Lecture Study Guideline

You need to follow three steps to study

Step 1: Watch the topic related video uploaded on LMS.

Step 2: Read the lecture notes attached.

Step 3: Read the topic from course book.

Topic: BJT and FET amplifiers

Step 1

Watch the topic related video uploaded on LMS.

Step 2

BJT Amplifiers

Amplifier operation :-

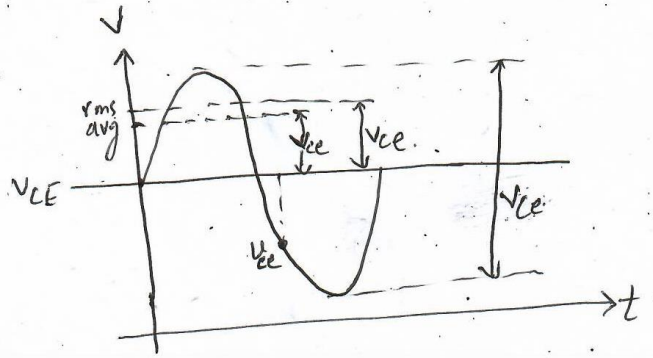
Biasing of a transistor is purely a dc operation. The purpose of biasing is to establish a Q-point about which variations in current and voltage can occur in response to an ac input signal.

AC Quantities :

DC quantities are represented by I_C, I_E, V_C and V_{CE}.

AC quantities are represented by I_c, I_e, I_b, V_c and V_{ce}. (rms, peak, and peak-to-peak)

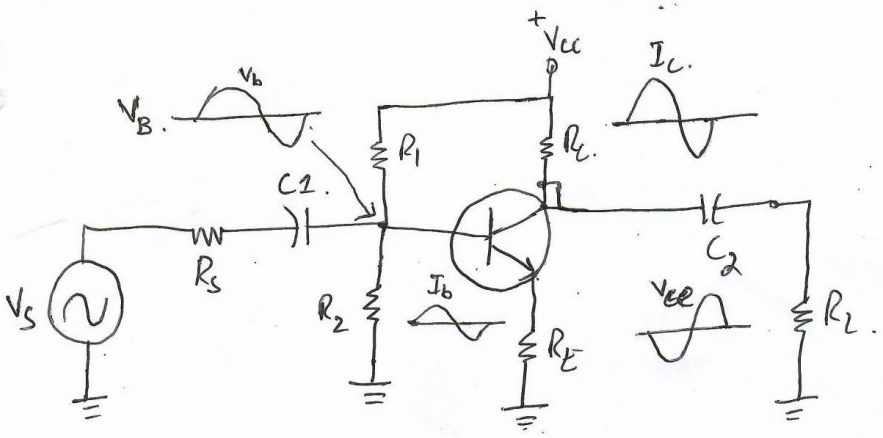
AC instantaneous quantities (i_c, i_e, i_b and v_{CE}).



The Linear Amplifier.

A voltag divider biased transistor with a sinusoidal ac source capacitively coupled to the base and collector through C_1, C_2.

C1 and C2 blocks dc.



Sinasoidal source voltage causes the sinusoidal base voltage to vary sinusoidally above and below its dc bias level.

Base current produces a large variation in collector current because of the current gain of the transistor.

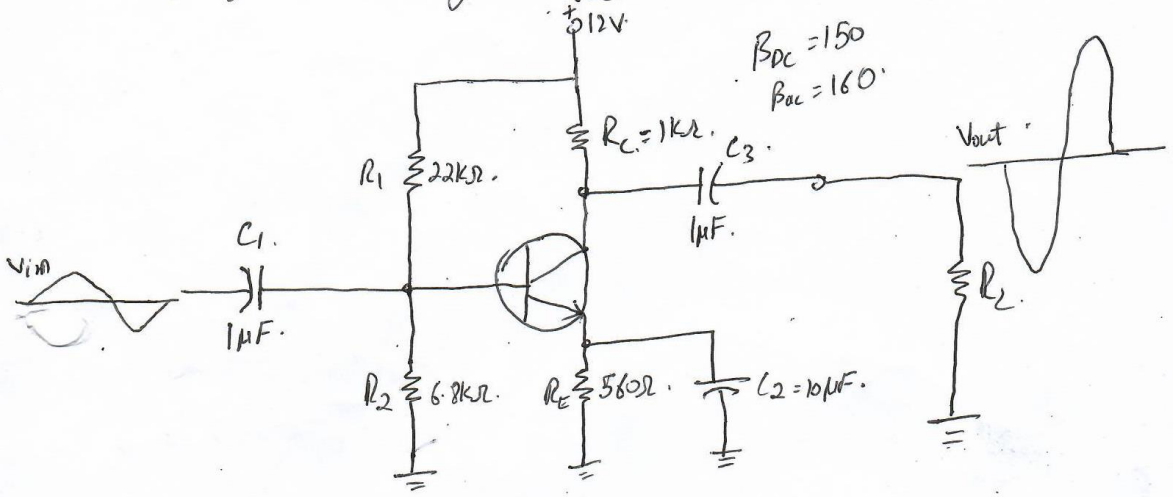
The collector current will be in phase with base current.

