

# ✓ Potentiometric MOSFET Gas Sensor & CO<sub>2</sub> Gas Sensor – 16 Marks Answer

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## 1. Introduction

- **Gas sensors** are devices used to **detect the presence and concentration of gases** in the environment.
  - **Potentiometric** and **MOSFET-based gas sensors** use changes in **voltage** or **electrical properties** to detect gases.
  - **CO<sub>2</sub> gas sensors** are used to measure **carbon dioxide levels** in air for safety, environmental, and industrial monitoring.
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## ◆ A. Potentiometric MOSFET Gas Sensor

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### ✓ 1. Construction

- Based on **MOSFET (Metal Oxide Semiconductor Field Effect Transistor)**.
  - A **gas-sensitive membrane** (e.g., solid electrolyte like YSZ – Yttria Stabilized Zirconia) is placed on the **gate** region.
  - Acts as a **chemically sensitive field-effect transistor** (CHEMFET or ISFET).
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### 2. Working Principle

- The **gas interacts** with the membrane.
  - Causes a change in **ion concentration** → leads to a change in **electrical potential (voltage)** at the gate.
  - This modifies the **current between source and drain**.
  - The change in current is proportional to **gas concentration**.
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### 3. Properties

- Selective to certain gases.
  - Works at **elevated temperatures** (200–400°C).
  - High sensitivity and fast response.
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### 4. Applications

- Detection of **H<sub>2</sub>, CO, NO<sub>2</sub>, NH<sub>3</sub>**.
  - Used in **automotive exhaust** systems.
  - **Industrial gas monitoring**.
  - **Medical gas sensors**.
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## ✓ 5. Advantages

- High **selectivity and sensitivity**.
  - **Compact and low power**.
  - Can be integrated with **electronics**.
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## ✗ 6. Disadvantages

- Sensitive to **temperature and humidity**.
  - May have **short lifespan** at high temperatures.
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## ◆ B. CO<sub>2</sub> Gas Sensor

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### ✓ 1. Types of CO<sub>2</sub> Sensors

- **NDIR (Non-Dispersive Infrared)** – Most common
  - **Chemical-based sensors**
  - **Solid-state (metal oxide) sensors**
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### ⚙️ 2. NDIR CO<sub>2</sub> Sensor – Working Principle

- Uses an **infrared light source** and **detector**.
  - **CO<sub>2</sub> absorbs IR light** at a specific wavelength (~4.26 μm).
  - The amount of IR light absorbed = **concentration of CO<sub>2</sub>**.
  - Detector measures this drop and gives the **CO<sub>2</sub> level**.
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### 📌 3. Properties

- Accurate and stable over time.
  - Selective to CO<sub>2</sub>, not affected by other gases.
  - Operates well in indoor/outdoor environments.
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### 📈 4. Applications

- **Indoor air quality monitoring**.
  - **Greenhouses and agriculture**.
  - **Industrial safety** systems.
  - **Medical use** – capnography (CO<sub>2</sub> in breath).
  - **HVAC systems** – automatic air control.
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### ✓ 5. Advantages

- High **accuracy** and **stability**.

- Long lifespan (NDIR ~10 years).
- Not affected by **oxygen or moisture**.

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## ✗ 6. Disadvantages

- NDIR sensors are **expensive**.
- Slower response time than MOS sensors.
- Requires **calibration**.

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## Summary

Sensor Type	Working	Target Gas	Advantages	Used In
<b>MOSFET Gas Sensor</b>	Voltage change due to gas at gate	H <sub>2</sub> , CO, NO <sub>2</sub> , NH <sub>3</sub>	Compact, sensitive	Auto exhaust, medical
<b>CO<sub>2</sub> Sensor (NDIR)</b>	IR absorption by CO <sub>2</sub> gas	CO <sub>2</sub>	Accurate, stable	Air quality, industry