

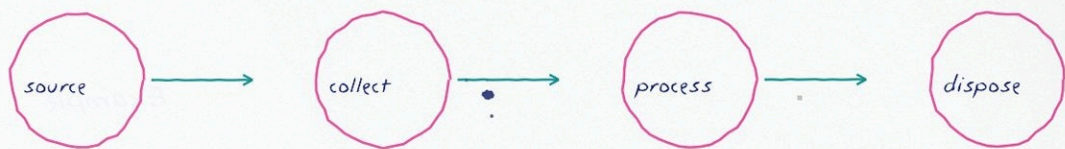
GATE Civil Revision Notes

Environmental Engineering Air Solid Waste and Noise

AIR POLLUTANTS

Definition :-

Primary pollutants are emitted directly. Secondary pollutants form through atmospheric reactions.



Concept :-

Particulates, sulphur oxides, nitrogen oxides, carbon monoxide and ozone affect health differently.

$$\text{emission load} = \text{concentration} \times \text{gas flow}$$

GATE check :-

Distinguish an emission standard at the source from an ambient air standard.

Question route :-

Identify the physical state, the given data and the required response. Select the governing relation only after this check.

- draw or list the known quantities
- convert units before substitution

Answer check :-

- attach the sign, direction and unit

ATMOSPHERIC STABILITY

Definition :-

Stability controls vertical mixing of an air parcel displaced from its original level.

Concept :-

Unstable air enhances dilution. Stable inversions trap pollution near the ground.

compare environmental and adiabatic lapse rates

GATE check :-

A strong inversion can create high concentration even when emissions are unchanged.

Question route :-

Identify the physical state, the given data and the required response. Select the governing relation only after this check.

- draw or list the known quantities
- convert units before substitution

Exam lens :-

Connect the wording to the governing physical balance. Keep the assumptions visible and compare the final trend with the concept.

- use a limiting case to reject impossible options
- attach the sign, direction and unit

Common trap :-

Do not combine equations based on different idealisations. Check whether the stated field condition is actually valid.

PLUME BEHAVIOUR

Definition :-

Wind and stability shape stack plumes into looping, coning, fanning, lofting or fumigation patterns.

Concept :-

Effective stack height includes physical height and plume rise.

$$\text{effective height} = \text{stack height} + \text{plume rise}$$

GATE check :-

Fumigation can cause severe short-term ground concentration.

Question route :-

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GAUSSIAN DISPERSION

Definition :-

The Gaussian model estimates downwind concentration from a continuous point source.

Concept :-

Wind speed, stack height and dispersion parameters control dilution.

centreline concentration falls with wind and spread

GATE check :-

Use dispersion coefficients for the correct stability class and downwind distance.

Question route :-

Identify the physical state, the given data and the required response. Select the governing relation only after this check.

- draw or list the known quantities
- convert units before substitution

Exam lens :-

Connect the wording to the governing physical balance. Keep the assumptions visible and compare the final trend with the concept.

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AQI & MONITORING

Definition :-

Air-quality monitoring compares measured pollutant levels with health-based categories.

Concept :-

An air-quality index reports the worst sub-index among selected pollutants.

$$AQI = \text{maximum pollutant sub-index}$$

GATE check :-

An acceptable daily AQI does not mean every pollutant was low at every hour.

Question route :-

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- draw or list the known quantities
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GRAVITY SETTLING

Definition :-

A settling chamber removes large particles by giving them time to fall from a slow gas stream.

Concept :-

It is simple and low-loss but ineffective for fine particles.

collection depends on settling velocity and chamber area

GATE check :-

Reducing gas velocity improves settling but requires a larger chamber.

Question route :-

Identify the physical state, the given data and the required response. Select the governing relation only after this check.

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CYCLONE SEPARATOR

Definition :-

A cyclone spins gas so particle inertia drives solids toward the outer wall.

Concept :-

Small diameter, higher velocity and particle density improve collection but increase pressure loss.

centrifugal force rises with velocity²

GATE check :-

Cyclones are often pre-cleaners before finer control equipment.

Question route :-

Identify the physical state, the given data and the required response. Select the governing relation only after this check.

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ELECTROSTATIC PRECIPITATOR

Definition :-

An ESP charges particles and attracts them to oppositely charged collection plates.

Concept :-

It handles large gas volumes with high fine-particle efficiency and modest pressure drop.

$$\text{efficiency} = 1 - \exp(-\text{migration area} / \text{flow})$$

GATE check :-

Very high or low dust resistivity can reduce ESP performance.

Question route :-

Identify the physical state, the given data and the required response. Select the governing relation only after this check.

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FABRIC FILTER

Definition :-

A bag filter passes gas through fabric and a dust cake that captures particles.

Concept :-

It gives high efficiency but needs cleaning and temperature-compatible fabric.

$$\text{air-to-cloth ratio} = \text{gas flow} / \text{cloth area}$$

GATE check :-

Condensation and sticky dust can blind the fabric.

Question route :-

Identify the physical state, the given data and the required response. Select the governing relation only after this check.

