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Syllabus: UNIT II - ENVIRONMENTAL POLLUTION

Definition – causes, effects and control measures of: (a) Air pollution (b) Water pollution (c) Soil pollution (d) Marine pollution (e) Noise pollution (f) Thermal pollution (g) Nuclear hazards – soil waste management: causes, effects and control measures of municipal solid wastes – role of an individual in prevention of pollution – pollution case studies – disaster management: floods, earthquake, cyclone and landslides. Field study of local polluted site – Urban / Rural / Industrial / Agricultural.

Objectives:

In this topic we are going to deal about different types of pollution and due to these types of pollution how our environment is facing disasters and calamities.

Introduction:

Environmental Pollution:

- Environmental pollution can be defined as "the unfavorable alteration of our surroundings"
- The quality of the environment is affected due to the presence of pollutants

Pollutants:

- Pollutants are any substance present in the environment which can cause harmful effects to the living organisms and materials.
- Pollutants may be solid, liquid or gas

Types or classification of pollutants:

1. Based on source:

a) Primary Pollutants: Substance emitted directly to the environment (Ex.: SO_2, NO_2, etc.,)
b) Secondary Pollutants: Formed from the primary pollutants (Ex.: H_2SO_4, H_2CO_3, etc.,)

2. Based on decomposition Properties:

a). Bio degradable pollutants: decompose rapidly by natural processes (Ex.: dead plants and animals)
b). Non- bio degradable pollutants: do not decompose or slowly decompose in the environment (Ex.: DDT, Mercury, Lead, etc.,)

Pollutions are of different kinds

1. **air pollution**
2. **water pollution**
3. **soil pollution**
4. **marine pollution**
5. **noise pollution**
6. **thermal pollution and**
7. **Nuclear hazards**

Air pollution:

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Composition of air:

S. No.	Constituents	%
1	Nitrogen	78
2	Oxygen	21
3	Argon	<1
4	Carbon dioxide	0.037
5	O_3, He, NH_3	Trace amount
6	Water Vapour	Remaining

Definition:

It may be defined as "the presence of one or more contaminants like dust, smoke, mist and odour in the atmosphere which are injurious to human beings, plants and animals

Sources of air pollution:

a) Natural Source: volcanic eruptions, forest fires, biological decay, etc.
b) Man – made Source: Harmful and hazardous chemicals from industries, automobiles, Thermal power plants, advance agricultural activities etc.

Classification of air pollutants:

1. Based on source:

a) Primary pollutant – these are those emitted directly in the atmosphere in harmful form like CO, NO etc
b) Secondary pollutant – these may react with one another or with the basic components of air to form new pollutants like H_2SO_4, H_2CO_3, etc.

2. Based on chemical composition:

a) Organic Pollutants: Hydrocarbone, aldehyde, ketone, amine
b) Inorganic Pollutants: NO_X, SO_2, SO_3, H_2S, HF, HCl

3. Based on state of the pollutants:

a) Gaseous Pollutants: CO, CO_2, NO_X, SO_X
b) Particulate Pollutants: It consists of finely divided solids, liquids, colloids (Ex.: Smoke, Mist, Dust, etc.)

4. Based on the level of air pollutants produced at indoor and outdoor:

a) Outdoor air pollutants:
   It occurs both in urban and rural areas
   This is due to human activities
   Ex.: NO_X, SO_2, CO
b) Indoor air pollutants:
   These are primary air pollutants
   Ex.: 1. Radon gas is emitted from building materials
   2. CO and Benzene from cigarette smoke
   3. Burning fuels in kitchen liberates CO, SO_2, formaldehyde, etc.

