Fundumantal of Electronic II

Second Class

Chapter08: FET Amplifier

Lec08_p1

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Introduction

FETs provide:

- **Excellent voltage gain**
- **High input impedance**
- **Low-power consumption**
- **Good frequency range**

FET Small-Signal Model

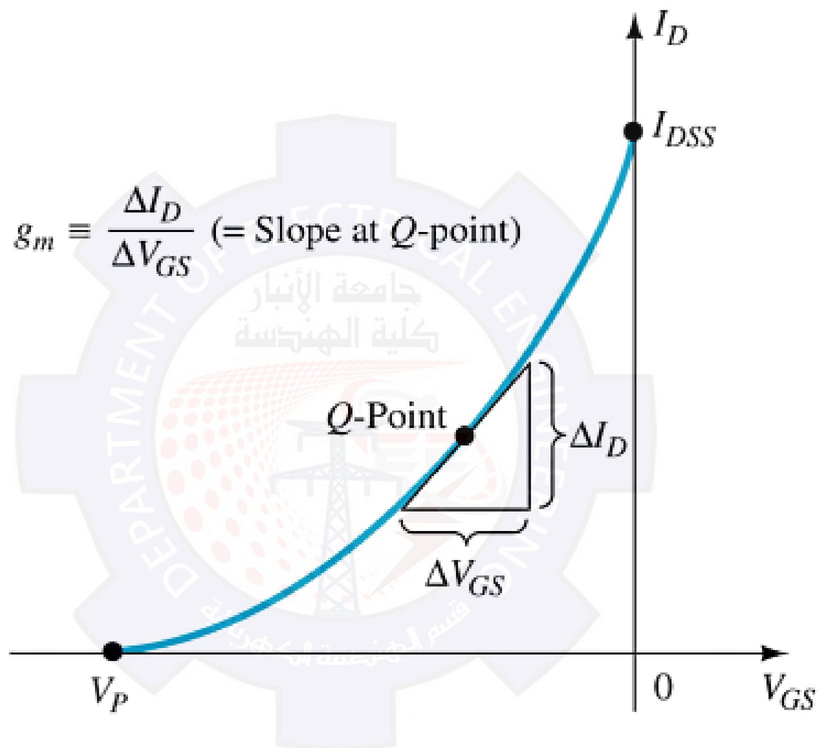
Transconductance

The relationship of a change in I_D to the corresponding change in V_{GS} is called transconductance

Transconductance is denoted g_m and given by:

$$g_m = \frac{\Delta I_D}{\Delta V_{GS}}$$

Graphical Determination of g_m



Mathematical Definitions of g_m

$$g_m = \frac{\Delta I_D}{\Delta V_{GS}}$$

$$g_m = \frac{2I_{DSS}}{|V_P|}\left[1 - \frac{V_{GS}}{V_P}\right]$$

Where V_{GS} =0V

$$g_{m0} = \frac{2I_{DSS}}{|V_P|}$$

$$g_m = g_{m0}\left[1 - \frac{V_{GS}}{V_P}\right]$$

Where

$$1 - \frac{V_{GS}}{V_P} = \sqrt{\frac{I_D}{I_{DSS}}}$$

$$g_m = g_{m0}\left(1 - \frac{V_{GS}}{V_P}\right) = g_{m0}\sqrt{\frac{I_D}{I_{DSS}}}$$

FET Impedance

Input impedance:

$$Z_i = \infty\Omega$$

Output Impedance:

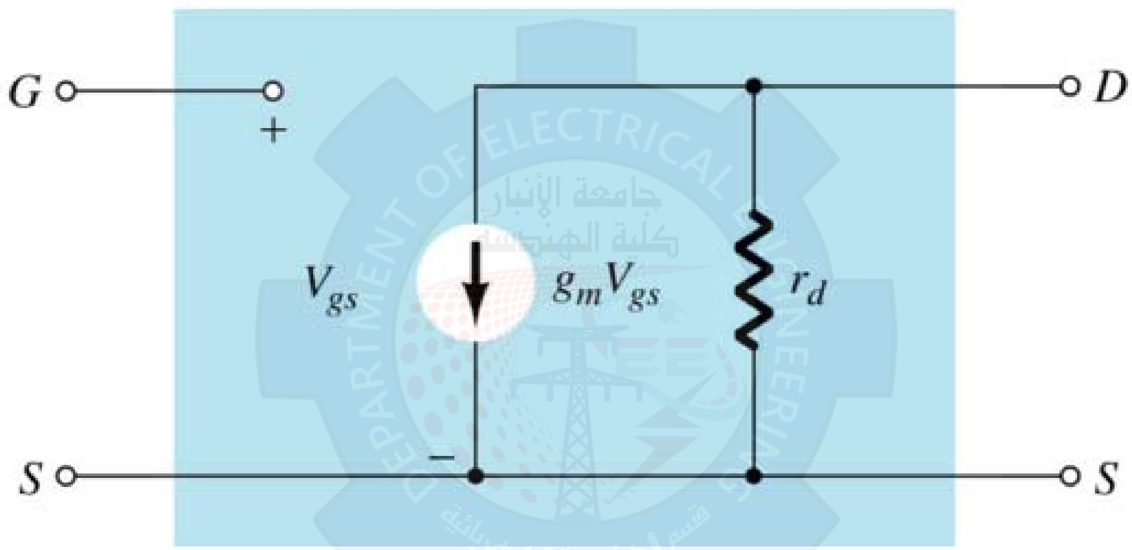
$$Z_o = r_d = \frac{1}{y_{os}}$$

where:

$$r_d = \left.\frac{\Delta V_{DS}}{\Delta I_D}\right|_{V_{GS} = \text{constant}}$$

