

ALM-1 - Brainstorming Session (24EC2104)

2400040454

2)

Illustrate with reason how Voltage divider bias help in stabilizing the operating point of a bjt amplifier Compared fixed bias!

Ans:

Voltage divider bias stabilizes the operating point better than fixed bias.

→ The Q-point (Quiescent point) is the dc current and Voltage of a transistor when no input signal

→ It sets the starting condition of the transistor so it can amplify signals without distortion.

→ For good amplification, the Q-point should stay stable even if temperature or transistor parameter change.

| <u>Fixed bias</u> | <u>Voltage Divider bias</u> |
|----------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------|
| 1) In fixed bias, a single Resistor R_b connects the base of the transistor to a Voltage source. | 1) Voltage Divide bias two resistor (R_1 & R_2) to create stable Voltage at the base, plus an emitter resistor R_E for feedback. |
| 2) Base Current I_B depend only on R_B and V_{CC} | 2) Voltage Divide $V_B = V_{CC} \cdot \frac{R_2}{R_1 + R_2}$ |
| 3) Transistor p(gain) $I_C = \beta I_B$ | 3) A emitter resistance R_E creates negative feedback. |
| 4, shift the Q-point, | |

→ Voltage Divider bias provide a more stable and reliable Q-point by using a resistive divider and negative feedback, making it much better than fixed bias of amplifier design.

ALM-2 Quiz/Test Question

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1) The Q-point in the active region ensure that the transistor work!

Ans: A) Amplifier

2) In Voltage divider bias, the Q-point is
B, independent of β

3) Given $V_{CC} = 12V$, $R_C = 2k\Omega$, $R_E = 1k\Omega$, $\beta = 180$, plot the load line and determine the Q-point (I_C and V_{CE})!

Ans: Given data:

$$V_{CC} = 12V, R_C = 2k\Omega, R_E = 1k\Omega, \beta = 180$$

Apply KVL at output loop

$$V_{CC} - I_C R_C - I_E R_E - V_{CE} = 0$$

$$V_{CC} - I_C (R_C + R_E) - V_{CE} = 0$$

$$V_{CE} = V_{CC} - I_C (R_C + R_E) \rightarrow (1)$$

Collector Current $I_C = 0$

$$V_{CE} = V_{CC} - 0 (R_C + R_E)$$

$$V_{CE} = V_{CC} = 12V$$

$$\boxed{V_{CE} = 12V}$$

from eq - (1)

$$V_{CC} - I_C R_C - I_E R_E - V_{CE} = 0$$

$$V_{CC} - I_C (R_C + R_E) - V_{CE} = 0$$

$$I_C (R_C + R_E) = V_{CC} - V_{CE}$$

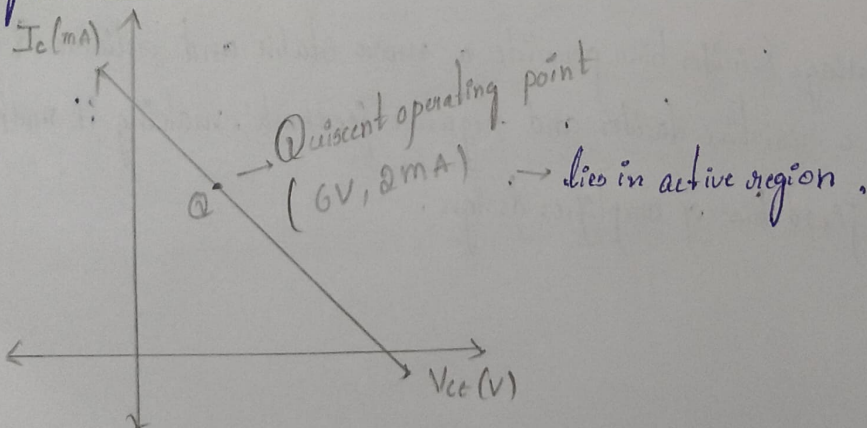
$$I_C = \frac{V_{CC} - V_{CE}}{R_C + R_E}$$

$$= \frac{V_{CC}}{R_C + R_E} = \frac{12}{2000 + 1000}$$

$$\boxed{I_C = \frac{12}{4000} = 4mA}$$

Quiescent operating point (V_{CEQ}, I_{CQ}) = (6V, 2mA)

