**PVP 23**

Code: 23EC2601

**III B.Tech – II Semester - Regular Examinations – APRIL 2026**

# E-WASTE MANAGEMENT
## (Common for ALL BRANCHES)

Duration: 3 hours Max. Marks: 70

Note: 1. This question paper contains two Parts A and B.
2. Part-A contains 10 short answer questions. Each Question carries 2 Marks.
3. Part-B contains 5 essay questions with an internal choice from each unit. Each Question carries 10 marks.
4. All parts of Question paper must be answered in one place.

BL – Blooms Level CO – Course Outcome

## PART – A

| | | BL | CO |
|---|---|---|---|
| 1.a) | What is mechanical processing in E-waste recycling? | L2 | CO1 |
| 1.b) | State two principles of E-waste management. | L2 | CO1 |
| 1.c) | What is India's policy regarding hazardous E-waste import? | L2 | CO2 |
| 1.d) | Mention two metro cities in India with significant E-waste generation. | L2 | CO2 |
| 1.e) | What is meant by monitoring compliance of E-waste rules? | L2 | CO3 |
| 1.f) | Write a short note on Extended Producer Responsibility (EPR). | L2 | CO3 |
| 1.g) | List the salient features of the E-Waste Rules, 2016. | L2 | CO4 |

| | | | |
|---|---|---|---|
| 1.h) | Write short notes on government assistance for Treatment, Storage and Disposal Facilities (TSDFs). | L2 | CO4 |
| 1.i) | Define the Rotterdam Convention. | L2 | CO4 |
| 1.j) | Mention two objectives of the Basel Convention. | L2 | CO4 |

## PART – B

| | | | BL | CO | Max. Marks |
|---|---|---|---|---|---|
| **UNIT-I** | | | | | |
| 2 | a) | Explain the hazardous properties of E-waste and their environmental implications. | L2 | CO1 | 5 M |
| | b) | Describe the steps involved in recycling and recovery of materials from E-waste. | L2 | CO1 | 5 M |
| **OR** | | | | | |
| 3 | a) | Discuss the major components involved in an effective E-waste management system. | L2 | CO1 | 5 M |
| | b) | Analyze the effects of E-waste pollutants on human health. | L4 | CO1 | 5 M |
| **UNIT-II** | | | | | |
| 4 | a) | Describe the essential factors influencing the global waste trade economy. | L2 | CO1 | 5 M |
| | b) | Discuss the methods used for estimation of E-waste generation in metro cities of India. | L2 | CO2 | 5 M |
| **OR** | | | | | |

| | | | | | |
|---|---|---|---|---|---|
| 5 | a) | Discuss waste trading as an important component of electronic recycling. | L2 | CO1 | 5 M |
| | b) | Illustrate the import of hazardous E-waste in India and its environmental implications. | L3 | CO2 | 5 M |
| | | **UNIT-III** | | | |
| 6 | a) | Explain the importance of cooperation among the producers, public, and government in managing E-waste. | L2 | CO3 | 5 M |
| | b) | Discuss the procedures and regulations related to the import of E-waste in India. | L2 | CO3 | 5 M |
| | | **OR** | | | |
| 7 | a) | Explain the mechanisms for monitoring compliance of E-waste management rules in India. | L2 | CO3 | 5 M |
| | b) | Discuss the need for stringent health safeguards and environmental protection laws in India for E-waste management. | L2 | CO3 | 5 M |
| | | **UNIT-IV** | | | |
| 8 | a) | Illustrate the importance of government assistance for Treatment, Storage and Disposal Facilities (TSDFs) in managing hazardous waste. | L3 | CO1 | 5 M |
| | b) | Explain the E-Waste (Management and Handling) Rules, 2011 and their significance in E-waste management in India. | L2 | CO4 | 5 M |

| | | | | | |
|---|---|---|---|---|---|
| **OR** | | | | | |
| 9 | a) | Differentiate the E-Waste Rules, 2011 and E-Waste Rules, 2016 with respect to scope, responsibilities and implementation. | L4 | CO1 | 5 M |
| | b) | Explain the role of producers under the E-waste management rules. | L2 | CO4 | 5 M |
| **UNIT-V** | | | | | |
| 10 | a) | Discuss the importance of international legislation in controlling global E-waste generation and trade. | L2 | CO4 | 5 M |
| | b) | Explain the Restrictions of Hazardous Substances (RoHS) Directive and its importance in reducing toxic materials in electronic products. | L2 | CO4 | 5 M |
| **OR** | | | | | |
| 11 | a) | Discuss the Bamako Convention and its significance in preventing hazardous waste dumping in Africa. | L2 | CO4 | 5 M |
| | b) | Discuss the Waste Electrical and Electronic Equipment (WEEE) Directive in the European Union and its impact on E-waste management. | L2 | CO4 | 5 M |

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III B.Tech II Sem – Reg Examinations Apri

E-Waste Management

(Common for All Branches)

Max. Marks:

PART- A Each Question 2 Marks.

1 a) Steps in mechanical processing - 2

1 b) Any Two principles (2x1M = 2M)

1 c) Two India's policies (2x1M = 2M)

1 d) Any Two Metro cities (2x1M = 2M)

1 e) Monitring compliance of rules - 2M

1 f) Any two points on EPR (2x1M=2

1 g) Any Two features 2x1M = 2M

1 h) Any Two points on TSDFs - 2M

1 i) Definition - 2M

1 j) Any two objectives 2x1M = 2M

PART- B

2 a) Hazardous properties - 3M

Environmental Implications - 2M

2 b) Diagram - 2M

Explaination - 3M.

