

**GENERAL STUDIES-III- (TECHNOLOGY, ECONOMIC DEVELOPMENT, BIO-DIVERSITY, ENVIRONMENT, SECURITY AND DISASTER MANAGEMENT)**

**About the Coal Gasification Scheme**

- **Third Category:** Under this, **Rs 600 crore** has been provisioned for **demonstration projects** (indigenous technology) or **small-scale product-based gasification plants**.
  - A lump-sum grant of **Rs 100 crore or 15 per cent of capex**, whichever is lower, will be given to the selected entity.
- **Selection of Entities:** The selection of entities under **categories II and III** through a **competitive and transparent bidding process**.

**What is Coal Gasification?**

Coal Gasification is a **thermo-chemical process** that **converts coal into simple molecules**, primarily carbon monoxide and hydrogen, called **synthesis gas or syngas**.

- **Mechanism:** In the gasification process, coal is **partially oxidised by air, oxygen, steam**, or carbon dioxide under controlled conditions to produce a liquid fuel known as syngas.
- **Significance:** The combustion of this gas is **cleaner and more efficient** than coal combustion since emissions are trapped at the gasification stage.
- **Methods of Coal Gasification:**
  - **In-situ method:** In this, **oxygen is infused** into the seam together with water and **ignited at high temperatures**, causing coal to partly oxidize into hydrogen, CO, carbon dioxide (CO<sub>2</sub>), methane (CH<sub>4</sub>), and hydrogen sulfide (H<sub>2</sub>S).
  - **Ex-situ reactors:** They are designed to **simulate the gasification process** above the ground's surface.
    - Sulphur in coal is **transformed to H<sub>2</sub>S** and trace volumes of **carbonyl sulphide (COS)** during the gasification process.

**Need for Coal Gasification**

- **A Proven Reserve of Thermal Coal:** A country's total estimated coal reserve (resource) per the Coal Inventory published by GSI, as of 01.04.2022 is **361411.46 million tonnes**.
- **Global Standing: Second largest** in the world after China.
  - **Production Surge: 14.8% rise in production** reaching 893 MT in the 2022-2023 financial year.
  - **Contribution:** India contributes **more than 10%** of the global coal production.
- **Coal Gasification Target:** The government has launched the **National Coal Gasification Mission** to achieve coal gasification and liquefaction of **100 MT of coal by 2030**.
- **Government Production Target:**
  - The Government aims for **self-reliance** by boosting domestic production.
  - Targeting over **1 billion tonnes in 2023-2024** and further increase it to 1.5 billion tonnes by 2029-2030.
- **Reducing Import Dependency:** India has a **huge dependency on imports** of crude and natural gas-based products mainly **methanol, ammonia, ammonium nitrate, and olefins**, which can be easily substituted by by-products derived from syngas.
- **Transition to Sustainable Energy:** India has **huge reserves of coal**, it would benefit India if it finds a sustainable way of using these reserves as the world including India is gradually **transitioning away from coal toward cleaner fuels** in the wake of climate change.
- **Sustainable Usage of Coal:** Given **India's growth potential and rising demand** for power, the demand for coal is projected to rise from the current requirement of nearly **one billion tonnes to 1.5 billion tonnes by 2029-30**.
- **Pharmaceutical Industry:** India plans to **produce active pharmaceutical ingredients (API)** domestically rather than importing them from China.
  - There is a **high potential for Syngas** to make APIs and methanol as a solvent.
- **Cleaner and environmentally Friendly:** Coal gasification plants produce **no scrubber sludge**.
  - The majority of the wash water is reprocessed, and **residual wastewater** from gasification plants can be **treated effectively**.
  - As a result, coal gasification is considered a **cleaner coal technology** than coal combustion.