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Sources and their effects:

S. No.	Name of the air pollutants	Source	Effects
1	CO	Incomplete combustion of fossil fuels, cigarette smoking	1. It causes anemia and headache 2. At high levels in blood leads to coma and death
2	Nitrogen dioxide	a. Burning of fossil fuels b. from automobiles c. Industrial power plants	Lung irritation and damage
3.	Sulphur dioxide	a. Coal burning in power plants b. various industrial process	Breathing
4.	Ozone	Formed by the chemical reaction between volatile Organic compounds emitted by cars and nitrogen oxides	It alters the climate change
5	Photochemical smog	In the presence of sunlight and sir unburnt hydrocarbon react with oxides of nitrogen results the photochemical smog and ozone.	a)Breathing problems, cough, eye, nose and throat irritation b) smog can reduce visibility
6.	Hydrocarbon	Agriculture, decay of plants, burning of wet logs	Carcinogenic in nature

Control Measures:

1. **Source control:**

a) Use only unleaded petrol
b) Use petroleum products and other fuels that have low sulphur and ash content
c) Plant trees along busy streets because they remove particulates and carbon monoxide and absorb noise.
d) Industries and waste disposal sites should be situated outside the city centre.
e) Use catalytic converters to help control the emissions of carbon monoxide and hydrocarbons.

2. **Control measures in Industrial centers:**

a) Emission rates should be restricted to permissible levels
b) Incorporation of air pollution control equipments in the design of the plant lay out.
c) Installation of chimney in industrial gas outlets reduces the accumulation of smoke
d) Use of coke powder filled tower can adsorb the acid and chemical fumes. The water may added on the top of the tower can be adsorbed.

Water pollution:

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It may be defined as "the alteration in physical, chemical and biological characteristics of water which may cause harmful effects on human and aquatic life.

Source of water pollution:

Water pollution can be takes place by point source and non-point source.

Source	Description	Examples
Point	A specific sites which releases effluents directly to water sources	Industries, nuclear and thermal power plant, Sewage treatment plant, etc.
Non-Point	They are usually large land areas and are scattered	Surface run off from agricultural fields, Municipal drainage overflow, etc.

Types, effects and sources of water pollution:

S. No.	Type of pollutants	Example	Source	Effect
1	Infectious agents	Bacteria, viruses, protozoa and parasitic worms	Human and animal wastes	Water born diseases like cholera, dysentery, typhoid, jaundice, etc.
2	Oxygen demanding wastes	Animal manure and plant debris that can be decomposed by aerobic bacteria	Sewage, paper mills, and food processing facilities	a) reduce DO content of water b) Causes aquatic life to die
3.	Inorganic toxic Chemicals	Heavy metals, Pesticides, cyanide, etc.	a) surface run off b) agricultural run off c) Industrial effluents d) house hold cleansers	Genetic mutations, birth defects and certain cancers
4.	Sediment	Sand, dirt, gravel, Soil, etc.	Surface run off	a) reduce photo synthesis b) decrease aquatic habitat
5.	Radioactive materials	Radioactive isotopes of Rn, U, Th, Cs, I_2	Nuclear power plants, mining, nuclear weapon	DNA mutation, lung cancer, Birth defects

Control measures of water pollution:

1. The management of water pollution should be in the hands of state or central government.
2. Industrial plants should be based on recycling operations, because it will not only stop the release of industrial wastes into natural water sources but by products can be extracted from the wastes.
3. Plants, trees and forests control pollution and they acts as natural air conditioners.

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4. Highly qualified and experienced persons should be consulted from time to time for effective control of water pollution.
5. Basic and applied research in public health engineering should be encouraged.
6. Adopt integrated pest management
7. Mixing of sewage with rain water can be avoided by the need of separate drainage for water and sewage

Soil Pollution:

Soil is the upper layer of the earth crust. Soil contains organic and inorganic matters which makes it suitable for living organisms.

Soil pollution may be defined as "the contamination of soil by human and natural activities which may cause harmful effects on living beings".

Types of wastes, sources and effects:

1. Industrial wastes

Sources and effects:- Pulp and paper mills, chemical industries, oil refineries, sugar factories etc. These pollutants affect and alter the chemical and biological properties of soil. As a result, hazardous chemicals can enter into human food chain from the soil; disturb the bio chemical process and finally lead to serious effects.

2. Urban wastes

Sources and effects:- Plastics, Glasses, metallic cans, fibers, papers, rubbers, street sweepings, and other discarded manufactured products. These are also dangerous.