3 a) Diagram — 2M
Explaination — 3M

3 b) Any 5 effects (5x1M = 5M)

4 a) Any 5 factors Explaination
— 5M.

4 b) Estimation in 4 metro cities
— 5M.

5 a) Waste trading as an important component of electronic cycling
explaination — 5M

5 b) Import of hazardous E-waste in India — 3M
Environmental Implications — 2M

6 a) Producers, Public, government co-operation Any five points
— 5M.

6 b) Procedures & Regulations — 2+3M
= 5M

7 a) Any five mechanisms — 5M

7 b) Explaination on health safeguards and environmental protection laws
— 3M+2M.

8 a) Importance - Any five

5 × 1M = 5M

8 b.) E-Waste Roles 2011 — 3M

Significance — 2M.

9 a) Any five differences

5 × 1M = 5M.

9 b) Explaination about EPR - 5M

10 a) Importance — any five points

— 5 × 1M = 5M

10 b) RoHs - Explaination - 3M

Importance in reducing toxic materials — 2M

11 a) Bamako Convention Explainations

— 3M

Significance — 2M

11 b) Explaination on WEEE - 4M

Impact on EWM — 1M.

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III B.Tech – II Sem – Regular Examinations.
– April 2026

E-Waste Management (Code 23EC2601)
(Common to ALL Branches)

**PART-A**

1 a) Mechanical processing in e-waste recycling involves sorting, size reduction, vibrating separator, magnetic separation, eddy current separator to recover valuable materials.

1 b) principles of E waste management (Any two)

- Reduce: Design products with longer lifespans, reduced toxicity, and minimal raw material consumption.
- Reuse : Promote the refurbishment, donation, or resale of functional electronics before they become waste.
- Recycle : Safely dismantle products to recover valuable materials (e.g., gold, copper, rare earth elements) and dispose of hazardous substances securely.
- Refurbish: repairing and upgrading used electronics to extend their functional life

1 c) To prohibit importing e-waste for disposal ,while allowing it strictly for recycling, recovery, and reuse.

1 d) Mumbai, New Delhi, Bengaluru (Any two)

1 e) Monitoring compliance of e-waste rules is the process of tracking, and verifying that manufacturers, producers, and recyclers adhere to environmental regulations regarding electronic waste disposal. This involves checking Extended Producer Responsibility (EPR) targets, authorization of recycling facilities, and ensuring hazardous substance reduction (RoHS).

1 f) To extend producers' responsibility to the post-consumer stage of the product life cycle and fix their responsibility for collection of end of life products and to ensure that such wastes are channelized for safe handling.

1 g) (Any two)

Extended Producer Responsibility (EPR), Target-Based Collection, Simplified Authorization, Responsibilities - Producers, Manufacturers, refurbishers/**Recyclers.** Deposit Refund Scheme, Liability and Penalty

1 h) Government encourages setting up of integrated Treatment, Storage and Disposal Facility (TSDFs) for hazardous waste management on Public Private Partnership (PPP) mode in clusters of hazardous waste generating industries. So far 28 TSDFs have been set up. The Ministry of Urban Development is implementing the Jawaharlal Nehru National Urban Renewal Mission (JNNURM) for providing assistance to the State Governments/ Urban Local Bodies for various projects including solid waste management.

1 i) Rotterdam Convention on the Prior Informed Consent (PIC) Procedure for Certain Chemicals and Pesticides in International Trade, regulates trade in hazardous wastes but contains no commitment to reduce their use and release.

1 j) (Any two)

* The objective of Basel Convention is on the Control of Transboundary Movements of Hazardous wastes and their Disposal.
  - Minimization of generation-quantity, degree of hazard
  - Promotion of environmentally sound management of hazardous wastes.

PART-B

2 a) Properties of hazardous waste:04

Ignitability: A waste is an ignitable hazardous waste, if it a flash point less than $60^0$C ,readily catches fire and burns so vigorously as to create hazard: or is an ignitable compressed gas or an oxidiser.

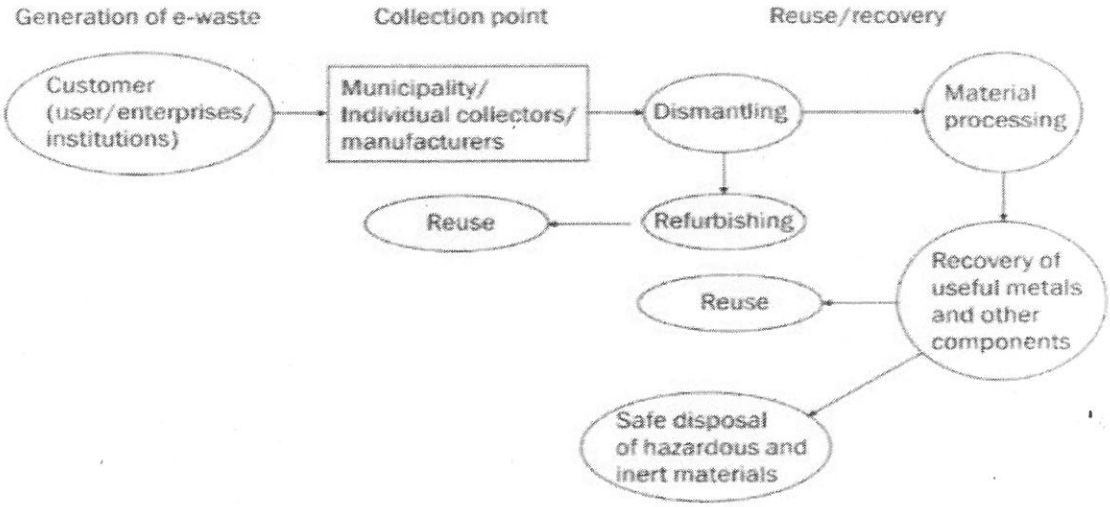
Corrosivity: A liquid waste which has a pH less than or equal to 2 or greater than or equal to 12.5 is considered to be a corrosive hazardous waste.