**Challenges with Coal Gasification in India**

- **Inferior Quality of Coals:** The **high ash content** in Indian coal is a **technical barrier** to a larger adoption of coal gasification.
  - The ash percentage of indigenously available coal ranges **between 30-35 per cent even after washing**, which is quite high.
- **Induced Subsidence of Surrounding Rocks:** The **space created by deep mining** during the coal gasification may cause **significant deformation in the remaining coal** and surrounding rocks.
- **Occupational Hazard:** The coal Gasification process **cannot be controlled** to the same extent as surface gasifiers, which **poses the risk of high temperature and pressure** in the cavity, furthering the workers' risk.

- **Environmental Factors:** According to some studies, coal gasification **generates more CO<sub>2</sub>** than a conventional coal power station.
- **Groundwater Contamination:** While the nation **already faces water scarcity**, coal gasification is a **more water-intensive energy** generation method.
- **Economy of Projects:** It is an inherently **‘unsteady’ state process**; the flow rate and the heating value of the product gas will **vary over time**.
  - **Changes in the quantity and quality** of gas produced will significantly impact the project’s economics.
- **Technological Concern:** **Lack of availability** of proven gasification technology **suitable for poor quality Coal**.

#### Way Forward

- **Regulation on Ash Content:** The ash content of coal supplies **needs to be enforced**. Present regulations limiting ash content to **34% are not being enforced**.
  - Coal washeries pose **challenges regarding investment, water usage and water disposal**.
  - **Coal blending** is the **path forward**, as waste streams from the gasification process are **easier to handle and can be value-adding in themselves** (e.g. sulphur, slag).
- **Level Playing Field:** **Exemption from currently applicable Cess / Duties** on Coal Feedstock prices should be provided for **environment-friendly Coal Gasification Projects** due to its **Clean Technology adaptation**.
- **National Policy on Coal Gasification & Liquefaction:** This should be **urgently formulated and promulgated** for faster and smoother implementation of Coal Gasification Projects.
- **Dedicated Closed Coal Mines for Coal Gasification:** Coal Mines should be **earmarked for Coal Gasification Projects** (to be awarded through Auction Linkage) for **better Coal Quality consistency**, sustained Supply & closer Mining & Transportation Cost control.
- **Viability Gap Funding:** **Financial incentives** from the government to support **very high CAP of gasification projects** needed to improve the viability of **‘Energy Security’ (Clean) projects**.

Coal gasification offers a cleaner energy alternative, but overcoming technical and environmental challenges requires **robust regulations, financial incentives, and sustainable practices** to ensure successful implementation.

### GENERAL STUDIES-II- (GOVERNANCE, CONSTITUTION, POLITY, SOCIAL JUSTICE AND INTERNATIONAL RELATIONS)

#### Women Leaders In Public Finance, Gender Responsive Budgeting Leads To Better Gender Outcomes

**Systemic gender inequalities** exist despite global gains in human development indicators and economic opportunities.

Gender Responsive Budgeting Leads To Better Gender Outcomes

**Unequal access to education, health services and legal rights, violence against women and cultural barriers result in unequal opportunities.**

- For instance, women’s labour force participation rate is **25% versus 58% for men** and on average, they are paid **34% lower than men**.
- Moreover, women are **disadvantaged** when it comes to **digital and financial inclusion**, access to social protection, land and housing.
- In fact, the **gender gap has become worse** after Covid and the **World Economic Forum’s Global Gap Report 2023** notes that at current progress, it will take us **131 years to close the gender gap**.
- **Affirmative action in resource allocation** is key to correcting historical inequalities.
- **Gender equality in the distribution of resources** has a positive multiplier effect for a country’s socio-economic development goals and **governments can play a catalytic role** through their planning and budgeting decisions.
- Here, **robust Public Finance Management (PFM) systems** can ensure that government expenditure improves public service delivery, speeds up poverty reduction, promotes equal opportunities and achieves sustainable development goals.
- With governments around the world **spending one-third of GDP on public services**, applying the gender lens to these spending decisions holds **great potential for achieving better gender outcomes**.

#### **Women in Leadership Positions Can Further the Agenda**

**IMF’s Gender Strategy 2022** notes that **female leadership** and diversity on boards of financial institutions are **associated with greater financial stability**.