3. Agricultural practices

Sources and effects:- Huge quantities of fertilizers, pesticides, herbicides, fungicides are added to increase the crop yield. Apart from these farm wastes, manure, slurry, are reported to cause soil pollution.

4. Radioactive pollutants

Sources and effects: These are resulting from explosions of nuclear dust and radioactive wastes (Ex.: isotopes of Ra, U, Th, K-40, C-14) penetrate the soil and accumulate there by creating land pollution. Radioactive wastes continuously emit gamma rays. This causes dangerous effect to living matters.

5. Biological agents

Sources and effects: Soil gets large quantities of human, animal and birds excreta which constitute the major source of land pollution by biological agents.

The following table consists of different industries and their wastes.

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S. No.	Name of the Industry	Nature of waste
1	Oil refineries	Acid, alkali, phenol, resins, oil
2	Drug	Acid, alkali, toxic organics, sediments
3	Thermal power plant	Sediments, heavy metals, salts
4	Explosives	TNT, organic acids, alcohol, metals
5	Steel	Acid, alkali, oil sediments, phenols

Control measures of soil pollution

The pressure on strengthening of farm activities increases for two reasons

1. population growth
2. Decrease of the available farm land due to urbanization

The soil pollution can be controlled by

1. forestry and farm practices
2. Proper dumping of unwanted materials
3. Production of natural fertilizers
4. Maintain proper Hygienic condition
5. Public awareness about sanitary habits
6. Recycling and Reuse of wastes
7. Ban on Toxic chemicals.

Marine pollution:

About 50% of world population lives nearest to sea shore.

Marine pollution may be defined as "the discharge of waste substances into the sea resulting in harm to living resources hazards to human health, hindrance to fishery and impairment of quality for use of sea water".

Sources and effects of marine pollution:

S. No.	Name of the source	Description	Effects
1	Rivers	a) Rivers passing through many places like big cities are highly polluted by sewage waste and mix with sea b) Industrial effluents are dumped into sea through river	1. The presence of heavy metals and organic pollutants cause more damage in birds as thinning of eggshell and tissue damage of egg. 2. Oil spilling causes abnormally low body temperature in birds resulting in hypothermia. 3. Oil films are able to retard significantly the rate of oxygen uptake by water. 4. Oil spilling reduces the DO content 5. Marine pollution causes ecological imbalance in the marine environment
2	Dumping of wastes	Various industries dumped their effluents (Contains toxic heavy metals like Pb, Cu, Zn, Ar, Ba, Hg, etc. and plastics) in the sea	
3	Oil drilling and shipments	Contamination of oil in sea water is happen due to the leakage of oil transportation, oil tanker disaster and ship accident	

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Control measures of marine pollution

1. Plants for conserving marine biodiversity must be taken into account of human needs.
2. People should be educated about marine ecosystems and the benefits offered by them.
3. Local communities must be involved in protecting and managing their coastal resources
4. Social and economic incentives must be offered for conserving and sustainable use of marine resources.
5. Governments must manage their own water while extending cooperation to the neighboring states.
6. Oil present in the marine water can be removed by proper techniques
7. Coastal water should be analyzed periodically to determine pollution level
8. The development activities should be minimized on the coastal area

Noise pollution:

It may be defined as "the unwanted, unpleasant or disagreeable sound that causes discomfort for all living beings"

Types of noise:

Based on the source noises are divided into two types

1. Natural Noise: Ex.: Thunder
2. Man made noise: Ex.: Noises from different vehicles, factories, TV, radio, Barking of dogs, etc.

Sources of noise:

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

Effects of Noise pollution

1. This affects human health, comfort and efficiency.
2. It causes muscles to contract leading to nervous breakdown, tension
3. It affects health efficiency and behavior.
4. In addition to serious loss of hearing due to excessive noise, impulsive noise also causes psychological and pathological disorders.
5. Brain is also adversely affected by loud and sudden noise as that of jet and aero plane noise etc.
6. Noise pollution affects the birds and animals also. They change their habitat due to noise pollution

Control and preventing measures

1. Source control – acoustic treatment to machine surface, design changes, limiting the operational timings
2. Transmission path intervention- the source inside a sound insulating enclosure, construction of a noise barrier or provision of sound absorbing materials
3. Oiling – Proper oiling will reduce the noise from the machines.
4. Planting more trees having broad leaves can absorb more noise and reduce noise pollution