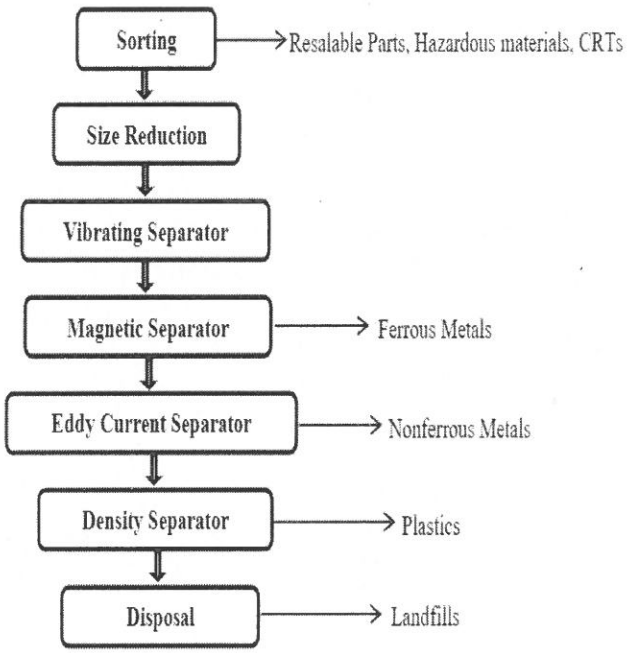
Reactivity: Identifies wastes that are unstable, react violently with water, generate toxic gases, or are explosive.

Toxicity: Identifies wastes that can leach hazardous substances at concentrations above established regulatory levels

Since e-waste also contains significant concentration of substances that are hazardous to human health and the environment, even a small amount of e-waste entering the residual waste will introduce relatively high amount of heavy metals and halogenated substances. Such harmful substances leach into the surrounding soil, water and air during waste treatment or when they are dumped in landfills or left to lie around near it. Sooner or later they would adversely affect human health and ecology.

**2 b)** Steps involved for recycling and recovery of materials Collection, dismantling, mechanical processing, and metal extraction are the major steps in recycling



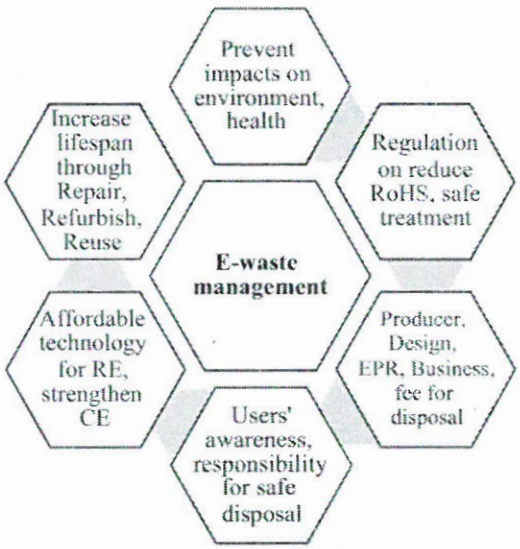




1. Collection and Sorting: The first step is to collect e-waste from various sources, such as households, businesses, and institutions. The collected e-waste is then sorted to separate different types of electronic devices and components.
2. Pre-processing: Before mechanical processing, large electronic devices like refrigerators and washing machines may need to be dismantled into smaller parts to facilitate further handling and processing.
3. Size Reduction: Mechanical shredding is used to break down e-waste into smaller pieces. Large electronic devices are shredded into smaller fragments using shredding machines, reducing them to manageable sizes.
4. Magnetic Separation: After size reduction, magnetic separation is employed to recover ferrous metals like iron and steel from the shredded e-waste. Magnets attract and separate magnetic materials from non-magnetic materials.

5. Eddy Current Separation: Eddy current separation is used to recover non-ferrous metals like aluminium, copper, and brass. The shredded e-waste is passed through an eddy current separator, which induces eddy currents in conductive materials, causing them to be repelled and separated from non-conductive materials.
6. Air Separation: Air separation or pneumatic separation is used to separate lightweight materials like plastics and foam from heavier materials like metals. Air jets are used to blow lightweight materials away from the heavier ones.
7. Vibratory Screening: Vibratory screens are used to further separate materials based on size. The shredded e-waste is passed through vibrating screens that segregate materials of different sizes.
8. Density Separation: Density separation is employed to separate materials based on their density. Techniques like air classifiers and water baths are used to separate materials with different densities.
9. Plastic Recycling: The recovered plastic materials are further processed through mechanical recycling techniques. These include processes like washing, grinding, and pelletizing to produce clean and recyclable plastic materials.
10. Metal Recovery: Recovered metals from magnetic separation, eddy current separation, and other processes are further processed to remove impurities and prepare them for reuse in manufacturing.

**3 a) Components in E-waste management:**

- The components of recycling and resource recovery in e-waste management are seen as a process of 'problem to resources', bringing circular economy (CE) and resource efficiency (RE) to centre-stage along with safe environment and human health.




