UNIT – II

ENVIRONMENTAL POLLUTION

Pollution is defined as the unfavorable alternation of our surroundings which affects the Human beings, plants, animals etc., **(2Mark)**

Classification:
Pollution may be classified into
a) Air pollution
b) Water pollution
c) Soil pollution
d) Thermal pollution
e) Nuclear hazards
f) Noise pollution
g) Marine pollution

Pollutants: **(2Mark)**
"A substance which is hazardous to human beings, plants animals and environment etc is called as pollutants.

Types of Pollutants: **(2Mark)**

1) Bio-degradable: This can be degraded or decomposed by natural processes. (Ex. Vegetable wastes, animal wastes)
2) Non-bio degradable: This cannot be degraded or decomposed by natural processes. (Ex. Plastics, polythene, rubber, etc.)

AIR POLLUTION

Definition: (2 Mark)
It is defined as "the presence of one or more contaminants in air and its harmful to human beings and animals.

Sources / causes of air pollution**: (2Mark)**
Natural sources: volcanic eruption, forest fires, biological decay, etc.
Man made sources: thermal power plants, vehicular emissions, fossil fuels, agricultural activities etc.

Classification of air pollutants: **(2Mark)**
Primary and secondary air pollutants.
Primary air pollutants: which emits directly to the atmosphere and harmful to the living beings.
E.g. CO_2, NO_2 and SO_2 etc

Secondary air pollutants:
Primary pollutants may react with one another to form new pollutant which is harmful to living beings.

E.g. NO_2 / SO_2 $\xrightarrow{\text{moist/ } H_2O}$ HNO_3 / H_2SO_4
Primary pollutants Secondary pollutants

Types, sources and effects of air pollution: (8 Mark)

S. No	Type of air pollutants	Sources /causes	Effects
1	CO_2 (Carbon monoxide)	➢ Cigarette smoking, ➢ incomplete combustion of fossil fuel, ➢ motor vehicle exhaust	➢ Headache ➢ anemia ➢ global warming
2	NO_2 (Nitrogen di oxide)	➢ incomplete combustion of fossil fuel in motor vehicles ➢ power plants	➢ Lung irritation & damage ➢ Acid rain which affects soil, aquatic bodies ➢ corrosion of metals, damage to monuments, fabrics etc.
3	SO_2 (Sulphur di oxide)	➢ Coal burning in power plants ➢ Industrial processes.	➢ breathing problems ➢ Reduces visibility ➢ acid rain which affects soil, aquatic bodies , ➢ corrosion of metals, damage to monuments, fabrics etc.
4	Photo chemical smog **(2 Mark) (**Brownish smoke like appearance)	➢ Chemical reactions among nitrogen oxide and hydrocarbon by sunlight	➢ Breathing problems ➢ nose, eye irritation, ➢ heart diseases.
5	Suspended particulate matter (SPM)	➢ Agriculture ➢ burning of coal in power plant ➢ industrial plants ➢ Burning diesel.	➢ Nose and throat irritation, ➢ Lung damage ➢ Asthma ➢ Cancer.
6	Ozone (O_3)	➢ Chemical reactions by volatile organic compound and nitrogen oxide	➢ Climatic change.
7	Lead	➢ Leaded petrol ➢ lead storage batteries	➢ Mental retardation in children ➢ Cancer.
8	Hydrocarbons	➢ Decay of vegetable matter	➢ Carcinogenic (cancer producing) effects
9	Chromium	➢ Paint ➢ Chromium manufacture ➢ Chromium plating	➢ Cancer, ➢ gastro intestinal problems ➢ affect the central nervous system

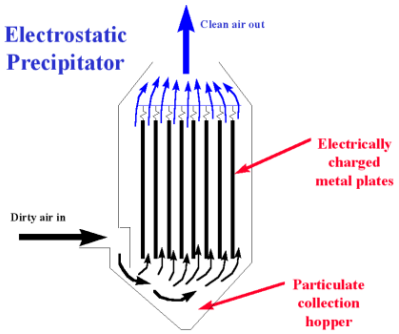
Control measures of air pollution: **(4 Mark)**

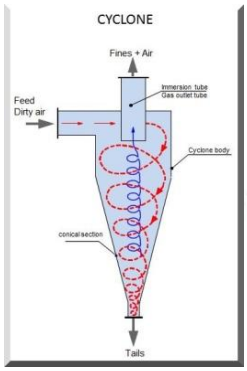
1. Use only unleaded petrol
2. Use petroleum products and other fuels that have low sulphur and ash content.
3. Reduce the number of private vehicles on the road by developing an efficient public transport system and encouraging people to walk or use cycles.

