Department of Electrical Engineering
Sessional Assignment
Date: 04/05/2020

Course Details

Course Title: Electronic Circuit Design **Module:** 04
Instructor: ______________ **Total Marks:** 20

Student Details

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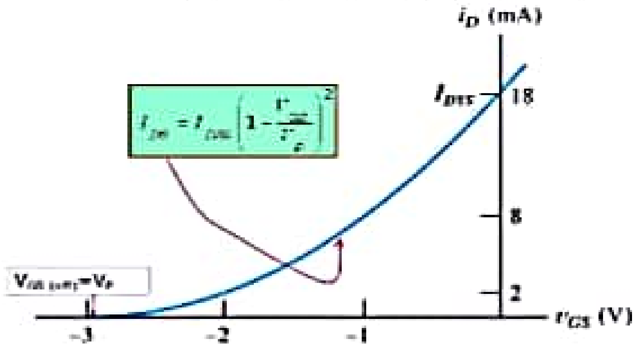
Q1.		Explain the trans conductance curve for n-channel JFET given below 	Marks 04 CLO 1
Q2.		State the characteristics of a practical operational amplifier.	Marks 04 CLO 1
Q3.		Calculate output voltage for summing amplifier if $V_1 = 0.2V$, $V_2 = 0.5V$ and $V_3 = 2V$ and $R_1 = R_2 = R_3 = R_f = 6k\Omega$	Marks 05 CLO 2
Q4.	(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.	Marks 04 CLO 2
	(b)	Outline the differences between an amplifier and a rectifier.	Marks 03 CLO 2

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Q1

Sol

The transconductance characteristics curve of n-channel JFET is the curve which shows the graph of the drain current, I_D verses the gate-source voltage, V_{GS}. The ratio of change in drain current,

The volt-ampere characteristics indicate that in saturation region, the values of drain current I_D depend on the reverse baising voltage V_{GS}. The transfer characteristics, a plot of I_D verses V_{GS} at a constant value of V_{GS} is a convenient method of displaying this relationship. Fig below illustrates the transfer characteristics of n-channel JFET at $V_{GS} = 10$. The drain current at $V_{GS} = 0$ is designated by the symbol I_{DSS}. For commercially fabricated JFETs values of I_{DSS} range from tens of microamperes to hundered of milliamperes.

The transfer characteristics can be expressed analytically as given by,

$$I_D = I_{DSS}\left(1 - \frac{V_{GS}}{V_P}\right)^2$$

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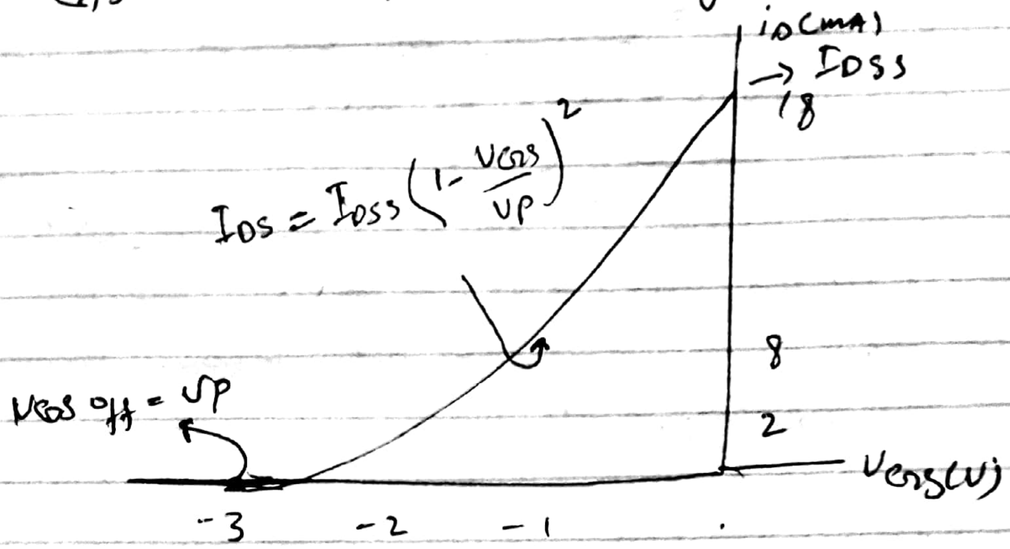
For an n-channel JFET both V_{GS} and V_P are negative



In a n-channel JFET, the relationship (Shockley's Equation) between V_{GS} (input voltage) and I_D (output current is used to define the transfer characteristics, and a little more complicated (and not linear).

At the pinch-off point:

- Any further increase in V_{GS} does not produce any increase in I_D.

V_{GS} at pinch-off is denoted as V_P.

- I_D is at saturation or maximum. It is reffered to as I_{DSS}.

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Notice that the transfer characteristic curve is parabolic. Because of this, JFET is referred to as a square-law device.
And also when V_{GS} approaches to 0V current increases faster so curve is nonlinear. ending points of this curve is I_{DSS} and $V_{GS(off)}$.

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Q2

Sol:-

characteristics of practical op-amp

These are practical op-amps that can be made to approximate some of these characteristics using a negative feedback arrangement. In practical, the input resistance, output resistance and bandwidth can be brought close to ideal values by this method.

The practical op-amps has the following characteristics.

① The open loop voltage gain A_o is maximum and finite, typical value for practical op-amp is considered to be 200,000.

