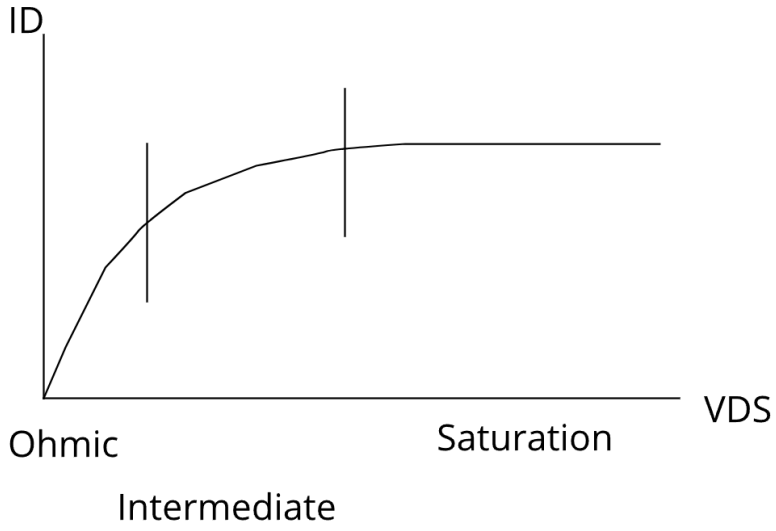
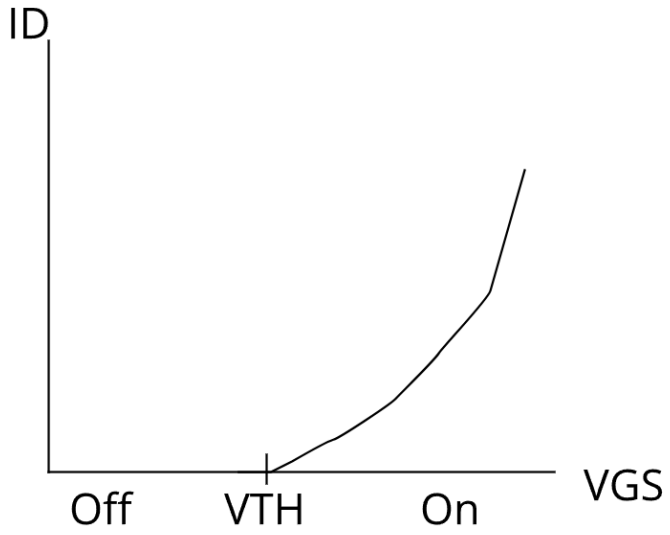
Hayden Fuller
Intro to Electronics HW8

1. 1. FET: This problem concerns properties of FETs.
    a. (a) Draw the ID versus VDS family of output curves of an FET (ID on vertical axis or ordinate and VDS on horizontal axis or abscissa). Indicate three significant regions in the drawing and name these regions.



    b. (b) Draw the ID versus VGS curve of an FET. Indicate two significant regions in the drawing and name these regions.



    c. (c) What is the relationship between source current and drain current of an FET?

IS=ID

    d. (d) What occurs when the gate voltage reaches the threshold voltage?

The FET turns on and starts to allow current flow

2. 2. FET: This problem also concerns properties of FETs.
    a. (a) What is the value of any DC gate current?

Essentially zero

    b. (b) The input power of a transistor may be defined as input voltage × input current. Given this definition, what is the input power of an FET? When comparing BJTs with FETs, which one of the two consumes a higher input power?

P=V_gate*I_gate, and I_gate is essentially zero, so P is essentially zero

    c. (c) Why is low input power (or zero input power) an advantage?

It consumes less power, allowing for devices to have less heat output and longer battery life

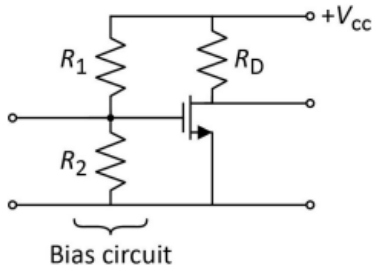
    d. (d) Point out some similarities between BJTs and FETs.