- It also points out that **female political leadership** is associated with **greater infrastructure spending** and the educational attainment of girls.
- Research on Indian **Panchayati Raj Institutions (PRIs)** shows that female political leaders have a **positive impact on female voter turnouts, health and education outcomes**, and the aspirations of young girls to take up leadership roles.
- Further, having more women in public administration makes the government **more responsible and accountable** to diverse public interests, **improves the quality of services** delivered, and instils trust amongst citizens towards it.
- Findings from the **private sector corroborate** that women at all levels of management showed up as **better leaders, more consistently supporting employees** and championing diversity, equity and inclusion.

- Hence, it is evident that women leaders **not only promote other women** and their needs but also make **informed and equitable spending decisions**.
- However, women are **under-represented** in decision-making roles, particularly in the public finance domain.
- Globally, only **11% of countries** have women leading the finance ministries.
- India is one of the few countries with a **woman finance minister** but women's representation in public finance at other levels is inadequate.
- Among states, only the Delhi government has a **woman finance minister**.
- **Central Finance Commissions (CFC)**, which are instrumental in resource allocation between **3 tiers of government**, do not have a favourable **women representation**.
- The recently commissioned 16th CFC has one female member out of 5 members.
- **Only two of the previous six CFCs** had women members, with only one-fifth representation.
- According to a statistics ministry report, women account for **only 22% of the total employees** in the Indian government's finance departments.
- Further, an assessment of employees in finance departments across states shows that **women held only 27% of senior positions** and only one state had a woman finance department head.
- The **low representation of women** in finance and public finance, in particular, is in **sharp contrast with the available talent pool**.
- Globally, women represent about **30% of economics graduates** and about **50% of business graduates (IMF 2018)**.
- Evidently, there are **barriers, independent of educational background**, preventing women from joining the field of finance and advancing to top positions.
- The barriers range from systemic ones such as **glass walls and glass ceilings**, or lapses in the provision of an inclusive working environment, including **childcare services**, to barriers such as **lack of access to patronage networks**, and inadequate training and mentoring.
- We **cannot ignore women's representation** in politics since elected representatives are key stakeholders in budget formulation, approval and monitoring.
- **Female politicians** are known to **represent the voices** of other women and advocate for gender-responsive policies and resource allocation.
- The **Women Reservation Act, 2023** is a milestone in guaranteeing the representation of women in Lok Sabha and state legislative assemblies.
- But it is **limited to one-third of all seats**.
- One-third of seats in **rural and urban local governments** are also reserved for women.
- In fact, **10 states have increased** women's reservations to **50% in PRIs**.
- Even though **equal representation needs to become the norm**, we need to move from mere representation to leadership.
- Female political leaders need to be **trained to better understand** and influence budgeting decisions.
- India, with a **woman finance minister**, has laid the pathway towards ensuring **equal representation in the domain of PFM** and raising aspirations of women to take up such roles.
- Increased assimilation of qualified women into PFM, having **access to a peer network, mentoring and training opportunities**, with a clear leadership trajectory, has the potential to **stimulate systemic change** while contributing to improved social and economic development outcomes.
- While there is **no quick fix to systemic gender inequalities**, **Gender Responsive Budgeting (GRB)** can serve as an approach and method to close gender gaps in labour force participation, education, and health outcomes.
- India is among **100 countries** to have **initiated GRB to address gender equality**, but its coverage is limited.
- Gender equality considerations and related **intersectionality are not adequately factored** in during the design, implementation and financing of government planning.
- There is a need to **mainstream gender in national development goals** and strategies by integrating GRB across all programmes, schemes and departmental budgets across tiers of the government.
- And who **better to lead this effort than women themselves**.

Promoting **gender equality in public finance** and leadership is crucial for sustainable development, and empowering women in these roles can **drive systemic change and socio-economic progress**.

**GENERAL STUDIES-III- (TECHNOLOGY, ECONOMIC DEVELOPMENT, BIO-DIVERSITY, ENVIRONMENT, SECURITY AND DISASTER MANAGEMENT)**

**Digital jurisprudence in India, in an AI era**

**ARTICLE HIGHLIGHTS**

- The landmark **Shreya Singhal judgment** upheld **Section 79 of the IT Act**.