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5. Noise pollution can be prevented by reducing traffic density in residential area
6. Sound proof tiles can be used for buildings which prevent sound from bouncing back

Thermal pollution:

It may be defined as the "addition of excess of undesirable heat to water that makes it harmful to man, animal or aquatic life or otherwise cause's significant departures from the normal activities of aquatic communities in water"

Sources:

S.No.	Source	Cause
1	Nuclear reactor	a) Nuclear reactor raises the temperature $10^{o}C$ higher than the receiving water b) this affect marine based aquatic flora and fauna
2	Coal fired power plant	a) This type of industries increases the temperature of water up to $15^{o}C$ b) this affect river or lakes based aquatic flora and fauna
3	Domestic sewage	a) Sewage has high temperature and it increases the temperature of the water bodies b) As temperature increases, DO content decreases c)Thus toxic gases are released
4	Industrial effluents	Effluents from textile, pulp, paper, sugar industries increases the temperature of the water bodies

The water released from hydroelectric power plant, soil erosion, deforestation is also increases the temperature of the water bodies.

Effects of thermal pollution

The following effects are arises when the temperature of the water bodies increases significantly.

a) Reduction in dissolved oxygen
b) Increase evaporation rate
c) Increase in Toxicity
d) Interference with biological activities
e) Interference with reproduction
f) Direct mortality
g) Food storage for fish
h) Alters the physical, chemical and biological properties of water
i) Thermal pollution disturb the aquatic ecosystem

Control measures of thermal pollution:

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The high temperature produced by the thermal pollution can be controlled by using cooling towers and cooling ponds.

a) **Cooling towers: -** This is used as a coolant
- wet cooling tower
- Dry cooling tower

b) Cooling ponds
- Spray ponds
- Artificial lakes – The heated effluents can be discharged into the lake at one end and the water for cooling purposes from the other end.

Nuclear Hazards or Radioactive pollution:

The addition of radioactive material to the environment which causes dangerous effect to living organisms is called radioactive pollution. The radiation hazard in the environment comes from ultraviolet, visible, cosmic rays and micro wave radiation which produces genetic mutation in man.

Sources of Nuclear Hazards:

1. Natural Sources : a) Space, volcano, earthquake, etc., emit cosmic radiations.
   b) Some living organism in soil, rock, air, water and food emit cosmic radiations
2. Man made sources (Anthropogenic sources) These are nuclear power plants, X-rays , nuclear accidents, nuclear bombs, diagnostic kits, cell phone, etc

Effects of Nuclear Hazards:

1. Exposure of the brain and central nervous system to high doses of radiation causes delirium, convulsions and death within hours or days.
2. The use of eye is vulnerable to radiation. As its cell die, they become opaque forming cataracts that impair sight.
3. Acute radiation sickness is marked by vomiting, bleeding of gums and in severe cases mouth ulcers.
4. Nausea and vomiting often begin a few hours after the gastrointestinal tract is exposed. Infection of the intestinal wall can kill weeks afterwards.
5. Unborn children are vulnerable to brain damage or mental retardation, especially if irradiation occurs during formation of the central nervous system in early pregnancy.

Control measures:

1. Nuclear devices should never be exploded in air.
2. In nuclear reactors, closed cycle coolant system with gaseous coolant may be used to prevent extraneous active products.
3. Containments may also be employed to decrease the radio active emissions.
4. Extreme care should be exercis3ed in the disposal of industrial wastes contaminated with radio nuclides.

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5. Use of high chimneys and ventilations at the working place where radioactive contamination is high. It seems to be an effective way for dispersing pollutants.

