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ECD Assignment

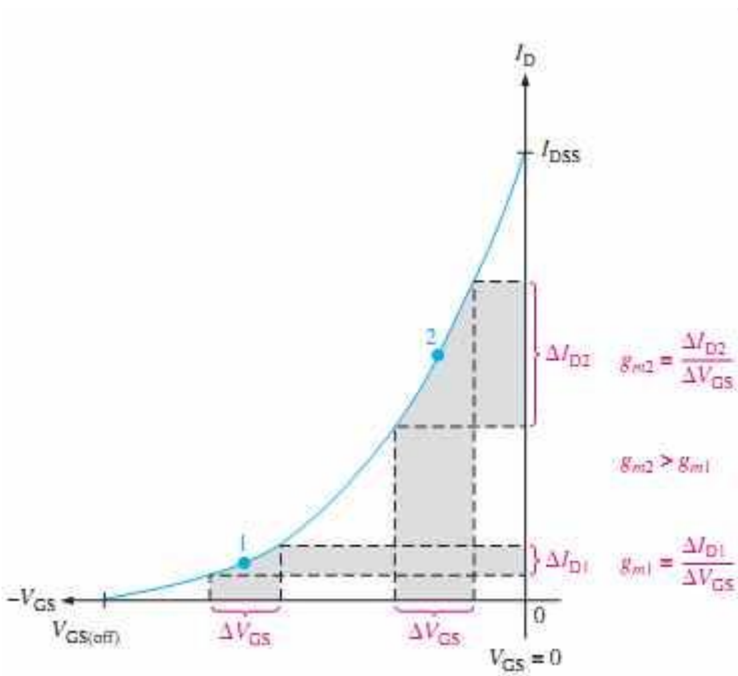
QNO 1: Explain the trans conductance curve for n-channel JFET given below

Ans=The forward transconductance (transfer conductance), gm, is the change in drain current (delta_ID) for a given change in gate-to-source voltage (delta_VGS) with the drain-to-source voltage constant. It is expressed as a ratio and has the unit of siemens (S).

gm = delta_ID / delta_VGS

Other common designations for this parameter are gfs and yfs (forward transfer admittance). As you will see in Section 9, gm is an important factor in determining the voltage gain of a FET amplifier.

Because the transfer characteristic curve for a JFET is nonlinear, gm varies in value depending on the location on the curve as set by VGS. The value for gm is greater near the top of the curve (near VGS = 0) than it is near the bottom (near VGS(off)), as illustrated



A datasheet normally gives the value of gm measured at VGS = 0V(gm0). For example, the datasheet for the 2N5457 JFET specifies a minimum gm0 (gfs) of (the mho is the same unit as the siemens (S)) with VDS = 15 V.

Given gm0, you can calculate an approximate value for gm at any point on the transfer characteristic curve using the following formula:

1000 mmhos

Equation 2

When a value of gm0 is not available, you can calculate it using values of IDSS and VGS(off). The vertical lines indicate an absolute value (no sign).

Equation 3

Input Resistance and Capacitance

As you know, a JFET operates with its gate-source junction reverse-biased, which makes the input resistance at the gate very high. This high input resistance is one advantage of the JFET over the BJT. (Recall that a bipolar junction transistor operates with a forward-biased base-emitter junction.) JFET datasheets often specify the input resistance by giving a value for the gate reverse current, IGSS, at a certain gate-to-source voltage. The input resistance can then be determined using the following equation, where the vertical lines indicate an absolute value (no sign):

RIN = VGS/IGSS

For example, the 2N5457 datasheet in FIG. 14 lists a maximum IGSS of -1.0 nA for VGS =-15 V at 25°C. IGSS increases with temperature, so the input resistance decreases.

The input capacitance, Ciss, is a result of the JFET operating with a reverse-biased pn junction. Recall that a reverse-biased pn junction acts as a capacitor whose capacitance depends on the amount of reverse voltage. For example, the 2N5457 has a maximum Ciss of 7 pF for VGS = 0

Q:2 Ans

Practical Op Amp Characteristics:

The Practical Op Amp Characteristics can be approximated closely enough, for many practical op-amps But basically the Practical Op Amp Characteristics are little bit different than the ideal op-amp characteristics.