- It grants intermediaries ‘**safe harbor**’ protection against hosting content, contingent upon meeting the due diligence requirements outlined in **Section 3(1)(b) of the Information Technology (Intermediaries Guidelines) Rules**.

### Context

#### Artificial intelligence(AI):

- It is a branch of computer science dealing with the simulation of intelligent behavior in computers.
- **It describes the action of machines** accomplishing tasks that have historically required human intelligence.
- **It includes technologies** like machine learning, pattern recognition, big data, neural networks, self algorithms etc.
- **g: Facebook’s facial recognition software** which identifies faces in the photos we post, the voice recognition software that translates commands we give to *Alexa*, etc are some of the examples of AI already around us.

#### Generative AI:

- **Generative AI industry** projected to increase **global GDP** by as much as **\$7 to \$10 trillion**, the development of generative AI solutions
- **It is a cutting-edge technological advancement** that utilizes machine learning and artificial intelligence to create new forms of media, such as text, audio, video, and animation.
- **With the advent of advanced machine learning capabilities:** It is possible to generate new and creative short and long-form content, synthetic media, and even deep fakes with simple text, also known as prompts.

#### AI innovations:

- GANs (Generative Adversarial Networks)
- LLMs (Large Language Models)
- GPT (Generative Pre-trained Transformers)
- Image Generation to experiment
- **Create commercial offerings** like DALL-E for image generation
- **ChatGPT for text generation.**
  - It can write blogs, computer code, and marketing copies and even generate results for search queries.

#### Previous Judgments and AI:

- **Christian Louboutin Sas vs Nakul Bajaj and Ors (2018):** Delhi High Court held that safe harbor protection applies solely to “passive” intermediaries
  - **referring to entities** functioning as mere conduits or passive transmitters of information.
- **S. Puttaswamy judgment (2017):** established a foundation for privacy jurisprudence in the country, leading to the enactment of the **Digital Personal Data Protection Act, 2023 (DPDP)**.
  - **The DPDP Act introduces the “right to erasure”** as well as “right to be forgotten”.
  - **Once a GAI model is trained on a dataset**, it cannot truly “unlearn” the information it has already absorbed.

#### Challenges for judiciary:

- **In Large Language Models (LLMs)**, making a distinction between user-generated and platform-generated content is challenging.
- **Liability in the case of AI chatbots** arises once the information is reposted on other platforms by the user
- **Mere response to a user prompt** is not considered dissemination.
- **The ambiguity in classifying GAI tools**, whether as intermediaries, conduits, or active creators, will complicate the ability of courts to assign liability, particularly in user reposts.
- **Classifying GAI tools, whether as intermediaries, conduits, or active creators**, will complicate the courts’ ability to assign liability.
- **ChatGPT’s ‘Terms of Use’ attempt to shift liability** to the user for any illegal output.
  - **But the enforceability** of such terms in India is uncertain.

#### AI and copyright in India:

- **Section 16 of Indian Copyright Act 1957 specifically provides that “no person” shall be entitled to protection of copyright except by the provisions of the Act.**
- **As in India, reluctance persists regarding the provisions of copyright protection to works generated by AI globally.**
  - **The 161st Parliamentary Standing Committee Report** found that the **Copyright Act of 1957** is “not well equipped to facilitate authorship and ownership by Artificial Intelligence”.
  - **Under current Indian law:** A copyright owner can take legal action against anyone who infringes on his/her work with remedies such as injunctions and damages.
    - **Copyright infringement by AI tools** is unclear.

#### Way Forward

- **Consider granting GAI platforms temporary immunity** from liability following a sandbox approach.