Disposal of radioactive waste or nuclear hazards:

- Nuclear waste materials are highly dangerous.
- These wastes are classified into three types. The following table contains level of waste and its disposal method

Types of nuclear waste	Example	Disposal method
High level waste (HLW)	Spend nuclear fuel/rod	a) Maintained at 100-150^{o}C for several years b)Then, the wastes are converted into inert material c) After that, they are buried deep into the earth or stored in salt mines
Minimum level Waste (MLW)	Filters, reactors components	a) they are solidified and mixed with concrete in steel drums b) after that they are buried deep mines or below the deep level
Low level waste (LLW)	Radioactive material contaminated liquids or solids	LLW are disposed off below the sea level

Solid Waste Management:

Management of solid waste is very important in order to minimize the adverse effects of solid wastes.
Types of solid wastes:

1. Urban wastes

Sources – a) Domestic wastes – Food waste, Cloth, Waste paper etc
B) Commercial wastes – Packing material, cans, bottles , polythene etc.
C) Construction Wastes – Wood, concrete debris etc.
D) Bio medical wastes – Anatomical wastes , infectious wastes etc.,

2. Industrial wastes

Sources – a) Nuclear power plants – generates radioactive wastes
B Thermal power plants – produces fly ash in large quantities

3. Chemical industries

Produces large quantities of hazardous and toxic materials

Steps involved in solid waste management :

1. Reduce , Reuse and Recycle of materials – raw materials re usage should be reduced , reuse of waste materials should be reduced and recycling of the discarded materials into new useful products should also be reduced.
2. Discarding wastes

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a) Land fill : Solid wastes are placed in sanitary landfill system in alternate layers of 80 cm thick refuse, covered with selected earth fill of 20cm thickness
b) Incineration: It is a hygienic way of disposing the solid waste. It is a thermal process and is very effective for detoxification of all combustible pathogens
c) Composting: It is another popular method practiced in many cities in our country. In this method , bulk organic waste is converted into a fertilizing manure by biological action.

Role of an individual in prevention of pollution:

- Man is the creator and destructor of the environment.
- The environmental pollution can be prevented or removed with proper implementation and individual participation
- Think globally act locally

Some suggestion for proper implementation and individual participation

1. Plant more trees
2. Help more in pollution prevention than pollution control
3. Use water, energy and other resources efficiently
4. Purchase recyclable, recycled and environmentally safe products
5. Reduce deforestation
6. Remove NO from motor vehicular exhaust
7. Use of eco friendly products.
8. Use public transport
9. Use organic manure and compost
10. Reduce the use of fossil fuels
11. Use rechargeable batteries
12. Use natural gas, LPG
13. Use CFC free refrigerator
14. Do not use plastic cup that have carcinogenic materials
15. Reduce population growth
16. Use LED pulp

Role of women in environmental protection:

The waste from house is responsible for all kind of pollution. This may be controlled or prevented by women in the house.

The various roles of women in environmental protection are as follows

1. Use cloth bags instead of plastic bags for shopping
2. Plant more trees, grass, vegetables with trip irrigation
3. Separate biodegradable and non-biodegradable waste and dispose properly according to the municipality suggestions
4. Use green products instead of chemical containing products that have low quality
5. Buy non phosphate detergents to reduce water pollution
6. Women bring the concept of environmental protection into families
7. Avoid to use packed food products (like flour, snacks, etc.,) that contains carcinogenic preservatives

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8. Women should know the usage of vegetable waste as manure
9. Avoid using chemical containing cleaning powder, shampoo, bathing soap, detergent cake, etc. Use our ancient material for the same.
10. Encourage gardening in the house

Disaster management

Hazard

It is a perceived natural event which threatens both life and property

Disaster

A disaster is the realization of this hazard

It is defined as the geological process and it is an event concentrated in time and space in which a society or subdivision of a society undergoes severe danger and causes loss of its members and physical property.

Ex.: Floods, Earthquake, Cyclones, Landslides, Tsunami, etc.,

Types

1. Natural disasters – refers to those disasters that are generated by natural phenomena
   Ex.: Floods, Earthquake, Cyclones, Landslides, Tsunami, etc.,
2. Man made disasters – refers to the disasters resulting from man made hazards.
   Ex.: Pollution, Fire, Accidents

Floods

Whenever the magnitude of water flow exceeds the carrying capacity of the channel within its banks the excess of water overflows on the surroundings causes floods.