The collector to emitter voltage will be 180° out of phase.

A transistor always produces phase inversion between the base voltage and the collector voltage.

The Common-Emitter Amplifier :-

Common-Emitter amplifiers exhibit high voltage gain and high current gain.

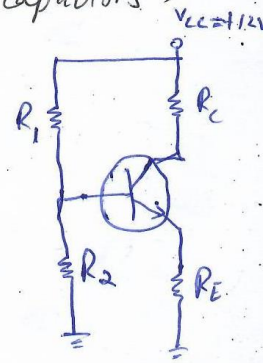


Circuit is complete combination of DC and ac operation.

C_1, C_3 coupling capacitor. C_2 bypass capacitor.

DC Analysis :-

Draw DC equivalent circuit removing all capacitors.
Capacitor become open for dc.



$$V_B = \left(\frac{R_2}{R_1+R_2}\right)V_{cc} = 2.83V.$$

$$V_E = V_B - V_{BE} = 2.83 - 0.7 = 2.13V.$$

$$I_E = \frac{V_E}{R_E} = \frac{2.13V}{5k\Omega} = 3.80mA.$$

$I_C \simeq I_E$ as I_B is very small in the case

$$I_E = I_C + I_B$$

$$V_C = V_{CC} - I_C R_C.$$

$$V_C = 8.20V.$$

$$V_{CE} = V_C - V_E = 8.20 - 2.13 = 6.07V.$$

Ac equivalent circuit on next page.

Common collector amplifier :-

Input is applied to base and output at the emitter. It has high input resistance and current gain. Maximum voltage gain 1.

Common - base amplifier :-

Common base provide high voltage gain with maximum current gain 1. It has low input resistance.

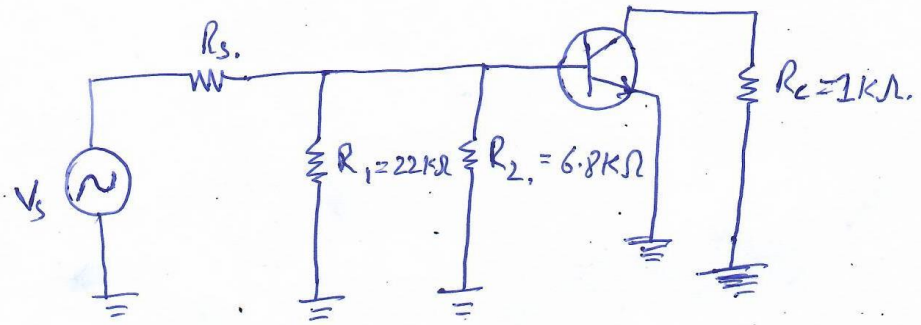
Input is applied to emitter and output at the collector.

3(a)

AC Equivalent circuit for common emitter :-

For - AC analysis capacitors C1, C2 and C3 become short circuits.

DC source is replaced by ground.

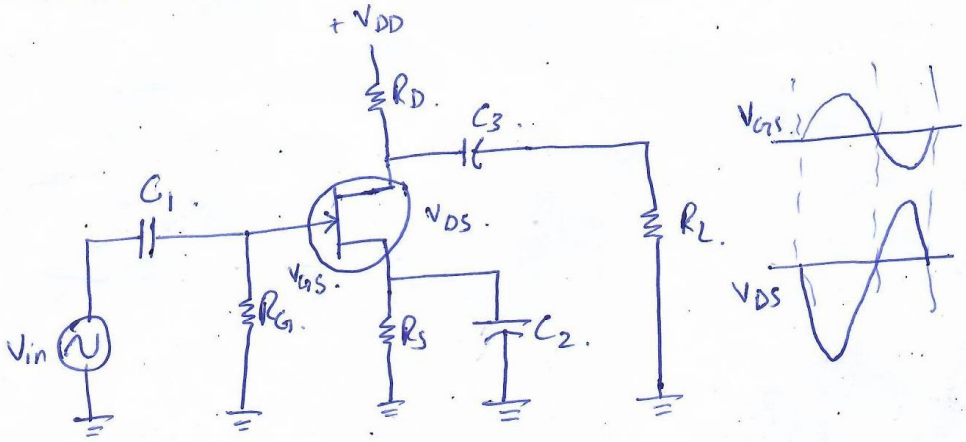


FET Amplifiers.

There are three FET amplifier configurations are common-source, common drain and common gate.

Common-Source Amplifier :-

(a) JFET common source amplifier.

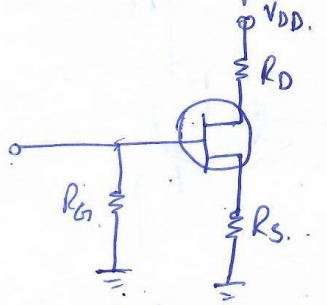


A self biased common source n-channel JFET amplifier with an ac source capacitively coupled to the gate as shown in fig.

