrs in advance, enabling timely evacuation.
2. **Cyclones (Cyclone Fani, 2019):**
    - Odisha's EWS and mass evacuation saved over 1 million lives.
3. **Tsunami (Indian Ocean, 2018):**
    - INCOIS issued alerts using seismic and ocean buoys; reduced coastal casualties.

**Advantages:**

- Saves lives and property.
- Reduces panic through timely communication.
- Strengthens community trust in institutions.

**Conclusion:**
Effective early warning systems transform **reactive disaster response into proactive risk reduction.**

---

**7. Explain Triage. Analyze the Importance of Initial Response in Disaster Management.** ***(8 Marks)***

**Definition of Triage:**
Triage is the process of **sorting and prioritizing patients** based on the severity of injuries to ensure optimal use of medical resources during emergencies.

**Triage Categories:**

1. **Immediate (Red):** Critical injuries requiring urgent care.
2. **Delayed (Yellow):** Serious but can wait.
3. **Minor (Green):** Minor injuries; can self-treat.
4. **Deceased/Expectant (Black):** No signs of life or hopeless cases.

**Importance of Initial Response:**

1. **Life-saving:** Quick triage and first aid reduce mortality.
2. **Efficient Resource Allocation:** Ensures limited resources serve the most critical cases first.
3. **Coordination:** Guides rescue teams, paramedics, and logistics.
4. **Stabilization:** Helps prevent worsening of conditions before hospital transfer.
5. **Data Collection:** Provides situational awareness for management decisions.

**Example:**
During the **2015 Nepal Earthquake**, triage-based emergency care helped hospitals manage overwhelming casualties effectively.

**Conclusion:**
Triage and a prompt initial response are crucial for **reducing fatalities and ensuring organized medical relief** during large-scale disasters.

| Triage category | Priority | Color | Conditions |
|---|---|---|---|
| Immediate | 1 | RED | Chest wounds, shock, open fractures, 2-3 burns |
| Delayed | 2 | YELLOW | Stable abdominal wound, eye and CNS injuries |
| Minimal | 3 | GREEN | Minor burns, minor fractures, minor bleeding |
| Expectant | 4 | BLACK | Unresponsive, high spinal cord injury |

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**8. Describe Non-Structural Measures for Pandemic Containment.** ***(6 Marks)***

**Definition:**
Non-structural measures involve **policy, behavioral, and administrative strategies** that control the spread of disease without physical infrastructure.

**Measures:**

1. **Health Surveillance Systems:** Early detection and contact tracing.
2. **Quarantine & Isolation Policies:** To break transmission chains.
3. **Public Awareness Campaigns:** Promoting hygiene and mask use.
4. **Vaccination Drives:** Immunization planning and monitoring.
5. **Travel Restrictions & Border Control:** Limiting disease spread.
6. **Digital Tracking Systems:** Aarogya Setu, CoWIN platforms for data management.

7. **Psychosocial Support:** Managing stress and misinformation.

**Conclusion:**
Non-structural strategies ensure **public compliance, efficient governance, and rapid containment** of pandemics through coordination and awareness.

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**9. Highlight the Protective Role of Natural Ecosystems against Disasters, with Examples. *(6 Marks)***

**Introduction:**
Natural ecosystems act as **biological barriers** that absorb and reduce the impact of natural disasters, protecting human life and infrastructure.

**Roles of Ecosystems:**

1. **Mangroves:**
    - Absorb wave energy and reduce coastal erosion and cyclone damage.
    - *Example:* Sundarbans mangroves protected coastal West Bengal during Cyclone Amphan (2020).
2. **Wetlands and Floodplains:**
    - Act as natural sponges, absorbing excess rainfall and reducing floods.
    - *Example:* Loktak Lake in Manipur moderates regional flood levels.
3. **Forests:**
    - Stabilize slopes and prevent **landslides** through root binding.
    - *Example:* Himalayan forests reduce soil erosion and debris flow.
4. **Coral Reefs:**
    - Break wave energy, protecting coastlines from tsunamis and storms.
5. **Sand Dunes and Vegetation:**
    - Reduce wind erosion and serve as natural buffers in coastal zones.

**Conclusion:**
Conserving ecosystems is an **eco-friendly and cost-effective mitigation strategy**, enhancing both biodiversity and disaster resilience.

