6.012 - Microelectronic Devices and Circuits

Lecture 19 - Differential Amplifier Stages - Outline

Announcements

Design Problem - coming out tomorrow; PS #10 looks at pieces; neglect the Early effect in large signal analyses

Review - Single-transistor building block stages

Common source: general purpose gain stage, workhorse

Common gate: small R_{in}, large R_{out}, unity A_i, same A_v as CS

Source follower: large R_{in}, small R_{out}, unity A_v, same A_i as CS

Series and Shunt feedback: we'll see in special situations

Differential Amplifier Stages - Large signal behavior

General features: symmetry, inputs, outputs, biasing **(Symmetry is the key!)**

Large signal transfer characteristic

Difference- and common-mode signals

Decomposing and reconstructing general signals

Half-circuit incremental analysis techniques

Linear equivalent half-circuits

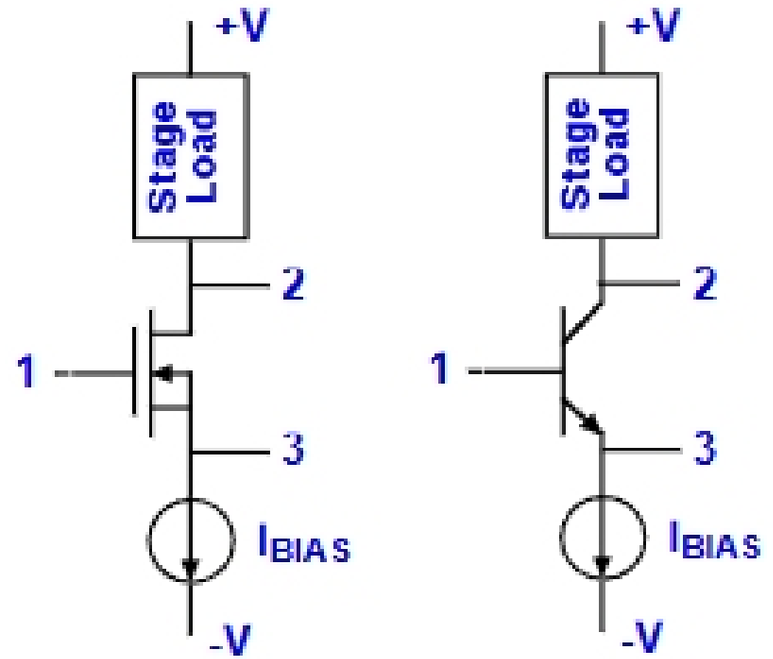
Difference- and common-mode analysis

Example: analysis of source-coupled pair

Linear amplifier layouts: The practical ways of putting inputs to, and taking outputs from, transistors to form linear amplifiers

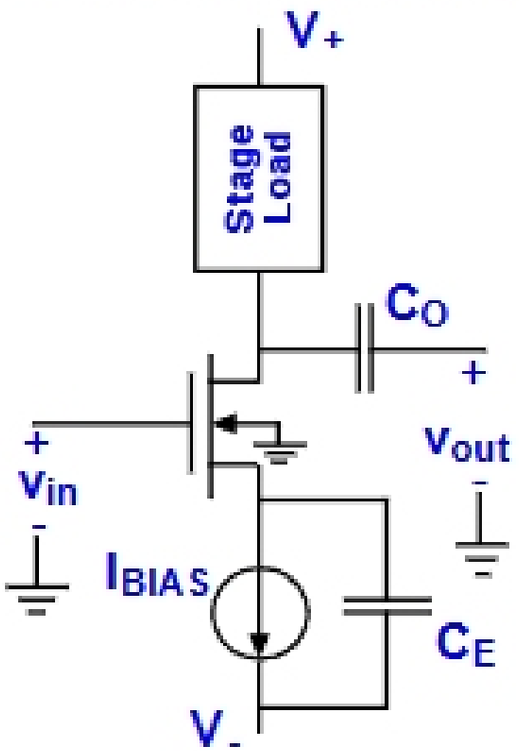
There are 12 choices: three possible nodes to connect to the input, and for each one, two nodes from which to take an output, and two choices of what to do with the remaining node (ground it or connect it to something).