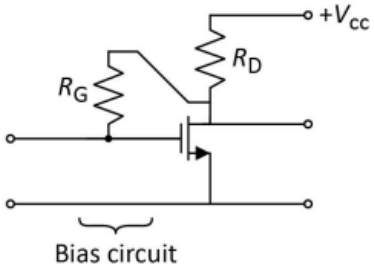
They are transistors, three terminal devices that control resistance between two terminals with a third terminal. PNP and NPN can be used as inverting and non inverting “amplifiers”

    e. (e) Point out some differences between BJTs and FETs.

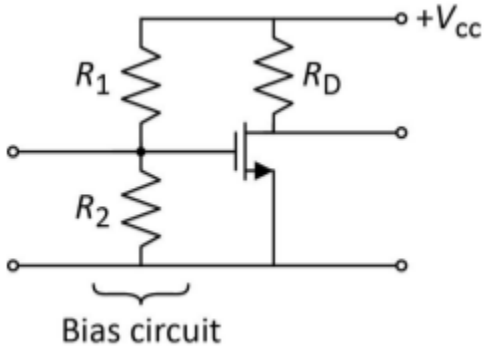
BJT’s have an active region that’s more useful for amplifying an analog signal, while FET’s are more useful for binary logic. FET’s have lower power consumption and near infinite input impedance

3. 3. FET bias circuits: Consider the bias circuits below. The power supply voltage is VCC = +10 V.





    a. (a) Draw the LHS (left hand side) circuit diagram. What kind of circuit is it? Assume Vth = 2 V, k = 5 mA/V2 , and ID = 4 mA. Determine the numerical values of R1 and R2 , assuming that R1 carries a current of 10 μA.

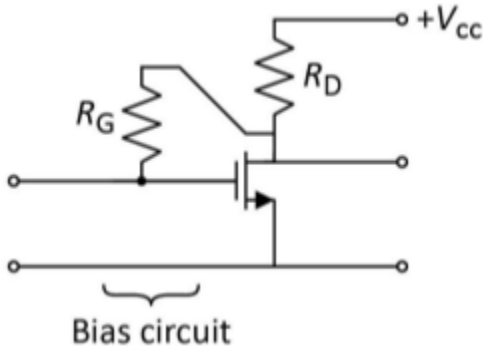


Common E amplifier
ID=1/2 k (VGS-VTH)^2
4=5/2 (VGS-2)^2
VGS=3.26491
R1+R2=10V/10uA=1Meg ohm
R1/(R1+R2)=VGS=3.26491
R1=326.5kOhm
R2=673.5kOhm

b. (b) Determine the numerical value of RD so that the Q-point is in approximately the middle of the load line.

VDS=VCC/2=10/2=5V
VDS=VCC-IRD*RD
5V=10V-4mA*RD
RD=5V/4mA=1.25kOhm=1250Ohm

c. (c) Draw the RHS (right hand side) circuit. What kind of circuit is it? Assume Vth = 2 V, k = 5mA/V2 , and ID = 4mA. Determine the numerical values of RD and RG .



ID=1/2 k (VGS-VTH)^2
4=5/2 (VGS-2)^2
VGS=3.26491
VGS=VCC-ID RD
3.2649=10-4RD
RD=1.684k

d. (d) Name an advantage of the LHS bias circuit.

Better biasing

e. (e) Name an advantage of the RHS bias circuit.

No constant power draw

4. 4. True / false questions: Are the following statements true or false? Explain your answer with one or two sentences.
    a. (a) Because the gate current is zero, the input power of an FET is zero.

True, P=IV and I=0 because infinite input impedance so there's no power draw.

    b. (b) Although an FET device does not consume any input power, an FET circuit (e.g. an FET amplifier circuit) may still consume an input power.

True, the surrounding circuitry will frequently have non infinite input impedance and consume some input power

    c. (c) In a BJT, the emitter current is slightly larger than the collector current.

True, IE=IC+IB, so it will be around 1% or less larger

    d. Similarly, in an FET, the source current is slightly larger than the drain current.

False, there is no input current, and therefore no output current