Components of e-waste management

- The CE and RE are associated with social and economic benefits including job creation, investment in technology development and infrastructure building.
- Higher rates of e-waste generation are caused by shorter life cycles of e-products, and fewer repair options.

- Thus, introducing resource recovery, REs and CE link with recycling/treating e-waste.
- Spreading awareness among users of e-products, user roles in minimising e-waste, and contribution to tax regime/fees for recycling also have become the agenda of e-waste management.
- The dominant discourse on governance of e-waste includes increasing e-waste collection and recycling; generating and harmonising statistics on e-waste across the world; existing regulatory/legislative framework, expansion of legal net and legal compliance; urban mining; economic potentials – resource recovery and reducing use of virgin materials; and protecting health of workers exposed to hazardous e-waste in improper working conditions; adhering environmental concerns.

**3 b) Effects of pollutant (E- waste) on human health**

| Metal | Danger |
|---|---|
| Lead | A neurotoxin that affects the kidneys and the reproductive system. High quantities can be fatal. It affects mental development in children. Mechanical breaking of CRTs (cathode ray tubes) and removing solder from microchips release lead as powder and fumes. |
| Plastics | Found in circuit boards, cabinets and cables, they contain carcinogens. BFRs or brominated flame retardants give out carcinogenic brominated dioxins and furans. Dioxins can harm reproductive and immune systems. Burning PVC, a component of plastics, also produces dioxins. Even the dust on computer cabinets contains BFR |
| Chromium | Used to protect metal housings and plates in a computer from corrosion. Inhaling hexavalent chromium or chromium 6 can damage liver and kidneys and cause bronchial maladies including asthmatic bronchitis and lung cancer. |
| Mercury | Affects the central nervous system, kidneys and immune system. It impairs foetus growth and harms infants through mother's milk. It is released while breaking and burning of circuit boards and switches. Mercury in water bodies can form methylated mercury through microbial activity. Methylated mercury is toxic and can enter the human food chain through aquatic. |
| Beryllium | Found in switch boards and printed circuit boards. It is carcinogenic and causes lung diseases. |
| Cadmium | A carcinogen. Long-term exposure causes Itai-itai disease, which causes severe pain in the joints and spine. It affects the kidneys and softens bones. Cadmium is released into the environment as powder while crushing and milling of plastics, CRTs and circuit boards. Cadmium may be released with dust, entering surface water and groundwater. |
| Acid | Sulphuric and hydrochloric acids are used to separate metals from circuit boards. Fumes contain chlorine and sulphur dioxide, which cause respiratory problems. They are corrosive to the eye and skin |

**4 a) Essential factors in global waste trade economy**

- Like most waste trade, e-waste export to the developing countries is governed by brute global economics in which market forces, if left unregulated, dictates that the toxic waste will always run "downhill" on an economic path of least resistance.
- Illegal export becomes possible when the environment and occupational regulations are non-existent, minimal, lax or not well-enforced, as they are in some developing countries.
- Low labour costs in these countries also provide the impetus (boost) for the export in wastes.
- In addition, exporting e-waste is more lucrative (profitable) for the exporter country than recycling or disposing it within the country.
- The U.S. produced five times more hazardous waste in 2002 (265 million tonnes) than it did in 1975 (57 million tonnes).
- The cost of managing such waste within the country would be enormous depending on the toxicity and reactivity of the substances. Thus, it would be more economical to ship toxic wastes to the developing countries when the cost is negligible
- Considering its cost effectiveness, export is an option chosen by some companies in the industrialized countries.
- The illegal exports are mostly justified as 'charity' or as 'recycling.
- Through these methods, obsolete devices find their way from the industrialized countries to the developing countries where they can be used for a few more years.
- Reuse or recycling may prolong the life span of a product but sooner or later, it would find its way into the waste mainstream.
- Therefore, while the developed countries legally avoid the problem of waste disposal, the developing countries are left to reckon with the ultimate problem of waste disposal.

**4 b) Estimation of E-waste generation in metro cities of India.**

The two main hubs where e-waste is re-cycled in the country are Delhi and Mumbai. The other two major hubs are Hyderabad and Bengaluru which have been the centres of the electronics and information technology industry. They are among the top ten cities in India which have been generating e-waste. Their status as primary centres of the e-waste recycling process - whether it concerns storage, dismantling, recycling, refurbishing, and distribution-has been a predictable fall-out of the electronic industrial growth and development in these cities.

**NEW DELHI**

- A report found that 70 per cent of electronic waste collected at recycling units in New Delhi was actually exported or dumped by the developed countries.
- In Delhi, it was estimated that about 5,000 metric tonnes (MT) of hazardous waste was produced annually. The amount of e-waste generated annually is about 12,000 tonnes. Though not the leading generator, Delhi is the leading processing centre of e-waste in the country.

- The work takes place in small illegal units where neither regulations nor environment or health safeguards are in place.
- There are many factors that contribute to the thriving e-waste recycling business in Delhi - its status as the capital and hence its connectivity to all parts of the country.
- The ewaste hub on the north-eastern fringe of Delhi, the Seelampur market is also called the largest electronics dismantling market in the country, where over 50 per cent of used computers end up for sale and recycling.
- Since waste processing is illegal in Delhi, the Government does not have an exact estimate of how much waste is produced in the city or how much is brought in for recycling. Even though officials claim that the units have moved out of Delhi, they cannot be sure of the numbers as the work largely takes place in the unorganized sector.