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Exam lens :-

Connect the wording to the governing physical balance. Keep the assumptions visible and compare the final trend with the concept.

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GASEOUS POLLUTANT CONTROL

Definition :-

Absorption transfers gas into a liquid. Adsorption holds it on a solid surface.

Concept :-

Combustion destroys suitable organics, while chemical scrubbing reacts with acid gases.

$$\text{removal} = \text{inlet load} - \text{outlet load}$$

GATE check :-

Select control by solubility, reactivity, concentration and gas temperature.

Question route :-

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VEHICULAR EMISSIONS

Definition :-

Engines emit carbon monoxide, hydrocarbons, nitrogen oxides and particles depending on combustion conditions.

Concept :-

Catalytic converters, cleaner fuel and inspection reduce emissions.

emission factor $\times$ vehicle activity gives load

GATE check :-

Cold starts and congestion can dominate urban emission exposure.

Question route :-

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NOISE BASICS

Definition :-

Sound pressure level uses a logarithmic decibel scale because human hearing spans a wide pressure range.

Concept :-

Equal decibel sources do not add arithmetically.

$$L_p = 20 \log_{10}(p/p_0)$$

GATE check :-

Doubling identical independent sources raises level by about 3 dB.

Question route :-

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Exam lens :-

Connect the wording to the governing physical balance. Keep the assumptions visible and compare the final trend with the concept.

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NOISE CONTROL

Definition :-

Noise can be controlled at the source, along the path or at the receiver.

Concept :-

Barriers work best when they block line of sight and sit near source or receiver.

total level uses logarithmic energy addition

GATE check :-

Hearing protection is the last control after quieter equipment and enclosure.

Question route :-

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SOLID WASTE CHARACTERISTICS

Definition :-

Municipal solid waste varies in density, moisture, composition and heating value.

Concept :-

Reliable characterisation guides collection, processing, composting and combustion choices.

$$\text{generation rate} = \text{waste mass} / \text{population} / \text{day}$$

GATE check :-

Season and income can change composition, so one sample is not enough.

Question route :-

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COLLECTION & TRANSFER

Definition :-

Collection is usually the costliest part of municipal solid-waste management.

Concept :-

Transfer stations consolidate small vehicle loads for efficient long-distance haul.

haul choice depends on break-even distance

GATE check :-

Route design should minimise dead travel while respecting vehicle capacity.

Question route :-

Identify the physical state, the given data and the required response. Select the governing relation only after this check.

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COMPOSTING

Definition :-

Composting biologically stabilises source-separated organic waste under aerobic conditions.

Concept :-

Moisture, oxygen, temperature, particle size and carbon-nitrogen ratio control the process.

good C/N is roughly 25 to 30

GATE check :-

Mixed waste contamination lowers compost quality and market value.

Question route :-

Identify the physical state, the given data and the required response. Select the governing relation only after this check.

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- convert units before substitution

Exam lens :-

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Common trap :-

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INCINERATION

Definition :-

Incineration reduces combustible waste volume and may recover energy.

Concept :-

Good combustion needs adequate temperature, time, turbulence and oxygen.

net energy depends on waste heating value and moisture

GATE check :-

Air-pollution control and ash management remain necessary after burning.

Question route :-

Identify the physical state, the given data and the required response. Select the governing relation only after this check.

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Exam lens :-

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SANITARY LANDFILL

Definition :-

A sanitary landfill isolates compacted waste with liners, cover, leachate and gas systems.

Concept :-

Methane forms under anaerobic decomposition and can be recovered or flared.

$$\text{cell volume} = \text{waste plus cover volume}$$

GATE check :-

Site closure needs long-term leachate, gas and settlement monitoring.

Question route :-

Identify the physical state, the given data and the required response. Select the governing relation only after this check.

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Exam lens :-

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QUICK FORMULA MAP

Core equations :-

Air Pollutants : emission load = concentration $\times$ gas flow

Atmospheric Stability : compare environmental and adiabatic lapse rates

Plume Behaviour : effective height = stack height + plume rise

Gaussian Dispersion : centreline concentration falls with wind and spread

Aqi & Monitoring : AQI = maximum pollutant sub-index

Gravity Settling : collection depends on settling velocity and chamber area

Cyclone Separator : centrifugal force rises with velocity²

Recall ladder :-

- state the physical assumption
- write symbols before numbers
- test units and limiting behaviour

Last-minute sequence :-

- model, equation, substitution, check
- keep one sign convention throughout

Use correctly :-

Write units beside every input. Check the sign and limiting case before selecting the answer.

GATE TIPS & TRAPS

High-return checks :-

Distinguish an emission standard at the source from an ambient air standard.

A strong inversion can create high concentration even when emissions are unchanged.

Fumigation can cause severe short-term ground concentration.

Use dispersion coefficients for the correct stability class and downwind distance.

Common mistakes :-

Condensation and sticky dust can blind the fabric.

Select control by solubility, reactivity, concentration and gas temperature.

Cold starts and congestion can dominate urban emission exposure.

Doubling identical independent sources raises level by about 3 dB.

Final recall :-

Sketch the physical system first. Keep one sign convention and test whether the result is realistic.