R_G keeps the gate voltage at zero volt ordc and its large value prevents loading of ac signal.

DC Analysis :-

Replace all the capacitors with open.

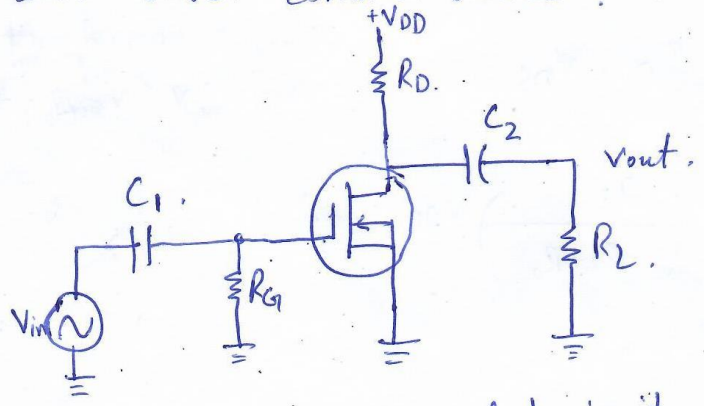


$$I_D = I_{DSS}\left(1 - \frac{I_D R_S}{V_{GS(off)}}\right)^2$$

Draw AC equivalent circuit.

(b) D- MOSFET Amplifier operation :-

Zero biased common source

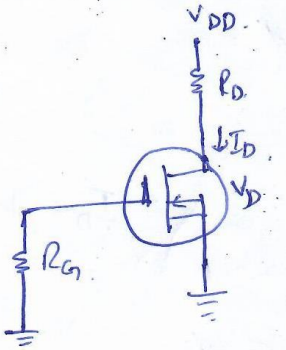


Draw AC equivalent circuit.

$V_{GS} = 0V$.

DC Analysis :-

$I_D = I_{DSS}$ at $V_{GS} = 0$.

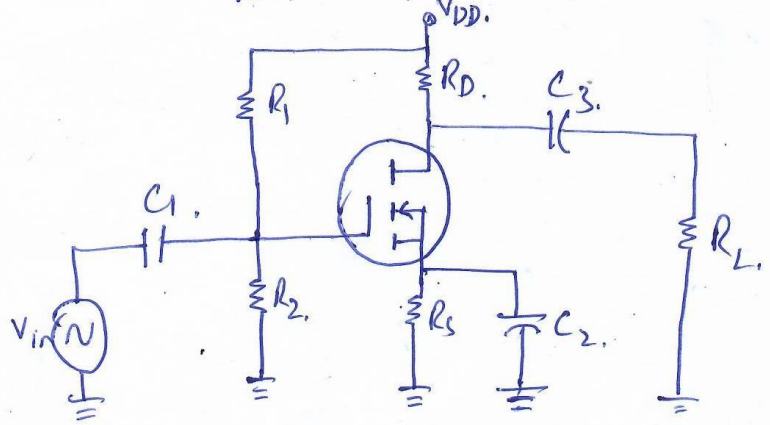


$$V_D = V_{DD} - I_D R_D.$$

$V_{DS} = V_D$.

Example 8-7 on next page.

(c) E - MOSFET Amplifier operation :-



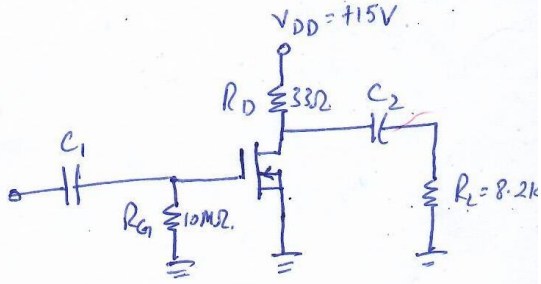
Draw AC equivalent circuit.

Example 8-7 :-

The particular D-MOSFET used in the amplifier 8-15 has an I_{DSS} of 200 mA. Determine dc drain voltage.

As amplifier is zero biased.

$\therefore I_D = I_{DSS} = 200\,mA$



$V_D = V_{DD} - I_D R_D$.

$V_D = 15 - (200\,mA)(33\Omega)$

$\boxed{V_D = 8.4V}$

Basics :-

BJT Transistor (4).

n-p-n transistor.

FET Transistor (7).

(a) JFET.

(b) MOSFET.

(i) Depletion MOSFET

(ii) Enhancement MOSFET.

Depletion MOSFET. biasing.
(zero biasing)

Enhancement MOSFET
(voltage divider biasing)
(drain Feedback biasing)

As amplifier.

BJT Transistor (6.)

n-p-n transistor
(common Emitter).

(i) DC Analysis

(ii) AC circuit.

FET transistor (8).

(a) JFET as common source

DC Analysis.

AC circuit.

(b) MOSFET.

Depletion MOSFET with zero biasing as common source.

DC Analysis.

AC circuit.

(C) Enhancement MOSFET with

Step3: Read topic 6.1, 6.2, 6.3, 8.1, 8.2 from text book (Thomas L Floyd 7th edition)