**MUMBAI**

- Among Indian cities, Mumbai ranks first among top ten cities generating WEEE in India.
- The market of e-waste in Mumbai is not concentrated in a single place, but spread over different areas, each handling a different aspect of recycling. The city has a large network of scrap traders.
- In spite of the absence of proper technology, each component is disassembled and recycled or reused in Mumbai.
- Most of the WEEE generated in the Pune Region is transported to the Mumbai Metropolitan Region (MMR) for further treatment and distribution.
- As per country level e-waste assessment study, Mumbai generates maximum wastes among all the cities in India.
- Total electrical and electronic waste generation in
  Maharashtra is 20270.6 tonnes, out of which
  Navi Mumbai contributes 646.48 tonnes,
  Greater Mumbai 11017.06 tonnes,
  Pune 2584.21 tonnes,
  Pimpri-Chinchwad 1032.37 tonnes.

**BENGALURU**

- In Bengaluru, the Silicon capital of India, e-waste recycling is a multi-crore market.
- The e-waste recyclers earn around Rs. 2-3 lakhs a month from selling the dismantled e-waste to Delhi. There are a few recycling centres in Karnataka like e- Wardd, e-Parisara, Ash Recyclers.
- According to industry surveys, 8,000 to 10,000 tonnes of e-waste is generated each year by IT firms and electronics manufacturers in and around Bengaluru.
- While the larger companies have warehouses for storing the waste, others sell them to small-time scrap dealers.
- The dealers, many concentrated around Mysore Road, often employ women and children to deal with the scrap and remove usable metal.
- What cannot be used at all is thrown into fields and channels or burned under unsafe conditions.
- Apart from affecting the health of the employees of the scrap dealers, air, soil and ground water also get polluted.

- Annual e-waste generation in Bengaluru from computer and printer, television and mobile phone is 6743.87 MT.

**HYDERABAD**

- Hyderabad has been known as the emerging Silicon capital of India.
- The annual e-waste generation has been estimated for Hyderabad at 3,263,994 MT from computers, printers, television and mobile phones.
- Most of the e-waste collectors and recyclers only do size reduction (shredding) and segregation.
- After segregation, the waste is sent to e- Parisara(Bengaluru) and in turn it gets exported to Belgium along with its waste for precious metal recovery.
- Resource recovering facility is available only in Belgium.
- With the fast rate of technological changes and growing dependency on information technology and other modern electronic household items, the quantum of e-waste is set to rise in every electronic item.
- Since most of the e-waste finds its way to the unorganized sector with profit as the prime motivating factor, e-waste recycling undeniably requires better management and improved working environment guided by strict regulations.

5 a) Waste trading as a important component part of electronic recycling:

Importing waste is a lucrative economy. The main objective behind the import of used electronics is the recovery of valuable metals and elements that are contained in electronic waste, including steel, aluminium, copper, tin, nickel, etc. which are in bulk; cadmium and mercury which are in smaller amounts; and barium, nickel, gold, titanium, cobalt, palladium, manganese, silver and platinum, etc. which are in traceable amounts. These various commodities provide useful raw material feedstock in the manufacture of new products. The largest market of a non-working equipment or e-waste is for the circuit boards that are rich in precious metals, i.e. silver, gold, palladium and platinum. Sound management practices for the recovery of these elements are debatable. However, export and import trade has become an essential aspect of the electronics recycling. Moreover, many of the markets for processed plastics and other raw materials derived from end-of-life electronics equipment are also outside of the U.S. In fact, there are no smelters for copper or for the recovery of precious metals from circuit boards in the U.S. The five primary copper and precious metal smelters in the world are located in Canada, Belgium, Sweden, Germany and Japan. There are no Cathode Ray Tube (CRT) glass furnaces in North America and there are less than 20 worldwide. There are approximately 15 in Asia (e.g. South Korea, Malaysia, India, Thailand, Singapore and China) and one in Poland. As the demand for the CRT glass cullet remains strong, the number of glass furnaces continues to be inadequate and insufficient. The challenge is further complicated by the Government restrictions.

**5 b) Import of hazardous E-waste in India:**

- India is one of the largest waste importing countries in the world.
- All types of wastes are imported into the country, in the form of cheap raw materials including hazardous and toxic wastes.

- India imports most of its Electronic waste from Belgium, Germany and United States.
- For the management and handling of hazardous waste, the Ministry of Environment & Forest has passed the Hazardous Waste (Management & Handling) Rules, 1989 under the Environment (Protection) Act, 1986.
- In 2009, India generated 5.9 million tonnes of hazardous waste domestically and imported 6.4 million tonnes.
- It generates about 3,50,000 tonnes of electronic waste every year and imports another 50,000 tonnes.
- India has been the destination of the hazardous and industrial wastes like :
    - mercury, electronic and plastic wastes from the United States
    - asbestos from Canada
    - defective steel and tin plates from the E.U., Australia and the U.S.
    - toxic waste oil from the United Arab Emirates, Iran and Kuwait
    - zinc ash, lead waste and scrap of metals such as cadmium, chromium, cobalt, antimony, hafnium and thallium from Germany, Denmark, the Netherlands, the United Kingdom, Belgium and Norway.
- These wastes contain toxic components which are damaging to the public health and environment
- The Hazardous Wastes (Management, Handling and Transboundary Movement) Rules, 2008 regulate the export import trade or transboundary movements of hazardous waste.
- According to these Rules, import of hazardous wastes for disposal is not permitted.
- However, import of waste is permitted only for reuse, recycling or reprocessing.
- Monitoring of units recycling hazardous wastes is the responsibility of the State Pollution Control Board or the Pollution Control Committee in a Union Territory.
- The Rules also require all import consignments to be accompanied by a movement document and a test report from an accredited laboratory or a pre-shipment inspection certificate from a recognized agency.
- Import of e-waste is considered for actual users only with the permission of Ministry of Environment and Forests and licence from Directorate General of Foreign Trade.