---

**10. Define Liquefaction and Debate the Merits of Retrofitting versus Relocation in Landslide-Prone Areas. *(6 Marks)***

**Definition:**
**Liquefaction** is a phenomenon during earthquakes where **water-saturated soil loses strength and behaves like a liquid**, causing building and infrastructure collapse.

**Merits of Retrofitting:**

1. Strengthens existing structures using slope stabilization, retaining walls, and anchoring.
2. Cost-effective compared to total relocation.
3. Preserves community and livelihoods.
4. *Example:* Retrofitting of roads and slopes in Himachal Pradesh using rock bolts.

**Merits of Relocation:**

1. Safest for extremely high-risk areas.
2. Prevents recurring loss of lives and property.
3. Allows ecological restoration of fragile zones.
4. *Example:* Relocation of villages from landslide zones in Uttarakhand (Chamoli district).

**Conclusion:**

- **Retrofitting** is suitable for moderate-risk areas, while **relocation** is essential where safety cannot be ensured.
  A **combination of both** ensures long-term stability and sustainability.

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**11. Enumerate Preparedness Measures for Minimizing Chemical Disaster Losses. *(5 Marks)***

1. **Hazard Identification and Risk Assessment (HIRA):** Identify potential leak points and high-risk zones.
2. **Emergency Planning:** Develop on-site and off-site emergency response plans.
3. **Installation of Safety Systems:** Gas detectors, pressure release valves, and automatic shutdowns.
4. **Training and Drills:** Regular mock drills for workers and local communities.
5. **Safety Regulations:** Compliance with the **Factories Act, 1948** and **Environment (Protection) Act, 1986**.
6. **Public Awareness:** Inform nearby residents about emergency response steps.
7. **Coordination with Local Authorities:** Quick response through fire, health, and police departments.

**Example:**
Post-Bhopal Gas Tragedy, the government implemented the **Chemical Accidents (Emergency Planning, Preparedness, and Response) Rules, 1996.**

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**12. Define Bio-shield and Explore its Utility in Disaster Mitigation, Particularly in Addressing Specific Hazards such as Floods, Landslides, and Coastal Erosion. *(5 Marks)***

**Definition:**
A **Bio-shield** refers to a **natural or man-made vegetative barrier** (trees, mangroves, shrubs) that protects areas from environmental hazards.

**Utility in Disaster Mitigation:**

1. **Floods:** Vegetation increases water absorption and reduces surface runoff.
    - *Example:* Bamboo plantations in Assam reduce riverbank erosion.
2. **Landslides:** Forests stabilize slopes through root reinforcement.
3. **Coastal Erosion:** Mangroves and casuarina plantations reduce tidal wave force.
4. **Cyclones:** Acts as a natural windbreak, reducing wind velocity near coastlines.
    - *Example:* Bio-shields along Tamil Nadu coast mitigated impact of the 2004 tsunami.

**Conclusion:**
Bio-shields are **low-cost, sustainable, and eco-friendly** mitigation strategies that enhance environmental resilience and protect local communities.

---

**13. Outline Structural Mitigation Measures Suitable for Drought-Prone Regions.** ***(5 Marks)***

1. **Water Harvesting Structures:**
    - Construction of check dams, farm ponds, and percolation tanks.
2. **Irrigation Infrastructure:**
    - Drip and sprinkler systems for efficient water use.
3. **Watershed Management:**
    - Contour bunding, terracing, and afforestation to conserve soil moisture.
4. **Groundwater Recharge Wells:**
    - Improves water table during dry seasons.
5. **Storage Reservoirs:**
    - Small dams for multipurpose water use.
6. **Drought-Resistant Cropping Systems:**
    - Promotion of short-duration, low-water crops.

**Example:**
The **Sukhomajri Project (Haryana)** implemented watershed and check dam construction to combat droughts effectively.

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**14. Examine the Multifaceted Components of Disaster Management, Including Preparedness, Response, Recovery, and Mitigation Strategies.** ***(10 Marks)***

**Introduction:**
Disaster Management is a **continuous, integrated process** encompassing preventive, responsive, and recovery measures.

**1. Preparedness:**

- Pre-disaster planning and training to ensure readiness.
- Activities: Early warning systems, mock drills, emergency kits.

**2. Response:**

- Immediate actions after disaster impact.
- Activities: Search & rescue, medical aid, relief distribution.