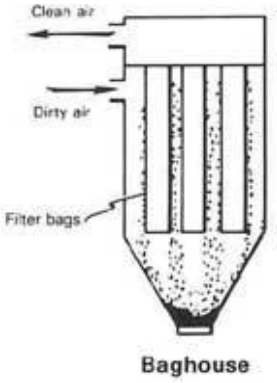
4. Plant more trees
5. Industries and waste disposal sites should be situated outside the city.
6. Use catalytic converters to help control the emissions of carbon monoxide and hydrocarbons

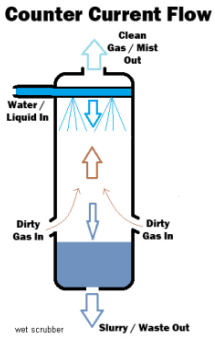
Control measures in industrial centers:
1. Emission rates should be restricted to permissible levels
2. Incorporation of air pollution control equipments in the design of the plant layout
3. Continuous monitoring of the atmosphere for the pollutants should be carried out to know the emission levels.

Equipments used to control air pollution:
(a) Scrubbers, (b) Cyclones (c) Bag houses (d) Electrostatic precipitators









WATER POLLUTION

Definition: (2 Mark)

Water pollution is defined as "the alternation in physical, chemical and biological characteristics of water which may cause harmful effects on human and aquatic life".

Sources
1. Infectious agents
2. Oxygen demanding wastes
3. Inorganic chemicals
4. Organic chemicals
5. Plant nutrients
6. Sediment
7. Radioactive materials
8. Heat

Types, sources and effects of water pollution (8 Mark)

1. Infectious agents: Ex: Bacteria, viruses, protozoa and parasitic worms.
Sources
- Human and animal wastes.

Effects

- Variety of diseases.

2. Oxygen demanding wastes:
Ex: Animal manure and plant debris that can be decomposed by aerobic bacteria.
Sources

- Sewage, paper mills, and food processing facilities.

Effects

- Wastes can degrade quality by depleting water of dissolved oxygen.

3. Inorganic Chemicals: Water soluble inorganic chemicals. Ex: Compounds of toxic metals such as lead, arsenic and selenium. Salt such as NaCl in Ocean water.
Sources

- Surface runoff, industrial effluents and sewage

Effects

- Genetic mutations, birth defects and certain cancers.

4. Thermal pollution (Heat)
Ex: Excessive heat.
Source

- Water cooling of electric power plants
- Some types of industrial plants.
- Cooling electric power plants.

Effects

- vulnerable to disease and toxic chemicals
- fish and other organisms are affected

5. Chemical oxygen demand: (COD) The amount of oxygen required to oxidize all the organic and inorganic impurities present in the sample
Source

- Sewage (waste comes from house), industrial effluents (waste comes from industries)

Effects

- Harmful to aquatic life
- Unuseful to drinking and irrigation processes

6. Biological oxygen demand: (BOD) The amount of oxygen required to oxidize all the organic compounds present in the water sample.

Source

- Food processing Industries and paper mills

Effects

- Degrade the water quality
- Harmful to aquatic life
- Unuseful to drinking and irrigation processes

7. Sediment E.x. soil, silt

Source

- Land erosion

Effects

- Reduce photosynthesis
- Affect food chain and food web
- Harmful to aquatic life

8. Radioactive materials E.x. isotopes of iodine, uranium and thorium

Source

- Nuclear power plant
- Mining industries
- Nuclear weapons production

Effects

- Genetic mutations
- Birth defects
- Cancer

Control of water pollution: (4 Mark)

1. Water pollution control should be in the hands of state and central government.
2. Scientific techniques are implemented (catchment areas of rivers ponds or streams).
3. Plant more trees.
4. Reduce deforestation.
4. Public awareness.
5. Reuse, reduce and recycle (3R) of sewage effluents and industrial waste. 2 Mark (3R rule)
6. Suitable laws and practices should be framed
7. Highly qualified and experienced persons should be consulted form time to time.
8. It is not advisable to discharge any type of waste, either treated or untreated in the fresh water bodies.