## UNIT-III

**6 a) Explain the importance of cooperation among the Producers-Public-Government in managing-waste.**

Producer-public-government cooperation is a collaborative approach aimed at addressing various societal and environmental challenges by involving key stakeholders, including producers (manufacturers), the public (consumers), and government authorities.

Producers (Manufacturers):

Responsibility and Accountability: Producers take responsibility for the environmental impact of their products throughout their lifecycle. This includes adopting sustainable production practices, reducing resource consumption, and ensuring the safe disposal or recycling of end-of-life products.

- Extended Producer Responsibility (EPR): Producers implement EPR programs where they actively participate in the collection and recycling of their products after consumer use. This approach fosters a circular economy and reduces the burden on public waste management systems.

- Product Innovation: Producers engage with the public and government to understand consumer needs and societal demands better. They can use this knowledge to design products that align with environmental and social goals.

2. Public (Consumers):

- Responsible Consumption: Consumers can support sustainable practices by making informed choices and purchasing products from environmentally responsible producers. They can also consider the environmental impact of products before making a purchase.

- Recycling and Disposal: The public's active participation in recycling and proper disposal of products, such as e-waste, is essential for effective waste management. Properly disposing of products ensures that valuable resources can be recovered and hazardous materials are handled safely.

- Advocacy and Awareness: Consumers can raise awareness about environmental issues and demand sustainable products and practices from manufacturers. Engaging in environmental advocacy can influence producers and policymakers to take more significant actions.

3. Government Authorities:

- Policy and Regulation: Governments play a crucial role in establishing and enforcing regulations that promote sustainable practices and hold producers accountable for their environmental impact. They can set standards for waste management, emission control, and environmental protection.

- Facilitating Collaboration: Governments act as facilitators to bring producers and the public together, encouraging dialogue and cooperation on environmental initiatives and issues.

- Incentives and Support: Governments can offer incentives or financial support to encourage producers to adopt sustainable practices and invest in eco-friendly technologies.

- More effective solutions: Collaboration ensures that all stakeholders' perspectives and expertise are considered, leading to more comprehensive and effective solutions to environmental challenges.

- Shared responsibility: By working together, the burden of environmental protection and sustainable practices is shared among producers, the public, and the government.

- Circular economy: Collaboration can drive the transition to a circular economy, where resources are used more efficiently and waste is minimized through recycling and reusing products.

- Public engagement: Involving the public in environmental initiatives fosters a sense of ownership and empowerment, increasing the likelihood of successful implementation.

Overall, producer-public-government cooperation is essential for addressing complex environmental and social issues and achieving sustainable development goals. By working together, these stakeholders can create a more sustainable and resilient society for the benefit of current and future generations.

6 b) Discuss the procedures and regulations related to the import of E-waste in India.

The standard procedure followed for importing a consignment to India involves an importer, an exporter, an agency registered and notified by the Directorate-General of Foreign Trade, a bank and the customs department at the port. First, the importer is required to get a pre-inspection certificate of the import material by a registered agency, which could be an Indian or a foreign company. After the agency issues the certificate, a bill detailing the number of containers, excise duty classification and product details is prepared. Thereafter, the consignment is shipped. When it reaches India, the customs officials at the port check the certificate, levy a customs duty on the product as specified in the Central Excise Tariff Act and release the consignment to the importer. The e-waste trade is a thriving business in India with strategic port cities like Singapore and Dubai serving as transit centres in the e-waste trade route. E-waste from Australia, North America, South Korea and Japan is received in Singapore and dispatched again to the importing Asian countries including India.

The transboundary movements of hazardous wastes, including e-waste are regulated under the Hazardous Wastes Rules, 2008. As per these Rules, import of e-waste is permitted to actual users in the country with permission of MoEF and licence issued by Directorate General of Foreign Trade (DGFT) for recycling or reprocessing only. Import of e-waste by traders is not permitted.

7 a) Explain the mechanism for monitoring compliance of E-waste management rules in India.

The State Pollution Control Boards or Committees responsible for grant of authorization, monitoring compliance of authorization and registration conditions can take action against violations of rules.

The Central Pollution Control Board (CPCB) can monitor the compliance of conditions stipulated for granting registration.

As per the draft e-waste Rules, producers, dismantlers, recyclers & collection centres, are required to seek authorization and registration from the State Pollution Control Board (SPCB) concerned and file annual returns.

SPCBs are required to submit annual reports to CPCB. CPCB will consolidate the information received from all SPCBs and submit an annual report on e-waste management, along with its recommendations, to the Ministry.

**7 b) Discuss the need for stringent health safeguards and environmental protection laws in India**

- Environmental activists opine that environment protection laws in India are not stringent enough to address the issues relating to either domestic waste or imports of hazardous waste including e-waste.
- There are no appropriate technology to ascertain the quantum and quality of wastes in the imported items.
- The problem of toxic waste imports cannot be addressed properly as none of the Indian ports (except the Jawaharlal Nehru Port at Nhava Sheva) has scanners to detect the actual contents of the consignments.
- There are expectations that the proposed E-waste (Management and Handling) Rules, 2010 will lay down explicit laws concerning e-waste and systematize various aspects of the e-waste recycling sector.
- The Government has consulted various non- governmental organizations (NGOs) in the process of developing a dedicated set of rules, which would govern the management and handling of electronic and electrical waste.
- Draft rules on e-waste management were jointly proposed and submitted to the Government by the Manufacturers' Association for Information Technology (MAIT).
- It is necessary that the legislation is clear in laying down the responsibility of every shareholder in the management of waste—from the producer to the consumer and the recycler.
- Besides, any legislation to be effective requires clear specification of the mechanisms to carry out each function.
- Strategies have been proposed for the effective management and handling of e-waste in the country, many of which are already in force or in consideration in the EU countries and other developed countries like the U.S. and Japan.