- **It will allow responsible development** while gathering data to identify legal issues that could inform future laws and regulations.
- **The process of data acquisition for GAI training requires an overhaul.**
  - **Developers must prioritize legal compliance** by ensuring proper licensing and compensation for the intellectual property used in training models.
  - **Include revenue-sharing or licensing agreements** with data owners.
- **Licensing data for GAI is complex as web-data lacks** a centralized licensing body similar to copyright societies in the music industry.
  - **Creation of centralized platforms**, akin to stock photo websites such as Getty Images,
  - **which simplify licensing**
  - **streamline** access to necessary data for developers
  - **ensure data integrity** against historical bias and discrimination.
- **A holistic, government-wide approach and judicious interpretations** by the constitutional courts are essential to maximize the benefits of this powerful technology,
  - **but safeguarding individual rights and protecting them** against unwelcome harm all the while.
- **It becomes imperative now to develop solutions through collaborative avenues** to safeguard confidential information, identities, and even human rights.

**GENERAL STUDIES-III (TECHNOLOGY, ECONOMIC DEVELOPMENT, BIO-DIVERSITY, ENVIRONMENT, SECURITY AND DISASTER MANAGEMENT)**

**Issues with safety inspections in industrial areas in India**

**Context:** The article highlights Maharashtra's ineffective safety inspections in industrial areas, leading to repeated accidents, including notable incidents in 2016, 2018, 2020, and 2023. It advocates for reforms aligned with international safety standards. A significant explosion in Dombivli in May 2024 caused multiple fatalities and injuries, underscoring the urgency for change.

**What are the issues with safety inspections in industrial areas in India?**

1. **Low Inspection Rates:** Across India, only 14.65% of registered factories and 26.02% of hazardous factories were inspected in 2021. This low nationwide rate reflects systemic issues in industrial safety oversight. This issue is widespread, with Maharashtra, Tamil Nadu, and Gujarat showing even lower rates than the all-India average.
2. **Inspector Shortages:** The shortage of inspectors exacerbates the problem. For instance, Maharashtra had only 48 out of 122 sanctioned inspectors appointed in 2021, resulting in each inspector being responsible for inspecting 818 factories annually.
3. **Corruption and Bribery:** There are reports of informal agreements between inspectors and factory owners, leading to compromised safety inspections.
4. **Ineffective Enforcement:** The prosecution rates are low, with Maharashtra at about 14% in 2021, reducing the deterrent effect of inspections. This contributes to repeated safety violations and accidents.

**What should be done?**

1. **Implement ILO Standards:** Follow International Labour Organization standards for inspections, including unannounced visits and sufficient staffing. This will enhance safety compliance.
2. **Penalize Non-Compliance:** Impose penalties on both companies and state officials for safety lapses. This will ensure accountability and prevent negligence.
3. **Tackle Corruption:** Address corruption by ensuring inspections are genuine and free from bribery. Reports of "understanding" between inspectors and factory owners must be eliminated for effective safety measures.

**PRELIM FACT**

**1. Jaadui Pitara (Magic Box)**

- **Union Education Minister** recently launched an **innovative learning material** for **foundational years of children** called "Pitara".

**Jaadui Pitara:**

- **About:** It consists of **playbooks, toys, puzzles, posters, flash cards, story books, worksheets** as well as reflecting the local culture, social context and languages is designed to **arouse curiosity** and accommodate the **diverse needs of learners** in the **foundational stage**.
- **Motto:** It has been designed on the motto of "learning through play" under the **National Curriculum Framework** & available in **13 Indian languages**.
- **Objective:** Enriching the **learning-teaching environment** and making it more **child-centric, lively and joyful** for the **Amrit Generation** as envisioned in the **NEP 2020**.
- **DIKSHA platform:** The resources on 'Jaadui Pitara' will be **digitally available on DIKSHA platform – portal and mobile app**.

## **2. Palm Trees**

**Context:** Odisha plans to plant **1.9 million palm trees** and restrict cutting to reduce lightning deaths, targeting areas heavily affected during pre-monsoon and monsoon seasons.

Palm trees are **part of tropical forest ecosystems and include varieties like Coconut, Oil Palm, Arecanut, and Palmyrah**. Palmyrah is the State Tree of Tamil Nadu. They act as natural conductors during lightning strikes, preventing loss of lives.

