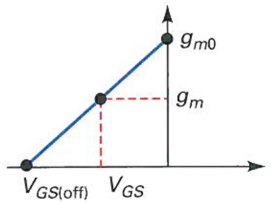
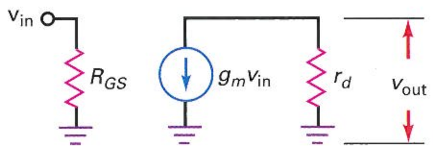
(13-16) Transconductance:



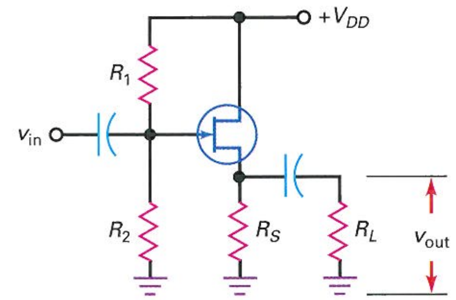
$$g_m = g_{m0}\left(1 - \frac{V_{GS}}{V_{GS(off)}}\right)$$

(13-17) CS voltage gain:



$$A_v = g_m r_d$$

(13-18) Source follower:



$$A_v = \frac{g_m r_s}{1 + g_m r_s}$$

Student Assignments

1. A JFET
   a. Is a voltage-controlled device
   b. Is a current-controlled device
   c. Has a low input resistance
   d. Has a very large voltage gain

2. A unipolar transistor uses
   a. Both free electrons and holes
   b. Only free electrons
   c. Only holes
   d. Either one or the other, but not both

3. The input impedance of a JFET
   a. Approaches zero
   b. Approaches one
   c. Approaches infinity
   d. Is impossible to predict

4. The gate controls
   a. The width of the channel
   b. The drain current
   c. The gate voltage
   d. All the above

5. The gate-source diode of a JFET should be
   a. Forward biased
   b. Reverse biased
   c. Either forward or reverse biased
   d. None of the above

6. Compared to a bipolar junction transistor, the JFET has a much higher
   a. Voltage gain
   b. Input resistance
   c. Supply voltage
   d. Current

7. The pinchoff voltage has the same magnitude as the
   a. Gate voltage
   b. Drain-source voltage
   c. Gate-source voltage
   d. Gate-source cutoff voltage

8. When the drain saturation current is less than I_{DSS}, a JFET acts like a
   a. Bipolar junction transistor
   b. Current source
   c. Resistor
   d. Battery

9. R_{DS} equals pinchoff voltage divided by
   a. Drain current
   b. Gate current
   c. Ideal drain current
   d. Drain current for zero gate voltage

10. The transconductance curve is
    a. Linear
    b. Similar to the graph of a resistor
    c. Nonlinear
    d. Like a single drain curve

11. The transconductance increases when the drain current approaches
    a. 0
    b. $I_{D(sat)}$
    c. I_{DSS}
    d. I_S

12. A CS amplifier has a voltage gain of
    a. $g_m r_d$
    b. $g_m r_s$
    c. $g_m r_s/(1 + g_m r_s)$
    d. $g_m r_d/(1 + g_m r_d)$

13. A source follower has a voltage gain of
    a. $g_m r_d$
    b. $g_m r_s$
    c. $g_m r_s/(1 + g_m r_s)$
    d. $g_m r_d/(1 + g_m r_d)$

14. When the input signal is large, a source follower has
    a. A voltage gain of less than 1
    b. Some distortion
    c. A high input resistance
    d. All of these

15. The input signal used with a JFET analog switch should be
    a. Small
    b. Large
    c. A square wave
    d. Chopped

16. A cascode amplifier has the advantage of
    a. Large voltage gain
    b. Low input capacitance
    c. Low input impedance
    d. Higher g_m