Not all these choices work well, however. In fact only three do:



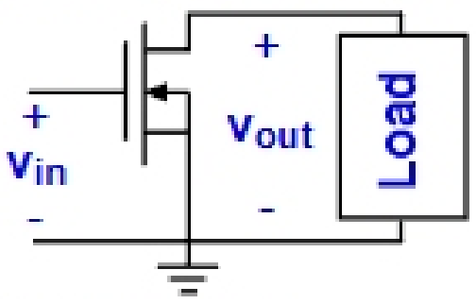
Name	Input	Output	Grounded
Common source/emitter	1	2	3
Common gate/base	3	2	1
Common drain/collector (Source/emitter follower)	1	3	2
Source/emitter degeneration	1	2	none

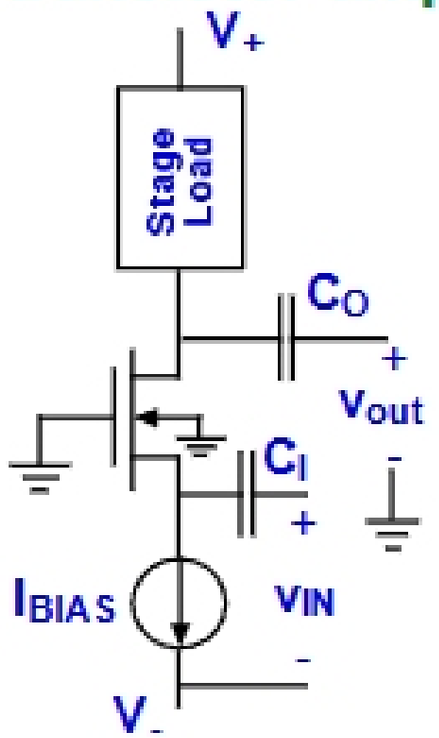
- **Three MOSFET single-transistor amplifiers**



COMMON SOURCE

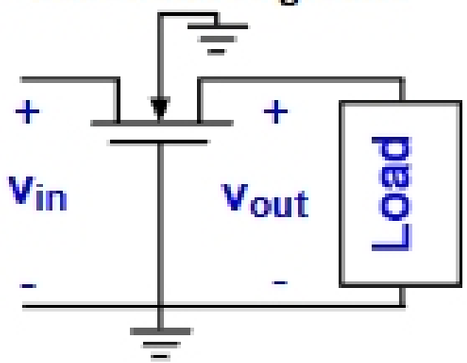
Input: gate
Output: drain
Common: source
Substrate: to source

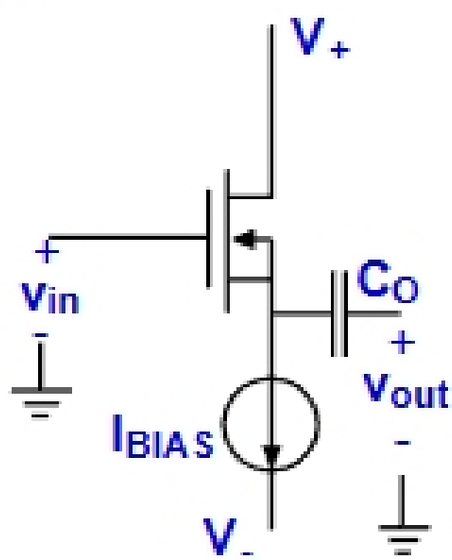




COMMON GATE

Input: source; Output: drain
Common: gate
Substrate: to ground





SOURCE FOLLOWER

Input: gate
Output: source
Common: drain
Substrate: to source