### **What is Lightning?**

- It is a **powerful electrical phenomenon** caused by the buildup of electrical charges within clouds and between clouds and the ground. It results in a **brilliant flash of light and thunder**.
- India is among a **few countries with an early warning system** for lightning, providing forecasts up to five days in advance. Lightning accounted for **2,880 deaths in 2021**, making up 40% of all accidental deaths due to natural forces, as reported by the National Crime Records Bureau (NCRB).
- Lightning frequency is highest in **northeastern states and West Bengal, Sikkim, Jharkhand, Odisha, and Bihar**.

## **3. Li-Fi technology**

**Context:** The Defence Ministry has adopted **Velmenni's Li-Fi technology** to tackle communication challenges in the Indian Navy.

Li-Fi, developed by Velmenni, **uses light for secure wireless communication**, supported by a grant under **India's iDEX initiative**.

### **What is Li-Fi Technology?**

- **LiFi (Light Fidelity) is a wireless communication technology** using visible light, specifically LED bulbs, to transmit data.
- Invented by Professor Harald Haas in 2011, LiFi **offers high-speed, bidirectional mobile communication** similar to WiFi but with faster speeds, lower latency, and greater bandwidth (thousands of terahertz).
- It operates by **modulating LED light to encode binary data**, which is then received and decoded by photodiodes to transmit data wirelessly via visible light communication. This **makes LiFi ideal for electromagnetic-sensitive environments** such as aircraft cabins, hospitals, and nuclear power plants, as it does not cause electromagnetic interference and utilizes unused visible light frequencies for communication.

## **4. Rudram-1**

**Context:** India successfully test-fires its first Indigenous anti-radiation missile, 'Rudram-1'

### **What is Rudram-1?**

- **It was developed by DRDO for the Indian Air Force** and is an **air-to-surface anti-radiation** missile launched from Sukhoi-30MKI fighter jets.
- It features INS-GPS navigation and a Passive Homing Head for accurate targeting of radiation-emitting sources.

With an effective range of 500 meters to 15 km in altitude and up to 250 km in distance, Rudram-1 significantly enhances the IAF's capability to suppress enemy air defences and neutralize critical installations.

### **ANSWER WRITING**

**India's industrial growth has been accompanied by recurring industrial accidents, raising concerns about the effectiveness of factory inspection mechanisms. In light of this, critically analyze the current state of factory inspection in India, examining its challenges and shortcomings. (15 Marks, 250 Words)**

India's industrial growth over the past few decades has positioned the country as a major global manufacturing hub. However, this rapid industrialization has been accompanied by recurring industrial accidents, underscoring significant deficiencies in factory inspection mechanisms. The recent explosion in a chemical unit in Thane, Maharashtra, which tragically killed 11 people, has brought these issues back into sharp focus.

### **Current State of Factory Inspection in India:**

- **Low Inspection Rates:** Low inspection rates lead to unchecked safety violations and hazardous conditions, increasing the risk of industrial accidents and undermining worker safety.  
For instance: In 2021, only 14.65% of registered factories and 26.02% of hazardous factories nationwide were inspected.
- **Inadequate Staffing:** The number of factory inspectors is insufficient relative to the vast number of factories, leading to infrequent and superficial inspections.  
For instance: The appointment rate for sanctioned officer positions across India was only 67.58%, indicating a severe shortage of personnel contributing to the low inspection rates.
- **Selective Enforcement:** Enforcement is sometimes selective, influenced by political and economic pressures, leading to uneven application of safety standards.  
For example: Fire at the Anaj Mandi factory in Delhi in December 2019. Despite safety regulations, the factory lacked proper fire safety measures and clearances. Inspections were reportedly lax, influenced by political and economic pressures, leading to the tragedy that claimed 43 lives.
- **Outdated Legislation:** The primary legislation governing factory inspections, the Factories Act of 1948, is outdated and does not adequately address the complexities of modern industrial operations.