**3. Recovery:**

- Restoring normalcy through rehabilitation and reconstruction.
- Activities: Infrastructure rebuilding, livelihood restoration.

**4. Mitigation:**

- Long-term measures to reduce hazard intensity and vulnerability.
- Activities: Structural works (dams, shelters), policies, and zoning regulations.

**Example:**
The **2013 Uttarakhand floods** showed the need for integrating all four components for effective disaster risk management.

**Conclusion:**
An effective DM plan must address **all phases** to ensure resilience, minimize loss, and promote sustainable recovery.


---

**15. Define Capacity Development and Illustrate its Application through a Case Study of Community-Based Disaster Management (CBDM). *(10 Marks)***

**Definition:**
**Capacity Development** means enhancing the abilities of individuals, institutions, and communities to anticipate, prepare for, and recover from disasters.

**Community-Based Disaster Management (CBDM):**

- A **bottom-up approach** where local communities actively participate in planning and response.
- Focuses on **empowerment, participation, and self-reliance.**

**Key Features:**

1. **Risk Identification:** Local mapping of hazards and vulnerabilities.
2. **Local Planning:** Development of community disaster plans.
3. **Training & Awareness:** First aid, evacuation, and early warning.
4. **Partnership:** Collaboration with NGOs and local authorities.

**Case Study — Orissa Cyclone (1999):**

- Post-disaster, **ODRAF and local NGOs** trained communities for cyclone shelter management.
- Resulted in massive reduction in casualties during **Cyclone Phailin (2013)** due to early evacuation and local preparedness.

**Benefits:**

- Builds **resilience and ownership** among local people.
- Enhances sustainability through **knowledge transfer**.

**Conclusion:**
CBDM integrates **local wisdom and modern tools**, ensuring sustainable and inclusive disaster risk reduction in India.

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**16. Enumerate Essential Do's and Don'ts for Disaster Preparedness and Response.** ***(10 Marks)***

**Do's:**

1. Keep emergency kits (torch, first aid, documents).
2. Know local evacuation routes and safe shelters.
3. Listen to official warnings and alerts.
4. Participate in community mock drills.
5. Help children, elderly, and disabled during evacuation.
6. Switch off gas, electricity, and water before leaving home.

**Don'ts:**

1. Don't spread rumors or panic.

2. Avoid using elevators during earthquakes.
3. Don’t ignore evacuation warnings.
4. Avoid floodwaters and damaged bridges.
5. Don’t stockpile essentials unnecessarily.

**Conclusion:**
Adhering to Do’s and Don’ts ensures **personal safety, efficient evacuation, and effective community response** during emergencies.

---

**17. Write a Short Note on Capacity Building.** ***(5 Marks)***

**Definition:**
Capacity building means **developing human, institutional, and community abilities** to effectively deal with disasters.

**Objectives:**

1. Enhance knowledge, skills, and resources.
2. Improve institutional coordination and preparedness.
3. Promote community participation and resilience.

**Components:**

- Training programs, awareness campaigns, and simulation exercises.
- Strengthening emergency infrastructure and communication systems.

**Example:**
The **National Institute of Disaster Management (NIDM)** conducts national and regional workshops for disaster responders and local volunteers.

**Conclusion:**
Capacity building creates a foundation for **effective disaster preparedness and long-term resilience** at all levels.

---

**18. Write a Short Note on Sea Walls, Embankments, and Bio-shields.** ***(5 Marks)***

**Sea Walls:**

- Reinforced concrete or rock structures built **parallel to the shoreline** to prevent sea waves from eroding coastal areas.
- **Function:** Reflect wave energy and protect coastal settlements and roads.
- *Example:* Sea walls along the **Chennai Marina Beach** reduce coastal erosion.

**Embankments:**

- Earthen or concrete barriers constructed along rivers or coasts to **prevent flooding and saltwater intrusion**.
- *Example:* River embankments in **Bihar** control seasonal floods.

**Bio-shields:**

- Natural or man-made **vegetative barriers** such as mangroves, casuarina, and palm trees planted along coastlines.
- **Function:** Absorb wave energy, reduce wind speed, and prevent soil erosion.
- *Example:* Tamil Nadu bio-shields mitigated tsunami impact in 2004.