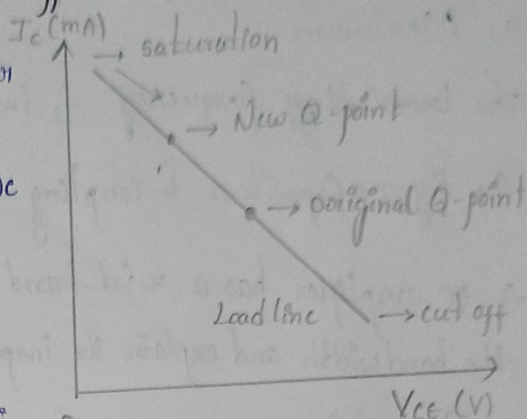
→ sketching a DC load line:



4) If base bias is increased, show the Q-point shifts on the load line, indicate whether moves towards saturation or cut-off!

Ans: The Q-point represents the DC Value of Collector emitter Voltage (V_{ce}) and Collector Current (I_c)

With no input signal, it is located on the DC load line which graphically plots (I_c vs V_{ce})



1) Increasing Base bias (\Rightarrow)

Increasing the base bias means increasing the base current (I_B) following to the BJT.

2) Effect on Collector Current (\Rightarrow)

Since Collector Current is a function of the base current ($I_c = \beta \times I_B$), an increase in I_B directly causes an increase in I_c .

3) Effect on Collector-Emitter Voltage (\Rightarrow)

The DC load line equation is $V_{ce} = V_{cc} - I_c R_c$. As I_c increases, the voltage drop across the collector resistor (R_c) increases.

\therefore Therefore Quiescent operating lies in 'Saturation region'.

Now explain in your own words why stabilizing Q-point is crucial for amplifier!

Stabilizing the Q-point is crucial because it ensures the amplifier operates correctly and consistently. If the Q-point shifts, the output may distort or the transistor may go into cutoff or saturation. Temperature changes and transistor variation can move the Q-point. A stable Q-point keeps the signal within the active region, resulting in clear, undistorted amplification.

ALM-3 Quiz / Test

Q1) At mid band frequency, the gain of CE amplifier is:

Ans: a) Maximum

Q2) The lower cutoff frequency f_L in CE amplifier is mainly due to?

a) Bypass Capacitor & Coupling Capacitor.

Q3) A CE amplifier has a mid-band gain of 100, $f_L = 100 \text{ Hz}$, $f_H = 100 \text{ kHz}$. Calculate the bandwidth and explain its importance!

Ans:

Given data

1, mid-band gain = 100

2) $f_L = 100 \text{ Hz}$ $f_H = 100 \times 1000 = 100,000 \text{ Hz}$

Bandwidth = $f_H - f_L \rightarrow$ (1)

$$= 100,000 \text{ Hz} - 100 \text{ Hz}$$

$$= 99,900 \text{ Hz}$$

Importance of band width

→ bandwidth is important it ranges the frequency an amplifier.

Can effectively process, it's the difference between highest & lowest frequency that circuit can amplify without signal loss.

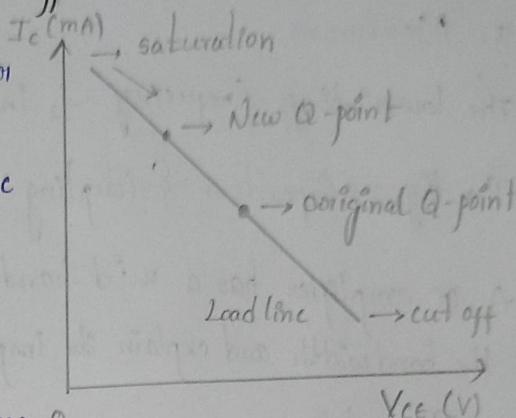
→ a wide bandwidth is crucial for high fidelity audio system to reproduce both low bass tones and high pitched symbols accurately. If the bandwidth is too narrow, the amplifier will "clip" or filter out the frequencies at the edges of audio spectrum, leading to loss of sound quality.