**Challenges in Factory Inspections in India:**

- **Bribery and Collusion:** Corruption is a significant issue, with reports of inspectors accepting bribes to overlook violations, which undermines the integrity of the inspection process.
- **Skill Gaps:** Many inspectors lack specialised training in the latest industrial safety standards and technologies, reducing their effectiveness in identifying and mitigating risks.  
For instance: The 2020 gas leak at the LG Polymers plant in Visakhapatnam, Andhra Pradesh, revealed that many factory inspectors lacked specialised training in the latest industrial safety standards and technologies.
- **Weak Penalties:** Penalties for non-compliance with safety regulations are often too lenient to deter violations, resulting in many factories finding it more economical to pay fines rather than implement necessary safety measures, undermining the deterrent effect of regulations.
- **Lack of Accountability:** There is little accountability for inspectors who fail to perform their duties effectively, often resulting in continued unsafe practices in factories.  
For example : In a 2021 Dhampur Sugar mills case in Uttar Pradesh, repeated safety violations were found despite regular inspections, with no consequences for the inspectors who failed to enforce regulations.
- **Limited Worker Involvement:** Workers often have little involvement in safety committees or inspection processes, leading to a lack of grassroots input on safety issues.
- **Insufficient Investment in Worker Safety:** In an effort to cut costs, some industries often neglect essential safety equipment and infrastructure, such as proper ventilation and fire safety measures.  
For example: A 2023 IIT Kanpur study highlights the critical need for increased investment in worker safety to reduce industrial accidents.
- **Underutilization of Technology:** The potential of modern technologies, such as IoT and AI, to enhance safety, monitoring and predictive maintenance is largely untapped within the current inspection framework.
- **Neglected Maintenance:** Failing to maintain equipment and systems leads to deterioration, increasing the risk of malfunctions and failures.  
For example: Neyveli thermal power plant accident in Tamilnadu where a boiler unexpectedly exploded while being revived, highlights critical failures in maintaining equipment.

**Way Forward:**

- **Increase Inspector Staffing:** Hire and train more inspectors to ensure adequate coverage and reduce the burden on existing staff, enabling more frequent and thorough inspections.
- **Enhance Training Programs:** Implement continuous training programs for inspectors to keep them updated on the latest industrial safety standards and technologies.  
For instance: The National Safety Council of India (NSCI) highlights that comprehensive training programs with regular drills are critical to reducing industrial accidents.
- **Strengthen Anti-Corruption Measures:** Establish stringent anti-corruption policies and regular audits to prevent bribery and collusion, ensuring integrity in the inspection process.  
For instance: According to a report of Transparency International, robust anti-corruption frameworks in Chile have significantly reduced corruption in industrial inspections.
- **Improve Accountability Mechanisms:** Introduce robust accountability measures for inspectors, including performance evaluations and penalties for negligence, to ensure thorough and responsible inspections.  
For instance: Clearly defined responsibilities for both employers and employees regarding safety, as outlined in the Occupational Safety, Health and Working Conditions Code, 2020
- **Increase Penalties for Non-Compliance:** Implement stricter penalties for safety violations to deter non-compliance and encourage factories to adopt necessary safety measures rather than opting to pay fines.  
For instance: The IIM Ahmedabad report on Industrial accidents highlights the need for improved enforcement to prevent industrial accidents.
- **Promote Worker Involvement:** Encourage worker participation in safety committees and inspection processes to ensure grassroots input on safety issues.
- **Leverage Modern Technology:** Invest in IoT and AI technologies for safety monitoring and predictive maintenance, enabling more efficient and proactive identification of potential hazards.
- **Centralised Data Management:** Create a centralised, computerised database to store the list of hazardous materials and the inventory of major hazard workplaces.  
For example: OECD promotes the Global Harmonized System of Classification and Labelling of Chemicals (GHS) to standardise risk assessments and improve compliance.
- **Public Transparency:** Increase transparency by publicly disclosing inspection reports and safety records of factories, promoting accountability and encouraging better compliance with safety regulations.