**Conclusion:**
All three act as **complementary protective measures**, balancing structural engineering with ecological protection.

---

**19. Differentiate between Structural and Non-Structural Measures of Flood Mitigation and Discuss the Importance of Forecasting, Warning, and Monitoring System in India.** ***(8 Marks)***

**A. Structural Measures:**

- Physical constructions designed to control floodwaters.

| **Structural Measures** | **Purpose** |
|---|---|
| Dams & Reservoirs | Store excess rainfall |
| Embankments & Levees | Prevent river overflow |
| Floodways & Channels | Divert floodwaters |
| Drainage Improvements | Enhance urban water flow |

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**B. Non-Structural Measures:**

- Policy and management strategies to reduce flood risk.

| **Non-Structural Measures** | **Purpose** |
|---|---|
| Flood forecasting & early warning | Timely evacuation |
| Land-use zoning | Prevents settlement in floodplains |
| Flood insurance | Provides financial relief |
| Public awareness & education | Promotes preparedness |

---

**C. Importance of Forecasting, Warning, and Monitoring in India:**

1. **Forecasting:**

- IMD and CWC use radar, satellites, and rainfall models for real-time prediction.
- Example: Flood forecasts along Ganga and Brahmaputra.

2. **Warning Systems:**
   - SMS alerts, radio, and television bulletins inform vulnerable populations.
3. **Monitoring:**
   - Use of GIS and remote sensing to track rainfall and river levels.
4. **Benefits:**
   - Saves lives, reduces damage, and supports evacuation and resource planning.

**Conclusion:**
Integrated use of **structural, non-structural, and early-warning systems** ensures comprehensive flood mitigation.

---

**20. Explain in Detail the Design Concepts and Construction Materials for Safe Construction of Facilities in Case of Earthquakes and Cyclones. Also Discuss Fire-Resistant Facilities.** ***(8 Marks)***

**A. Earthquake-Resistant Design Concepts:**

1. **Lightweight Structures:** Reduces inertia during shaking.
2. **Base Isolation Systems:** Rubber bearings absorb seismic shocks.
3. **Flexible Frames:** Steel and RCC frames to resist lateral forces.
4. **Symmetrical Layout:** Prevents torsion imbalance.
5. **Reinforced Concrete (RCC):** Strengthens columns, beams, and joints.

**Materials:**

- Reinforced concrete, structural steel, and ductile materials with high tensile strength.

---

**B. Cyclone-Resistant Design Concepts:**

1. **Aerodynamic Shape:** Reduces wind pressure on walls and roofs.
2. **Anchoring:** Roofs and walls tied to foundation with metal straps.
3. **Strong Foundations:** Pile foundations in coastal areas.
4. **Use of Wind-Resistant Materials:** Corrugated metal, reinforced masonry.
5. **Storm Shutters & Ventilation:** To withstand high-speed winds.

---

**C. Fire-Resistant Facilities:**

1. **Use of Non-Combustible Materials:** Brick, RCC, gypsum board.

2. **Automatic Sprinkler Systems** and **fire alarms.**
3. **Fire Exits:** At least two per building with illuminated signs.
4. **Smoke Ventilation:** Vertical shafts for smoke release.
5. **Firefighting Equipment:** Extinguishers, hydrants, and water tanks.

**Conclusion:**
Adherence to **IS building codes** and fire-safety norms ensures **structural resilience and occupant safety** during disasters.

---

**21. Explain Vulnerability with Reference to Floods and Cyclones. List Down Preparatory Measures for Minimizing Vulnerabilities Related to Tsunami.** ***(6 Marks)***

**Vulnerability (Definition):**
The degree to which people, infrastructure, or systems are **susceptible to damage** from disasters.

**Flood Vulnerability:**

- Settlements in low-lying floodplains.
- Poor drainage and encroachments.
- Weak housing and lack of embankments.

**Cyclone Vulnerability:**

- Coastal settlements with inadequate shelters.
- Poorly built houses and power lines.
- Dependence on fishing and agriculture.

**Preparatory Measures for Tsunami:**

1. Installation of **tsunami early warning systems (INCOIS)**.
2. Construction of **elevated shelters** and evacuation routes.
3. **Community awareness** and mock drills.
4. Coastal **afforestation (bio-shields)**.
5. **Zoning regulations** restricting coastal construction.