- 4) If base bias is increased, show the Q-point shifts on the load line. indicate whether moves towards saturation or cut-off!

Ans:

The Q-point represent the Dc Value of Collector emitter Voltage (V_{ce}) and Collector Current (I_c)

With no input signal. it is located on the Dc load line which graphically plot (I_c Vs V_{ce})



- 1) Increasing Base bias (\Rightarrow)

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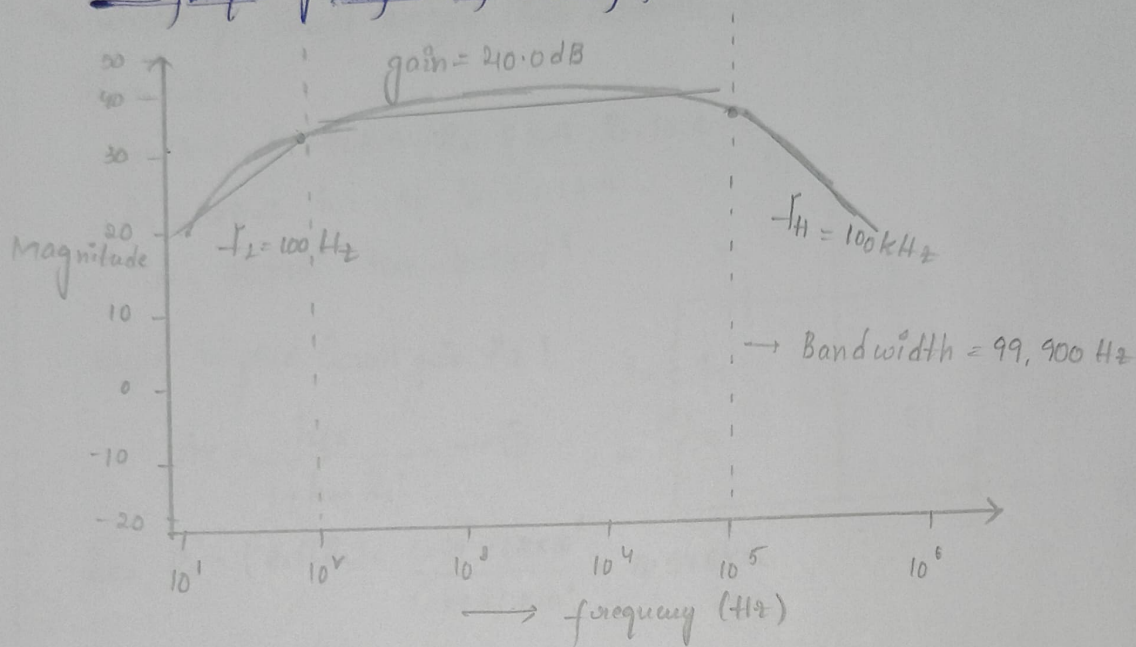
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- 6) plot the ideal frequency response of CE amplifier and mark f_L , f_H bandwidth and midgain

Ideal frequency response of CE amplifier



- plotted an ideal CE amplifier frequency response.

Now Write a short notes on what happens to amplifier performance if bandwidth is too narrow?

If bandwidth is narrow of an amplifier is too narrow, it limits the range of frequency the amplifier can handle effectively.

- only a small portion of signal input signal frequency range will be amplified properly.

- In audio system, for example, the sound may lack bass or treble making it unclear or flat.

- The original shape of the signal might change, causing distortion.

- Narrow band will make the amplifier unsuitable for wide range signals like music, Video, or Complex data.