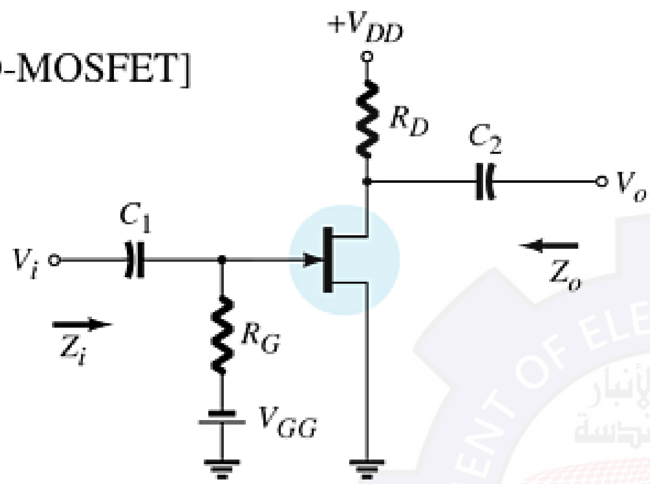
y_{os}= admittance parameter listed on FET specification sheets.

FET AC Equivalent Circuit

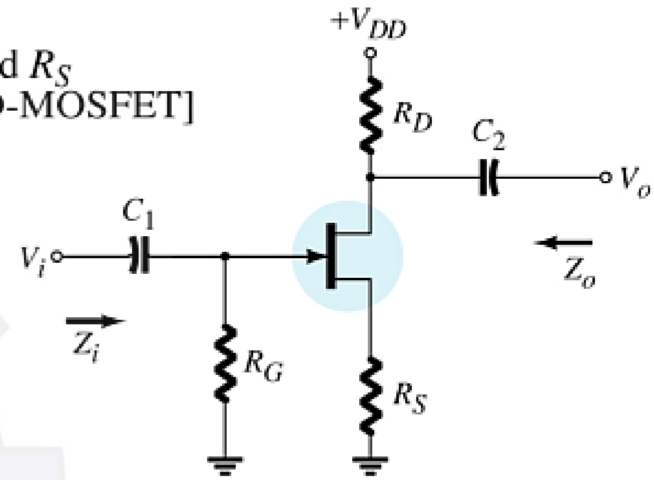


Summary Table

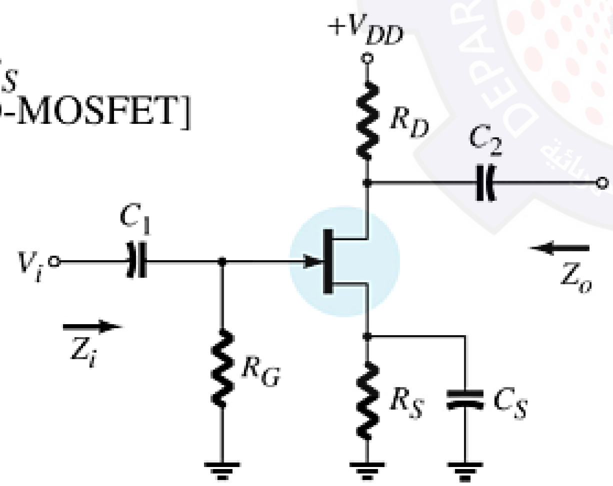
Fixed-bias
[JFET or D-MOSFET]



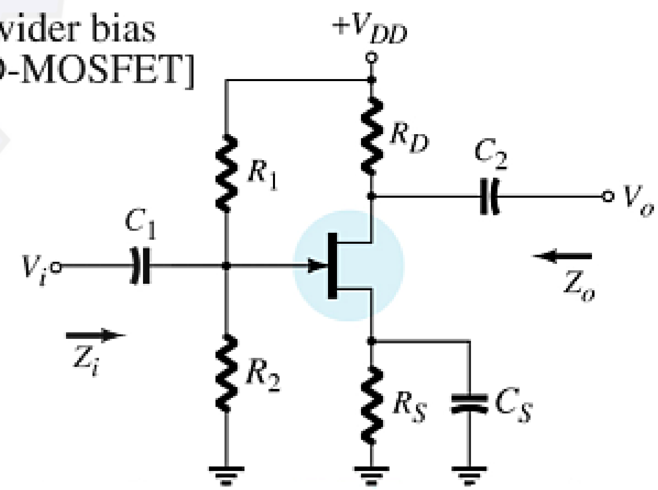
Self-bias
Unbypassed R_S
[JFET or D-MOSFET]



Self-bias
bypassed R_S
[JFET or D-MOSFET]



Voltage-divider bias
[JFET or D-MOSFET]



Troubleshooting

Check the DC bias voltages:

If not correct check power supply, resistors, FET. Also check to ensure that the coupling capacitor between amplifier stages is OK.

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Check the AC voltages:

If not correct check FET, capacitors and the loading effect of the next stage

Practical Applications

Three-Channel Audio Mixer
Silent Switching
Phase Shift Networks
Motion Detection System