SOIL POLLUTION

Definition: (2 Mark)

The contamination of soil by human and natural activities may cause harmful effects on living things.

Sources and Effects of Soil pollution: (8 Mark)

1. Industrial wastes
2. Urban wastes.
3. Agricultural practices
4. Radioactive pollutants.
5. Biological agent

1. Industrial wastes

Sources

- Pulp and paper mills, chemical industries, oil refineries, sugar factories.

Effects

- Alter the chemical and biological properties of soil.
- Affect the food chain & food web
- Disturb the bio chemical process and finally lead to serious effects on environment.

2. Urban wastes

Sources

- Plastics, Glasses, metallic cans, fibers, papers, rubbers, street sweepings etc.

Effects

- **A**lter the chemical and biological properties of soil.
- Industrial waste can still be dangerous
- They cannot be easily degraded

3. Agricultural practices

Sources

- fertilizers, pesticides, herbicides, and weedicides etc.

Effects

- These farm wastes, manure, slurry, are reported to cause soil pollution.
- Alter the chemical and biological properties of soil.
- Inorganic chemicals are reported to cause soil pollution

4. Radioactive pollutants

Sources

- Nuclear testing laboratory and industries, radio nuclides of radium, thorium, uranium and isotopes of K- 40 and C- 14.

Effects

- Penetrate the soil and accumulate there by creating land pollution.
- Affect brain and central nervous system
- Serious health effects

5. Biological agents

Sources

- Human, animal and birds excreta (solid waste)

Effects

- Land pollution by biological agents.
- Serious effects to plants
- Affects the agriculture practice and heavy soil pollution

Control measures of soil pollution: (4 Mark)

1. Control of soil erosion
2. Proper dumping of unwanted materials
3. Production of natural fertilizers
4. Proper hygenic condition
5. Public awareness
6. Recycling, reduce and reuse (3R) of wastes
7. Ban on toxic chemicals.

MARINE POLLUTION

Definition: (2 Mark)

It is defined as"The discharge of waste substances into the sea resulting in harmful to living beings, aquatics and also degrade the quality of sea water".

Sources and Effects of marine pollution: (8 Mark)

Sources

- Dumping the untreated waste
- Sewage waste and industrial effluents.
- Garbage, agricultural discharge and pesticides
- Heavy metals (Pb, Sn, Se Cr and U)
- Huge quantity of plastics
- Heavy petroleum products
- Oil pollution of marine water

Effects

- More damage in birds as thinning of eggshell and tissue damage of egg.
- The great damage to water is caused by the petroleum products.
- Oil pollution cause damage to marine fauna (animal) and flora (plsnt) including algae and fungi.
- Oil spilling in the sea water causes low body temperature in birds resulting in hypothermia.
- Oil films are able to retard significantly the rate of oxygen uptake by water.
- Detergents used to clean up the spill are also harmful to marine life.

Control measures of marine pollution: (4 Mark)

- Plant for conserving marine biodiversity
- People should be educated about marine ecosystems
- Local communities must be involved
- Protecting and managing their coastal resources.
- Social and economic incentives must be offered
- Conserving and sustainable use of marine resources.
- Government must manage their own waters while extending cooperation to the neighboring states.

NOISE POLLUTION

Definition: (2 Mark)

It's defined as "the unwanted or disagreable sound that cause discomfort for all living beings". It is measured using "**Decibel**" unit.

