# Properties of the Differential Amplifier

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# 1 Introduction - Prelab

## 1.1 Metal Oxide Semiconductor Field Effect Transistors (MOSFET)

1. Enhancement MOSFET: - The transistor is normally off when no gate voltage is applied. - A positive (for NMOS) or negative (for PMOS) gate voltage is required to induce a conductive channel and turn it on. - Commonly used in modern electronics due to its low power consumption in the off state.
   Depletion MOSFET: - The transistor is normally on without any gate voltage applied. - A gate voltage opposite to the type of the MOSFET (negative for NMOS, positive for PMOS) is applied to turn it off. - Less common compared to enhancement-mode MOSFETs.

2. NMOS Transistor:

   - Built using n-type material as the channel. - Requires a positive voltage at the gate relative to the source to turn it on. - Typically faster and has better electron mobility than PMOS. - Used for high-speed and high-performance applications.
   PMOS Transistor:

   - Built using p-type material as the channel. - Requires a negative voltage at the gate relative to the source to turn it on. - Slower than NMOS due to lower hole mobility. - Often used for low-power applications.

## 1.2 MOSFET as Amplifier

## 1.3 MOSFET as Switch

1. When $U_{in}$ is 0V the mosfet is off, no current flows so $V_{RD} = 0\text{V}$ and $V_{DS} = V_{DD} = 10\text{V}$.

2. when $U_{in}$ is 2.4V

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## 2.1 Voltage Transfer Characteristic of a CMOS inverter

1.