The recurring industrial accidents highlight significant challenges, including inadequate staffing, insufficient training, corruption, outdated legislation, and limited worker involvement. Addressing these shortcomings requires a comprehensive approach, incorporating international best practices, robust regulatory frameworks, enhanced accountability, and leveraging

modern technologies. By adopting these measures, India can improve its industrial safety standards, protect its workforce, and sustain its economic growth with a more secure and compliant industrial environment.

**MCQS**

- Consider the following statements about Li-Fi technology:
  - Li-Fi uses visible light spectrum to transmit data.
  - Li-Fi can work through walls like Wi-Fi.
  - Li-Fi offers higher data transfer rates compared to Wi-Fi.

How many of the above statements is/are correct?

a) Only one                      **b) Only two**  
c) All three                      d) None
- Consider the following statements about India's anti-radiation missile 'Rudram-1':
  - It is developed by DRDO for the Indian Air Force.
  - It is an air-to-surface anti-radiation missile.

Which of the above statements is/are correct?

a) 1 only                      b) 2 only  
**c) Both 1 and 2**                      d) Neither 1 nor 2
- Consider the following statements:
  - Lightning always strikes the tallest object.
  - Lightning is hotter than the surface of the sun.
  - Thunder is caused by the rapid expansion of air around a lightning bolt.

How many of the above statements is/are correct?

a) Only one                      **b) Only two**  
c) All three                      d) None
- Facial recognition technology' primarily relies on which of the following techniques?
  - Voice modulation analysis
  - Fingerprint scanning
  - Image processing and machine learning**
  - Retinal scanning
- Consider the following statements about Atal Pension Yojana (APY):
  - It is an initiative of the Government to provide financial security and cover future exigencies for the people in the unorganised sector.
  - It is administered by Life insurance corporation (LIC) under the overall administrative and institutional architecture of the National Pension System (NPS).

Which of the above statements is/are correct?

**a) 1 only**                      b) 2 only  
c) Both 1 and 2                      d) Neither 1 nor 2
- Consider the following statements about Pradhan Mantri Suraksha Bima Yojana (PMSBY):
  - It is a one-year accidental insurance scheme renewable from year to year offering coverage for death or disability due to accident.
  - Persons in the age group of 21-60 years having an individual bank or a post office account are entitled to enroll under the scheme.
  - The premium under the scheme is auto debited every year from the subscriber's bank account based on a one-time mandate from the account holder.

How many of the above statements is/are correct?

a) Only one                      **b) Only two**  
c) All three                      d) None
- Consider the following statements about Pradhan Mantri Jeevan Jyoti Bima Yojana (PMJJBY):
  - It is a one-year life insurance scheme renewable from year to year offering coverage for death due to any reason.
  - Persons in the age group of 18-50 years having an individual bank or a post office account are entitled to enroll under the scheme.
  - The premium under the scheme is auto debited every year from the subscriber's bank account based on a one-time mandate from the account holder.

How many of the above statements is/are correct?

a) Only one                      b) Only two  
**c) All three**                      d) None
- Recently, which organization announced the 'New World Soil Health Index' at the International conference on Soils?
  - United Nations Environment Programme (UNEP)
  - World Health Organization (WHO)
  - United Nations Educational, Scientific and Cultural Organization (UNESCO)**
  - World Bank
- Consider the following statements about NASA's DART (Double Asteroid Redirection Test) mission:
  - It utilises "Nuclear explosion" to alter the path of Asteroid.
  - The mission successfully altered the orbit of Asteroid Dimorphos.

Which of the statements given above is/are correct?

a) 1 only                      **b) 2 only**  
c) Both 1 and 2                      d) Neither 1 nor 2
- Consider the following statements about the Pacific Decadal Oscillation (PDO):
  - The PDO is a long-term oceanographic phenomenon characterised by variations in the sea surface temperatures of the Pacific Ocean.
  - During the positive phase of the PDO, sea surface temperatures are warmer than average along the west coast of North America.
  - The PDO has a regular and predictable cycle, making it easier to forecast its impacts on climate.

Which of the above statements is/are correct?

a) 1 only                      **b) 1 and 2 only**  
c) 1 and 3 only                      d) 2 and 3 only