② The input impedance Z_i is max and is finite i.e in the order of 100k or more.

③ The output impedance Z_o is minimum and not zero, in the order of 100 or less.

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(4) The CMRR is maximum and finite.

(5) Bandwidth is maximum and finite i.e. it can amplify dc to 1MHz signal.

(6) Slight drift of characteristics due to the change in temperature not null.

(7) Two terminal may be virtually ground not $V_d = 0$ exactly, for all conditions.

(8) Maximum slew-rate and has the finite value.

(9) output is negligible due to dc-bias, when the input is zero.

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Q3

sol:

Given data

$V_1 = 0.2V$, $V_2 = 0.5V$ and $V_3 = 2V$

$R_1 = R_2 = R_3 = R_f = 6k\Omega$

Required

$V_{out} = ?$

Solution

⇒ formula

$$V_{out} = -\left(\frac{V_1}{R_1} + \frac{V_2}{R_2} + \frac{V_3}{R_3}\right) R_f$$

puts values in formula

$$V_{out} = -\left(\frac{0.2}{6} + \frac{0.5}{6} + \frac{2}{6}\right) \times 6$$

$$\boxed{V_{out} = -2.70V}$$

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Q 4

(a)

Ans

We worked on an audio circuit in lab and neglect class B power amplifier.

Reason:

class B amplifiers have a much high gain. one of the main disadvantage of class B type push-pull amplifiers is that they suffer from an effect known commonly as crossover distortion.

Transistors takes approximately 0.7 volts (measured from base to emitter) to get a bipolar transistor to start conducting. In a pure class B amplifiers, the output transistors are not "pre-biased" to an "ON" state of operation.

This means that the part of the output waveform which falls below this 0.7 volts window will not be reproduced accurately as the transition between the two transistors (when they are switching over from one transistor to the other), the transistors do not stop or start conducting exactly at the zero crossover point even if they are specially matched pairs.

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The output transistors for each half of the waveform (positive and negative) will each have a 0.7 volt area in which they are not conducting. The result is that both transistors are turned "OFF" at exactly the same time.

A simple way to eliminate crossover distortion in a class B amplifier is to add two small voltage sources to the circuit to bias both the transistors at a point slightly above their cut-off point. This then would give us what is commonly called an class AB Amplifier circuit.

The class B topology eliminates the dc bias current and dissipates significantly less power. Its ouput put transistors are individually controlled in a push-pull manner, allowing the MH device to supply positive currents to the speaker, and ML to sink negative currents. This reduces output stage power dissipation, with only signal current conducted through the transistors. The class B circuit has inferior sound quallity, however, due to nonlinear behavior (crossover distortion) when the output current passes through zero and the transistors are changing between the on and off conditions

Q4 (b) amplifier vs rectifier

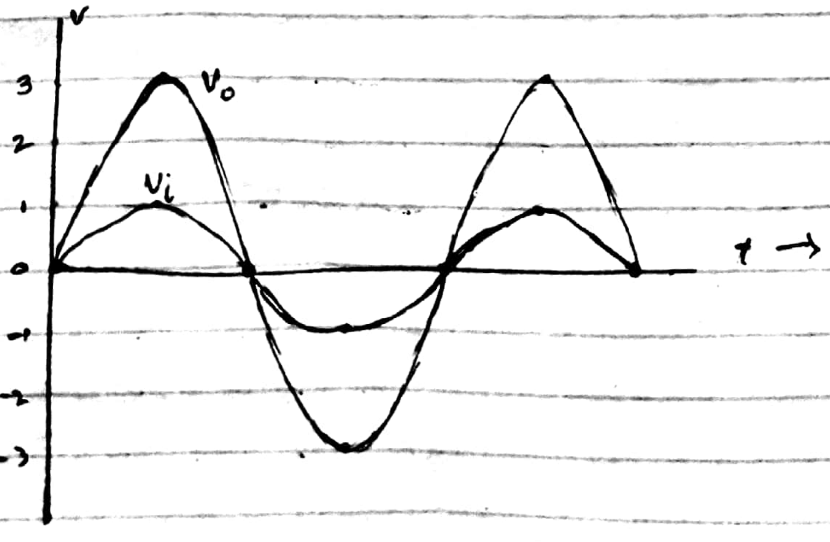
Sol:-

Amplifier:

An amplifier is used to increase the strength of an electric signal. Amplifier in a circuit amplifies the weak signal and raises the amplitude of the signal. The process is called amplification.

Amplification means increasing the amplitude (voltage or current) of a time-varying signal by a given factor, as shown here below. The graph shows the input $v_i(t)$ and the output voltage $v_o(t)$ of an ideal linear amplifier with an arbitrary signal applied as input. In this figure the amplifier has a voltage gain of 3; that is at any instant

$v_o = 3v_i$



Rectifiers:

It is a device which converts a AC signal to DC. Although at class 12 level one might be knowing about halfwave 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 converts AC voltages of 100V or greater to DC voltages.

Rectifiers have many uses, but are often serving as components of DC power supplies and high-voltage direct current power transmission systems. Rectification may serve in roles other than to generate direct current for use as a source of power.

Depending on the type of alternating current supply and the arrangement of the rectifier circuit, the output voltage may require additional smoothing to produce a uniform steady voltage. Many applications of rectifiers, such as power supplies for radio, television and computer equipments, require a steady constant DC voltage.