## UNIT-IV

**8 a) Illustrate the importance of government assistance for Treatment, Storage and Disposal Facilities (TSDFs) in managing hazardous waste.**

- The Government has taken a number of initiatives to address issues related to disposal of wastes.
- It encourages setting up of integrated Treatment, Storage and Disposal Facility (TSDFs) for hazardous waste management on Public Private Partnership (PPP) mode in clusters of hazardous waste generating industries.
- So far 28 TSDFs have been set up. The Ministry of Urban Development is implementing the Jawaharlal Nehru National Urban Renewal Mission (JNNURM) for providing assistance to the State Governments/ Urban Local Bodies for various projects including solid waste management.

- On the basis of proposals received from the States, the Centre has provided financial assistance to the State Pollution Control Boards for setting up of integrated TSDFs
- The financial assistance disbursed from 2007 to 2010, State-wise and year-wise is as follows

| Year | State | Amount (in lakhs) |
|---|---|---|
| 2007- 2008 | Tamil Nadu | 80.00 |
| 2007- 2008 | Andhra Pradesh | 80.00 |
| 2007- 2008 | Maharashtra | 96.64 |
| 2008- 2009 | Maharashtra | 160.00 |
| 2009- 2010 | Maharashtra | 2.40 crore |
| 2009- 2010 | Uttar Pradesh | 80.00 |
| 2009- 2010 | Kerala | 80.00 |

- To offset any possibility of the amount allocated for setting up of the TSDFs getting diverted for other activities or projects, a Memorandum of Understanding (MoU) is signed between the Ministry of Environment and Forests, State Pollution Control Board and the entrepreneur before release of financial assistance for setting up of TSDF.
- One of the conditions of the MoU is to constitute a committee to monitor progress of the facility.
- Further release of financial assistance is made only on submission of audited Utilization Certificate and physical progress report by the respective State Pollution Control Board.

**8 b) Explain E-waste Management and handling rules 2011 and their significance in India.**

Extended Producer Responsibility (EPR): Producers (manufacturers, importers, brand owners) became legally responsible for the collection and disposal of e-waste generated from their products.

Authorization Requirement: Only authorized dismantlers and recyclers are permitted to process e-waste.

Bulk Consumer Accountability: Bulk users (e.g., banks, public sectors) must channel their e-waste to authorized facilities and maintain records.

Collection Responsibility: Producers are mandated to set up collection centers or take-back systems.

Scope: Applied to all electrical/electronic equipment (IT, telecommunication, consumer electronics).

Consumer Responsibility: Consumers must deposit e-waste at designated centers.

Significance: Before 2011, nearly 95% of India's e-waste was handled by the "informal sector" (unregulated scrap dealers). These workers often used primitive methods like open-air burning and acid baths to extract precious metals, releasing toxic fumes. The 2011 Rules were significant because they aimed to formalize the recycling chain.

Environmental and Health Protection: By restricting hazardous substances (RoHS) and mandating "environmentally sound management," the rules aimed to prevent heavy metals from leaching into groundwater and soil, thereby reducing the risk of neurological and respiratory diseases in local communities.

9 a) Differentiate E-waste management rules 2011 and E-waste rules 2016

| E-waste (Management & Handling) Rules, 2011 | E-Waste (Management) Rules, 2016 |
|---|---|
| **Applicability:** | |
| *Producer, consumer or bulk consumer, collection centre, dismantler and recycler.<br>* Only to Electrical and Electronic Equipment (EEE) | * expanded to manufacturer, dealer, refurbisher and Producer Responsibility Organization (PRO)<br>* Extended to components, consumables, spares and parts of EEE in addition to equipment.<br>* Compact Fluorescent Lamp (CFL) and other mercury containing lamp brought under the purview of rules. |
| **Exemption** | |
| Micro and Small industry sector as defined in Micro Small and Medium Developmental Act, 2006 | Micro enterprises as defined in the Micro, Small and Medium Enterprises Development Act, 2006 |
| **Extended Producer Responsibility (EPR)** | |
| The Producers are required to obtain authorization from SPCB/PCCs for implementing their Extended Producer Responsibility for effective channelization of E-waste to the registered dismantlers/recyclers | * Single EPR Authorization for Producers is now being made CPCB's responsibility to ensure pan India implementation.<br>* Procedure for seeking the authorization and for effective implementation has now been elaborated with various kind of flexibilities provisions |
| **Responsibilities of Manufacturer, dealers, refurbisher** | |
| No provision | To collect e-waste generated during the manufacture of any electrical and electronic equipment and channelise it for recycling or disposal and seek authorization from SPCB.<br>*The dealer shall collect the e-waste by providing the consumer a box .Dealer or retailer shall refund the amount as per take back system or Deposit Refund Scheme of the producer to the depositor of e-waste<br>* collect e-waste generated during the process of refurbishing and channelise the waste to authorised dismantler or recycler through its collection centre and seek one time authorization from SPCB |
| **Economic Instrument for implementation of the rules** | |
| No specific citation | Deposit Refund Scheme has been introduced as an additional economic instrument wherein the producer charges an additional |

| | |
|---|---|
| | amount as a deposit at the time of sale of the electrical and electronic equipment and returns it to the consumer along with interest when the end-of-life electrical and electronic equipment is returned. |

**9 b) Explain the role of producers under the E-waste management rules.**

The principle of the Extended Producers Responsibility (EPR) which underlines the current framework of the draft e-waste rules is an innovative step in the management of e-waste in the country.