Types of noise (2Mark)

1. Industrial noise
2. Transport noise
3. Neighborhood noise

Sources and Effects of noise pollution: (8 Mark)

Sources

- Transportation (Motor vehicles, buses, trucks and diesel engine vehicles)
- Celebration functions
- Elections and electric home appliances.
- Heavy machineries, industries and factories
- Road and train traffic noise
- Aircraft noise
- Neighborhood noise (Musical instruments, TV, radios, transistors, telephones and loud speakers)

Effects

- Affect human health, comfort and efficient
- Affect central nervous system and tension
- Damage to heart, brain, kidneys and liver
- Produce emotional disturbances
- Physiological and psychological changes.
- Loss of hearing
- Neurological problems
- Birth defects and abortion
- Increase the rate of heart beat and contraction of blood vessels

Control of noise pollution: (4 Mark)

- Reduction in sources of noise
- Heavy vehicles and old vehicles may not be allowed in the populated areas.
- Noise making machines should be kept in containers with sound absorbing media.
- Proper oiling will reduce the noise from the machinery.
- Use of sound absorbing materials.
- Plant more trees.
- Through law of legislation can ensure that sound production is minimized at various social functions.
- Unnecessary horn blowing should be restricted especially in vehicle congested areas.

THERMAL POLLUTION

Definition: (2 Mark)

It's defined as "the addition of excess of undesirable heat to water that makes it harmful to man, animal and aquatic life".

Causes and effects of thermal pollution: (8 Mark)

Sources

- Nuclear power plant
- Toxic radio nuclides
- Emission of nuclear reactors
- Coal fired power plants
- Thermal power plants
- Heated effluents

- Heat producing industries
- Refineries steel mills
- Domestic sewage
- Hydro electric power plant

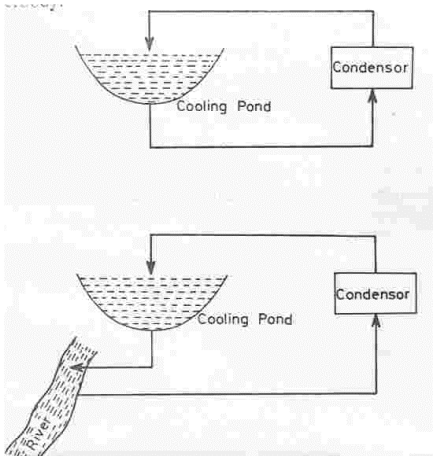
Effects

- Reduction in dissolved oxygen content of water
- Decreased as the solubility of oxygen in water
- Increases in toxicity
- Interference with biological activities
- Interference with reproduction
- increase in water temperature (harmful to aquatics)
- Affects the flora (plant) and fauna (animal)
- Changes the Metabolic activity of aquatic organisms
- Disturb spauning, hatching and migration depend on optimum temperature
- Fish migration is affected due to formation of various thermal zones.

Control of thermal pollution: (8 Mark)

Types of control methods

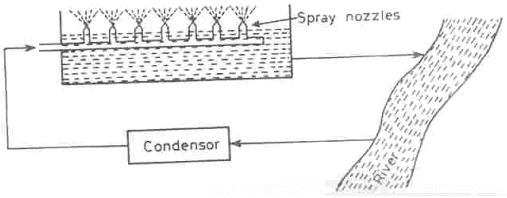
1. Cooling ponds
2. Cooling towers
3. Spray ponds



1. Cooling ponds:

- Water from condensers is stored in ponds
- Natural evaporation cools the water
- Re-circulated or discharged in nearby water body.

2. Spray ponds:

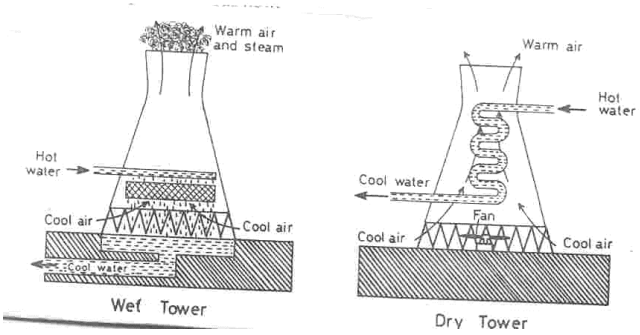


- The water from condensers is received in spray ponds.
- Here the water is sprayed through nozzles
- Fine droplets are formed.
- Heat from fine droplets is dissipated to the atmosphere.