**Conclusion:**
Reducing vulnerability requires **awareness, early warning, and resilient infrastructure.**

---

**22. Define the Term Mitigation.** ***(5 Marks)***

**Definition:**
Mitigation refers to **measures taken to minimize the impact or intensity of a disaster** before it occurs.

**Types:**

1. **Structural Mitigation:** Physical measures like embankments, shelters, dams.
2. **Non-Structural Mitigation:** Policies, awareness, insurance, and zoning laws.

**Goal:**
To **reduce vulnerability** and prevent disasters from becoming catastrophic.

**Example:**
Retrofitting buildings in earthquake zones and constructing cyclone shelters in Odisha.

**Conclusion:**
Mitigation focuses on **prevention and preparedness** to safeguard lives and infrastructure.

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**23. What Are Different Mitigation Measures for Tsunami and Cyclones?** ***(10 Marks)***

**A. Tsunami Mitigation:**

1. **Early Warning Systems (INCOIS):** Real-time seismic and ocean data.
2. **Coastal Zoning:** No-construction buffer zones.
3. **Bio-shields:** Mangrove and casuarina plantations.
4. **Tsunami Shelters:** Elevated reinforced concrete structures.
5. **Community Education:** Evacuation drills and awareness.
6. **Structural Measures:** Sea walls and embankments to reduce wave energy.

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**B. Cyclone Mitigation:**

1. **Cyclone Shelters:** Concrete shelters for coastal communities.
2. **Improved Housing:** Wind-resistant roofs and foundations.
3. **Early Warning & Evacuation:** IMD alerts and siren systems.
4. **Coastal Embankments:** Prevent saline intrusion.
5. **Afforestation:** Acts as a natural windbreak.
6. **Disaster Insurance:** Financial safety for affected families.

**Conclusion:**
Combining **engineering, environmental, and community-based measures** ensures reduced disaster impacts.

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**24. Enlist Structural Mitigation Measures for Flood.** ***(5 Marks)***

1. Construction of **dams and reservoirs** for water storage.

2. Building **embankments and levees** along rivers.
3. **Drainage system improvement** in urban areas.
4. **Retention ponds and floodways** to divert excess water.
5. **Desilting and dredging** of riverbeds.
6. **Stormwater management systems** in cities.

**Example:**
The **Ganga Flood Control Commission** implements structural flood mitigation projects in North India.

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**25. Explain Bio-shield and Sea Wall in Detail with Schematic Diagram. *(10 Marks)***

**Bio-shield:**

- A **living barrier** of vegetation like mangroves, palm, and casuarina planted along coastlines.
- **Functions:**
    1. Reduces wind and wave energy.
    2. Prevents soil erosion and salinity intrusion.
    3. Provides habitat and livelihood (fisheries, honey).
- *Example:* Post-2004 tsunami, Tamil Nadu initiated massive bio-shield plantations.

**Sea Wall:**

- A **man-made reinforced structure** built parallel to the coast to prevent erosion and tidal flooding.
- **Functions:**
    1. Reflects and dissipates wave energy.
    2. Protects settlements and infrastructure.
    3. Serves as a foundation for coastal roads or promenades.
- *Example:* Sea walls in Kerala and Chennai.

**Combined Effect:**
Both act as **complementary barriers**—one engineered, one ecological—for coastal protection.

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**26. What Are Do's and Don'ts in Earthquake, Tsunami, and Cyclone? *(10 Marks)***

**A. Earthquake**
**Do's:**

- Drop, Cover, and Hold On.

- Move away from glass windows.
- Switch off gas and power lines.
  **Don’ts:**
- Do not use elevators.
- Don’t run outside during tremors.

**B. Tsunami**
**Do’s:**

- Move to higher ground immediately after tremors.
- Listen to official warnings (INCOIS).
- Keep emergency kits ready.
  **Don’ts:**
- Do not go near the shore to watch waves.
- Avoid returning until official clearance.

**C. Cyclone**
**Do’s:**

- Stay indoors; secure windows and roofs.
- Keep torches, radio, and first-aid kits ready.
- Evacuate if advised by authorities.
  **Don’ts:**
- Don’t drive or wade in floodwaters.
- Avoid standing near glass doors or weak structures.

**Conclusion:**
Following the correct **Do’s and Don’ts** minimizes injuries, panic, and property loss during disasters.

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