The concept of EPR aims to place full responsibility of collection of end-of-life electronic products and their safe disposal on to the producers. They would have to ensure that the polluting products will be recycled in an environmental friendly manner by refurbishes, dismantlers or recyclers.

It would require the producers and dealers to collect e-waste by providing the consumer a box, bin or a demarcated area to deposit e-waste. It has been suggested that major municipal corporations should take the responsibility of collecting e-waste directly from consumers to be handed over to a recycler. All major electronic brands have service centres all across the country and these can be used as collection points. The incentive, that a customer gets to give an old electronic good for recycling would be key to its success

**UNIT-5**

**10 a) Discuss the importance of international legislation in controlling global E-waste generation and trade.**

International law is the primary mechanism used to stop the dumping of hazardous electronic scrap from developed to developing countries.

The Basel Convention: This treaty prohibits the export of hazardous waste without the prior informed consent of the importing country.

Bamako Convention is on the Ban of the Import into Africa and the Control of Transboundary Movement of Hazardous Wastes to manufacturers.

E-waste contains harmful materials like lead, mercury, and cadmium. Rotterdam Convention regulates the import of hazardous chemicals and pesticides.

International laws encourage the adoption of EPR, which shifts the responsibility for end-of-life management of products.

Sustainable Design: Companies are compelled to design products that are easier to disassemble, repair, and recycle.

Financing Collection: Manufacturers must set up collection points and fund recycling processes their by reducing the burden on Government.

International legislation ensures uniform standards for treating e-waste, preventing the environmental damage associated with informal recycling, such as open incineration and acid leaching.

**10 b) Explain the Restrictions of Hazardous substances (ROHs) directive and its importance in reducing toxic materials in Electronic products.**

As a legislative initiative to solve the problem of huge amounts of toxic e-waste, a Directive on the restriction of the use of certain hazardous substances in electrical and electronic equipment, namely 2002/95/EC, commonly referred to as the Restriction of Hazardous Substances Directive or RoHS was adopted in February 2003 by the European Union.

The RoHS Directive came into force with effect from 1 July 2006, and is required to be enforced and become law in each member state.The Directive restricts the use of six hazardous materials in the manufacture of various types of electronic and electrical equipment.

In order to prevent the generation of hazardous waste, the RoHS Directive requires the substitution of various heavy metals, namely lead, mercury, cadmium, hexavalent chromium and brominated flame retardants like polybrominated biphenyls (PBB) or poly-brominated diphenyl ethers (PBDE) in new electrical and electronic equipment put on the market since 1 July, 2006.The goal of RoHS is to reduce potential environmental and health risks caused by the use of hazardous substances during the utilization, collection, treatment and disposal of increasing amounts of electrical and electronic waste.

11 a) Discuss the Bamako Convention and its significance in preventing hazardous waste dumping in Africa.

The Bamako Convention is on the Ban of the Import into Africa and the Control of Transboundary Movement of Hazardous Wastes was adopted by the twelve nations of the Organization of African Unity at Bamako, Mali in January, 1991, and came into force in March, 1999.153 The Convention aims to protect human health and environment from dangers posed by hazardous wastes by reducing their generation to a minimum in terms of quantity and/or hazardous potential. All Parties are obliged to prohibit the import of all hazardous wastes, for any reason, into Africa from non-Contracting Parties.

The need to sign the Bamako Convention arose from the failure of the Basel Convention to prohibit trade of hazardous waste to the less developed countries, and from the realization that many developed nations were exporting toxic wastes to Africa. The Bamako Convention places the duty on the Parties to monitor their respective waterways to ensure that no dumping occurs. Each State Party has to report annually to the Secretariat.

What differentiates the Bamako Convention from the Basel Convention is that the former uses a format and language similar to that of the Basel Convention, but which is much stronger in prohibiting all imports of hazardous waste. Additionally, it does not make exceptions on certain hazardous wastes like those for radioactive materials made by the Basel Convention.

**11 b) Discuss Waste Electrical & Electronic Equipment (WEEE) Directive in European Union and its impact on E-waste management.**

The Waste Electrical and Electronic Equipment (WEEE) Directive is the European Community directive (2002/96/EC) on waste electrical and electronic equipment.

- WEEE , together with the Restriction of Hazardous Substances (RoHS) Directive (2002/95/EC), became European Law in February, 2003 setting collection, recycling and recovery targets for all types of electrical and electronic goods.
- The WEEE Directive obliged the twenty-five EU member states to transpose its provisions into national law by 13 August, 2004.
- In May, 2001, the EU Parliament approved a directive that required producers of electronic gazettes to take responsibility—financial and otherwise—for the recovery and recycling of e-waste.
- Recognizing the scope and urgency of e-waste problem, the European Union has taken the lead in addressing it by proposing an ambitious system of the Extended Producer Responsibility (EPR).
- The EPR has been defined as "an environmental protection strategy to reach an environmental objective of a decreased total impact from a product, by making the manufacturer of the product responsible for the entire life cycle of the product and especially for the take back, recycling and final disposal of the product".