The various characteristics of a practical op-amp can be described as below

1. **Open loop gain :** It is the voltage gain of the op-amp when no feedback is Practically it is several thousands.
2. **Input impedance : It** is finite and typically greater than 1 M 0. But using FETs for the input stage, it can be increased upto several hundred M
3. **Output impedance :** It is typically few hundred ohms. With the help of negative feedback, it can be reduced to a very small value like 1 or 2 ohms.
4. **Bandwidth :** The bandwidth of practical op-amp in open loop configuration is very small. By application of negative feedback, it can be increased to a desired value.
5. **Input offset voltage :** Whenever both the input terminals of the op-amp are grounded, ideally, the output voltage should be zero. However, in this condition, the practical op-amp shows a small non zero output voltage. To make this output voltage zero, a small voltage in millivolts is required to be applied to one of the input Such a voltage makes the output exactly zero. This d.c. voltage, which makes the output voltage zero, when the other terminal is grounded is called **input offset voltage** denoted as V_{ios}. How much voltage, to which terminal and with what polarity, to be applied, is specified by the manufacturer in the datasheet. The input offset voltage depends on the temperature.
6. **Input bias current :** For ideal op-amp, no current flows into the input The practical op-amps do have some input currents which are very small, of the order of 10^{-6} A to 10^{-14} A.

Most of the op-amps use differential amplifier as the input stage. The two transistors of the differential amplifier must be biased correctly. But practically, it is not possible to get exact matching of the two transistors. Thus, the input terminals which are the base terminals of the two transistors, do conduct the small d.c. current. These small base currents of the two transistors are nothing but bias currents denoted as I_{bi} and 42•

So input bias current can be defined as the current flowing into each of the two input terminals when they are biased to the same voltage level i.e. when the op-amp is balanced.

QNO 3:Calculate output voltage for summing amplifier if V_1 = 0.2V, V_2 = 0.5V and V_3 = 2V and $R_1=R_2=R_3=R_f$ = 6kΩ

Given:

V_1=0.2V

V_2=0.5V

V_3=2V

R_1=R_2=R_3 =Rf= 6k Ohms

Required:

Vout=?

Solution:

Formula: Vout= -(Rf/R) * (V1+ V2)

=-(6k/6k)* (0.2+0.5+2)

= -2.7V Answer

QNO4(a): You are working on an audio circuit in the lab. Which class of power amplifier will you not consider for your work?
Justify your answer with reason.

For Class A

- And class A is always ON .it is used for “signal" level circuits (where power requirements are small) because they maintain low distortion.
- They are very inefficient and are rarely used for high power designs.
- 75% (or more) of the supplied power is dissipated by DC

For Class B

- Peak efficiency of the class B output stage is 78.5 %, much higher than class A.
- Class B amplifiers are used in low cost designs or designs where sound quality is not that important.
- Class B amplifiers are significantly more efficient than class A amplifiers.
- Before the advent of IC amplifiers, class B amplifiers were common in clock radio circuits, pocket transistor radios, or other applications where quality of sound is not that critical.

For Class C

- Class C amplifiers are never used for audio circuits.

- They are commonly used in RF circuits.

- Class C amplifiers operate the output transistor in a state that results in tremendous distortion (it would be totally unsuitable for audio reproduction).
- So the class C isn’t able for audio circuits

Q:4 (b)

Difference between rectifier and amplifier

Rectifier : It is a device which converts a AC signal to DC. Although at class 12 level one might be knowing about half wave rectifier and full wave rectifier using transformers, diodes and capacitors, there are other types also which uses thyristors and whole full semester course on this topic. Rectifiers are generally used to convert AC voltages of 100V or greater (generally) to DC voltages. This can be explained in a simple fashion as making the average of the signal non zero. In plane AC , the average voltage is zero but consider a rectified AC, the average is non-zero.

Amplifiers : It is a device which increases the strength / voltage of the signal (By strength, it is generally the power of the signal). There are many types of amplifiers like voltage, power, current etc. (Refer to Sedra and Smith for more.). In practice (there may be exceptions) voltages of the order of milli volts or microvolts is amplified (to 1V or near 1V). In general they work on the principle of cross-conductance / voltage dependent current source / current dependent voltage source etc.. To be simple, voltage/current flowing through one pair of terminals must affect voltage/current flowing through other pair.