3. Cooling tower:

a) Wet cooling tower:

- Hot water is sprayed over baffles.
- Cool air entering from sides takes away the heat and cools the water.
- This cool water can be recycled or discharged.



b) Dry cooling tower:

- The heated water flows in a system of pipes.
- Air is passed over these hot pipes with fans.
- There is no water loss in this method

NUCLEAR HAZARDS OR NUCLEAR POLLUTION

Definition (2 Mark)

It's defined as "the radioactive materials which are harmful to human beings, animals, plants and environment".

Sources and effects of nuclear pollution (8 Mark)

Sources

- cosmic rays from outer space
- radioactive radon -222
- Natural sources E.g. Soil, rocks, air, water and food which contain one or more radioactive substances.
- Nuclear power plants
- Nuclear accidents,
- Man made sources (nuclear bomb)
- X-ray, γ- ray and cosmic ray

Effects

- Genetic damage
- Affect the brain cell and central nervous system
- Delirium (mental disorder) conversions and death
- eye is vulnerable to radiation
- Eye cataract and cancer of bone, thyroid, breast lungs and skin.
- Impair sight to eye
- Vomiting, bleeding of the gums and mouth ulcers
- Internal bleeding and blood vessel damage
- Unborn children are vulnerable to brain damage and mental retardation
- Damage of the central nervous system in early pregnancy.

Control of nuclear pollution: (4 Mark)

- Sitting of nuclear power plants should be carefully
- Proper disposal of wastes from laboratory
- Nuclear waste should be exploded underground
- Use closed cycle coolant system
- Using tightly sealed boxes and closed cycle system of nuclear waste
- Production of radio isotopes should be minimized
- Minimum number of nuclear installations should be commissioned
- Nuclear mines, wet drilling may be employed along with underground drainage
- Nuclear medicines and radiation therapy should be applied
- Nuclear fission reactions should be minimized

SOLID WASTE MANAGEMENT (8 Mark)

- Management of solid waste is very important in order to minimize the adverse effects of solid wastes. **(2 Mark)**

Types / sources of solid wastes (8 Mark)

- Solid waste can be classified as municipal, industrial, agricultural, medical, mining waste and sewage sludge.
- They main sources of industrial solid wastes are chemical industries, metal and mineral processing industries.

a) Urban waste Sources

- Domestic wastes – Food waste, Cloth, Waste paper.
- Commercial wastes – Packing material, cans, bottles, polythene.
- Construction Wastes – Wood, concrete, debris.
- Bio medical wastes – Anatomical wastes, infectious wastes.

b) Industrial waste Sources

- Nuclear power plants – generates radioactive wastes
- Thermal power plants – produces fly ash in large quantities

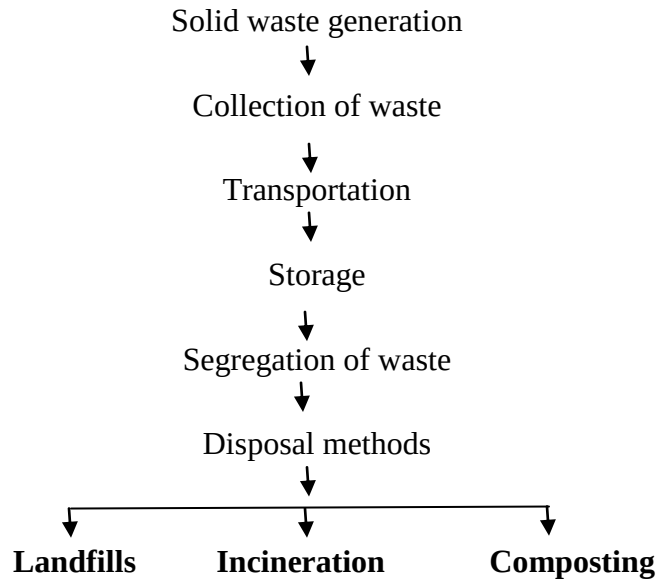
c) Chemical industries

- Produces large quantities of hazardous and toxic materials

d) Other industries

- They are produces packing materials, rubbish, organic waste, acids, alkalis, rubber, plastic, paper, glass, wood, oils, paints, dies etc.,