17. VHF covers frequencies from
    a. 300 kHz to 3 MHz
    b. 3 to 30 MHz
    c. 30 to 300 MHz
    d. 300 MHz to 3 GHz

18. When a JFET is cut off, the depletion layers are
    a. Far apart
    b. Close together
    c. Touching
    d. Conducting

19. When the gate voltage becomes more negative in an *n*-channel JFET, the channel between the depletion layers
    a. Shrinks
    b. Expands
    c. Conducts
    d. Stops conducting

20. If a JFET has I_{DSS} = 8 mA and V_P = 4 V, then R_{DS} equals
    a. 200 Ω
    b. 320 Ω
    c. 500 Ω
    d. 5 kΩ

21. The easiest way to bias a JFET in the ohmic region is with
    a. Voltage-divider bias
    b. Self-bias
    c. Gate bias
    d. Source bias

22. Self-bias produces
    a. Positive feedback
    b. Negative feedback
    c. Forward feedback
    d. Reverse feedback

23. To get a negative gate-source voltage in a self-biased JFET circuit, you must have a
    a. Voltage divider
    b. Source resistor
    c. Ground
    d. Negative gate supply voltage

24. Transconductance is measured in
    a. Ohms
    b. Amperes
    c. Volts
    d. Mhos or siemens

25. Transconductance indicates how effectively the input voltage controls the
    a. Voltage gain
    b. Input resistance
    c. Supply voltage
    d. Output current

Problems

SEC. 13-1 BASIC IDEAS

13-1 A 2N5458 has a gate current of 1 nA when the reverse voltage is −15 V. What is the input resistance of the gate?

13-2 A 2N5640 has a gate current of 1 μA when the reverse voltage is −20 V and the ambient temperature is 100°C. What is the input resistance of the gate?

SEC. 13-2 DRAIN CURVES

13-3 A JFET has I_{DSS} = 20 mA and V_P = 4 V. What is the maximum drain current? The gate-source cutoff voltage? The value of R_{DS}?

13-4 A 2N5555 has I_{DSS} = 16 mA and $V_{GS(off)}$ = −2 V. What is the pinchoff voltage for this JFET? What is the drain-source resistance R_{DS}?

13-5 A 2N5457 has I_{DSS} = 1 to 5 mA and $V_{GS(off)}$ = −0.5 to −6 V. What are the minimum and maximum values of R_{DS}?

SEC. 13-3 THE TRANSCONDUCTANCE CURVE

13-6 A 2N5462 has I_{DSS} = 16 mA and $V_{GS(off)}$ = −6 V. What are the gate voltage and drain current at the half cutoff point?

13-7 A 2N5670 has I_{DSS} = 10 mA and $V_{GS(off)}$ = −4 V. What are the gate voltage and drain current at the half cutoff point?

13-8 If a 2N5486 has I_{DSS} = 14 mA and $V_{GS(off)}$ = −4 V, what is the drain current when V_{GS} = −1 V? When V_{GS} = −3 V?

SEC. 13-4 BIASING IN THE OHMIC REGION

13-9 What is the drain saturation current in Fig. 13-43*a*? The drain voltage?

13-10 If the 10-kΩ resistor of Fig. 13-43*a* is increased to 20 kΩ, what is the drain voltage?

13-11 What is the drain voltage in Fig. 13-43*b*?

13-12 If the 20-kΩ resistor of Fig. 13-43*b* is decreased to 10 kΩ, what is the drain saturation current? The drain voltage?

SEC. 13-5 BIASING IN THE ACTIVE REGION

For Problems 13-13 through 13-20, use preliminary analysis.

13-13 What is the ideal drain voltage in Fig. 13-44*a*?

13-14 Draw the dc load line and *Q* point for Fig. 13-44*a*.

13-15 What is the ideal drain voltage in Fig. 13-44*b*?

13-16 If the 18 kΩ of Fig. 13-44*b* is changed to 30 kΩ, what is the drain voltage?

13-17 In Fig. 13-45*a*, what is the drain current? The drain voltage?