Causes of floods

1. Heavy rain, rainfall during cyclone causes floods
2. Sudden snow melt also raises the quantity of water in streams and causes flood
3. Sudden and excess release of impounded water behind dams
4. Clearing of forests for agriculture has also increased severity of floods.
5. Sediment deposition in the channel causes floods

Effects:

- It causes a great damage to the economy and health
- It damages the crops and livestock
- It washed away the houses and properties of people who are living in low lying areas

Flood management

1. Deepening of river channels
2. River networking will reduce flood

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3. Encroachment of flood ways should be banned
4. Building walls prevent spilling out the flood water over flood plains
5. Diverting excess water through channels or canals to areas like lake, rivers etc., where water is not sufficient,
6. Optical and microwave data from IRS is also used for flood management
7. Flood forecasts and flood warning are also given by the central water commission

Cyclones:

It is a meterological process, intense depressions forming over the open oceans and moving towards the land.
In India cyclone originate from Bay of Bengal and it occurs during October – December, or April – May.

Effect:
1. The damage depends on the intensity of cyclone the damage to human life, crops, roads, transport, could be heavy
2. Cyclone occurrence slow down the developmental activities of the area
3. it affect the wealth and heath of the people

Cyclone management:

1. Satellite images are used by meterological departments for forecasting the weather conditions which reveal the strength and intensity of the storm.
2. Radar system is used to detect the cyclone and is used for cyclone warning
3. The effect of cyclone are reduced by planting more trees, construction of dams, etc.,

Land slides:

The movement of earthy materials like coherent rock, mud, soil and debris from higher to lower region to gravitational pull is called land slides

Causes:
1. Movement of heavy vehicles on the unstable sloppy regions create landslides
2. Earthquake, shocks, vibrations and cyclone create landslide
3. Underground mining leads to land slides
4. Soil erosion due to surface runoff during rain leads to land slides
5. Disturbances in resistant rock by overlying rock of low resistance

Effects:
1. It leads to soil erosion
2. It leads to fall of trees and block the road
3. It affects the communication
4. It damages totally houses, crop, livestocks, etc.

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Management:

It is difficult to control landslides. However it can be minimized as follows.

1. Unloading the upper parts of the slope
2. Concrete support at the base of the slope
3. Soil stabilization is done by quick lime
4. Improving the cultivation in the slopping region
5. Steepness of the slope can be reduced by developing benches
6. Providing slope support like gabions

Earth quakes:

The earth crust has several tectonic plates of solid rocks which move along their boundaries. An earthquake is a sudden vibration caused on earth surface with the sudden release of tremendous energy stored in rocks under the earth's crust.

The effect of earthquake is measured by using Richter scale.

S. No.	Richter scale	Seveority
1	Less than 4	insignificant
2	4 – 4.9	Minor
3	5 – 5.9	Damaging
4	6 – 6.9	Destructive
5	7 –7.9	Major
6	More than 8	Great

Causes:

1. Disequilibrium in any part of the earth crust
2. Underground Nuclear testing
3. Decrease of underground water level.

Effect:

Damage the settlements and transport systems
Collapses houses and their structures
Deformation of ground surface
Leads Tsunami

Earthquake management:

Constructing earthquake resistant building
Wooden houses are preferred
Seismic hazard map should give the information about the magnitude of intensity of anticipated earthquakes.

Case studies:

1. Effluents treatment at MRL , Chennai
2. The Taj Trapezium case or M.C. Mehta Vs Govt. of India
3. The Bhopal gas tragedy

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4. Arsenic pollution in ground water
5. Soft drink bottling unit
6. Mercury wastes
7. Palar river pollution
8. The miniamatta epidemic (marine pollution)
9. Chennai oil spill – 2017
10. Gulf war
11. Chernobyl nuclear disaster
12. Nuclear holocaust in Japan during second world war
13. Nuclear accident in USA
14. Uranium Processing
15. Solid waste management – Love canal episode
16. Flood in Bangaladesh
17. Earthquake in Iran
18. Landslides in UP
19. Tsunami in India
20. Cyclone in orissa – 1999

Field study of local polluted site
Tirupur in Tamilnadu
Pallavaram in chennai