Steps involved (control method) in solid waste management (8 Mark)
Flowchart



- Collection waste from various sources

- Transportation – to transfer the collected waste to the destination point
- Storage – To store the collected waste mean while time of the disposal
- Segregation – Home separation for recycling
- Disposal methods – It includes 3 methods

a) **Land fill**
b) **Incineration**
c) **Composting**

a) Land fill
- Waste materials are dumped in low lying areas

b) Incineration
- Burning of solid waste material and reducing the volume, weight and residual ash

c) Composting
- Process of converting the organic solid waste material to a kind of fertilizer manure by the anaerobic bacterial activity.

ROLE OF INDIVIDUAL IN PREVENTION OF POLLUTION (8 Mark)

1. Help more in pollution prevention than pollution control.
2. Use eco-friendly products.
3. Use CFC free refrigerators. (CFC – Cholro Fluoro Carbon)
4. Reduce, Recycle and Reuse (3R) waste materials.
5. Save electricity.
6. Use renewable energy resources.
7. Use biological control.
8. Do not use pesticides, paints, solvents, oils or other harmful chemicals into the drain or ground water.
9. Use only required amount of water for various activities.
12. Reduce population growth.
13. Plant more trees.
14. Reduce deforestation.
15. Use pollution free transport system.

DISASTER MANAGEMENT

Definition (2 Mark)

It is defined as "event, concentrated in time and space, in which society or sub-division of society undergoes severe danger and causes loss of its members and physical property"

FLOOD (4 Mark)

It is defined as "Water flow exceeds the carrying capacity of the channel within its banks, the excess of water overflow on the surroundings"

Causes

- Heavy rainfall
- Sudden Snow melt
- Clearing of forest for agriculture
- Sudden release of water from dams

Effects

- Damage to building and property
- Soil erosion is the major loss of agriculture
- Great economy loss and health related problems

Control measures

- River - networking in the country also reduce flood
- Afforestation
- Proper weather report and prior intimation to the people.

EARTHQUAKE (4 Mark)

It is defined as "sudden vibration on earth surface due to the sudden release of tremendous amount of energy stored in the rocks under the earth crust."

Causes

- Underground nuclear testing
- Volcanic eruption
- Pressure of manmade dams, reservoirs and lakes
- movements of plates of earth

Effects

- Cause **Tsunami** (earthquake occur under the sea)
- Deformation of ground surface
- In hilly and mountain areas may cause landslides
- Damage the settlement and transport system

Control measures

- Governments are informing to the people earlier about the earthquake.
- Building should be designed
- Wooden houses are preferred in earthquake prone zone

CYCLONE (4 Mark)

Cyclone is "meteorological phenomena intense depressions forming over the open oceans and moving towards the land"

Causes

- It is formed because of heat and moisture.
- Sea surface temperature (SST) should be above 260^{o}C.
- Spin at the speed of 10-30 km per hour and diameter varying between 100-1500 Km.
- In India it occurs mostly in Bay of Bengal.

Effects

- Damage to human life, crops, roads, transport, communication, etc.
- Slow down the developmental activities of the area.

Control measures

- planting more trees on coastal areas
- construction of dams
- Radar system is used to detect cyclone

LANDSLIDES (4 Mark)

"The movement of earth materials like coherent rock, mud, soil and debris from higher region to lower due to gravitational pull" is called landslide

Causes

- Earthquake, shock, vibration
- Deep water ground mining
- Movement of heavy vehicles on the unstable sloppy region

Effects

- Increase in soil erosion
- Block the roads
- Damage the houses, crop yield, live stock etc.

Control measures

- Planting of deep rooted vegetation
- Encouragement for construction of bridges in water ways
- Unloading the upper parts of the slope
- Concrete support can be made at the base of the slope

POLLUTION CASDE STUDIES

1. Bhopal gas tragedy: (Air Pollution)
2. Gulf War: (Marine Pollution)
3. Chernobyl Disaster: (Nuclear pollution)
4. Minamata Disease: (Marine Pollution)

Bhopal gas tragedy (4 Mark)

- Pesticide factory-Union Carbide- corporation leak large volume of methyl iso cyanate – atmosphere
- Bhopal- India-midnight on December 3,1984-city- change gas chamber-within a week 10,000 people died
- 1000 people turned blind- lakhs of people still continue to suffer various diseases

Gulf War (4 Mark)

- Gulf war was fought between Iraq and US-Period of 6 weeks in 1991
- American fighters dropped a lakh of bombs-force the Iraq army to withdraw from Kuwaitretreat of Iraq-burning of 700 oil wells
- near sea shore–oil from well spills out into the sea-the floating oil oversea water nearly 80 km long-burning of oil wells nearly 10 months-released huge amounts of pollutants likeCO_2 and SO_2 into the atmosphere
- 1 million birds killed. Occur at Chernobyl in USSR 28th April,1986-the reactor exploded- result of uncontrolled nuclear reactions-radioactive fuel spread out in to the surrounding areas
- Killed at least 20,000 people-damage to soil, water and vegetation around 60 km.

Chernobyl Nuclear disaster (4 Mark)

- Chernobyl is a small area in the Ukraine of Soviet Union. The explosion took place on April 26.1986.
- The human error caused the unmanageable fire and explosion in the reactor due to failure of cooling system in the light water graphite reactor.
- In this accident more than 80,000 people died, 3.5 million people were affected by abnormalities, thyroid disorders, bone necrosis, skin cancer, pigment discoloration eye disease and others.
- Nearly 1, 50,000 people were evacuated to a safe place at a distance 30 km from the Chernobyl.

Minamata disease (4 Mark)

- Minamata- Small coastal village in Japan –Chicago-chemical company produces Vinyl polymer plastics
- Industry release its effluent into Minamata sea-Effluents containing mercury ions-converted into methyl mercury- highly toxic consumed by fishes
- Affect human being through food chain-damage central nervous system-loss of vision and hearing
- Loss of muscular coordination and severe headache- nervous disorders

QUESTION BANK

PART-A

1. Define Pollution.
2. What are the types of pollutants? *
3. What are the types of Air pollutants? *
4. How will you control air pollution?
5. Give the major water pollutants with example.
6. Define photochemical smog.*
7. Define BOD and COD. *
8. Define soil pollution.
9. What are the sources of soil pollution?
10. What are the sources effects of marine pollution? *
11. What are the control methods of thermal pollution?
12. Give the sources of radio activity. *
13. Classify solid wastes.
14. What are the sources of urban and industrial wastes? *
15. Why do earth quake occur?
16. What are the various types of natural disasters? *
17. What are the roles of a citizen in reducing pollution?
18. What is composting. *
19. What are incinerators?
20. Define disaster management. *
21. What is Municipal Solid Waste (MSW)? *
22. What is composting?
23. What are domestic sewage and effluents? *

PART- B

1. Mention the sources and effects of various air pollutants. (8) *
2. Describe the method of control of air pollution. (4)
3. Briefly describe the sources effects and control of noise pollution. (8) *
4. Enumerate with example the major sources of surface and ground water pollution. (8) *
5. Write short note on a)Minimata disease b)Chernobyl Nuclear disaster c)Bhopal gas tragedy (12)
6. Explain the method of sewage water treatment. (8) *
7. Describe major sources and effects of soil pollution? (8)
8. What are the measures to be taken to prevent soil pollution? (4)
9. Explain in detail the Solid waste management techniques. (8) *
10. Write notes on (i) Floods (ii) Landslides (iii) Cyclones (iv) Earthquake (8) *
11. Explain any two case studies on nuclear pollution. (8) *
12. What are the sources, effects & control measures of Marine pollution? (8) *
13. Explain the various sources, effects and control measures of nuclear pollution. (8)
14. Explain the causes, effects & control measures of Water pollution. (8) *
15. What are the effects of improper municipal solid waste management? State the measures recommended for proper management of the solid waste. (8)
16. Explain the methods of disposal of municipal solid waste. (8) *
17. Explain the sources, effects and control of thermal pollution (8) *
18. Discuss the role of individual in prevention of pollution (8) *

(Note: *– Repeated university questions)