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ALM-1 - Brainstroming Session (24EC2104) 2400040454

1, 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.

Fixed bias	Voltage Divider bias
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 β(gain) $I_C = \beta I_B$	3, A emitter resistence R_E Creates negitive feedback.
4, shift the Q-point,	

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→ 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.

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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

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3) Given $V_{cc} = 12V$, $R_C = 2k\Omega$, $R_E = 1k\Omega$, $\beta = 180$, plot DC 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

$$V_{cc} - I_c R_c - I_c R_E - V_{CE} = 0$$

$$V_{cc} - I_c (R_c + R_E) - V_{CE} = 0$$

$$V_{CE} = V_{cc} - I_c (R_c + R_E) \rightarrow (1)$$

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)

$$V_{cc} - I_c R_c - I_c R_E - V_{cc} = 0$$

$$V_{cc} - I_c (R_c + R_E) - V_{CE} = 0$$

$$I_c (R_c + R_E) = V_{cc} - V_{CE}$$

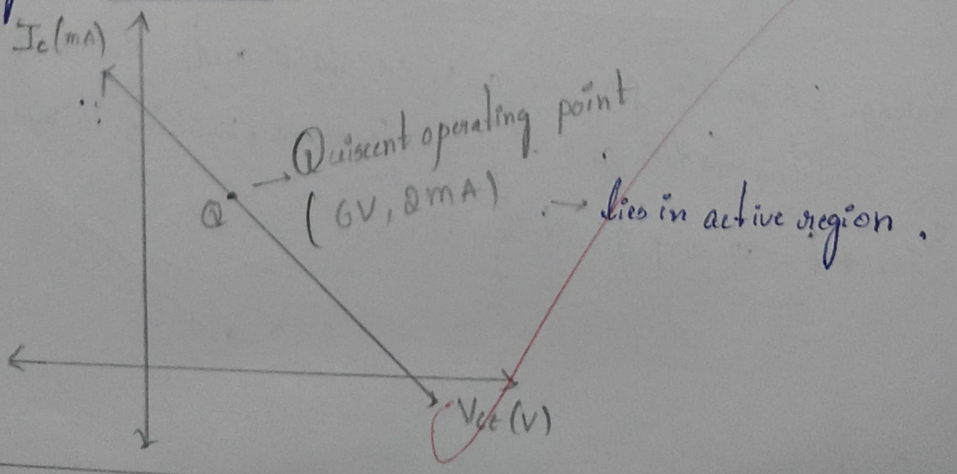
$$I_c = \frac{V_{cc} - V_{CE}}{R_c + R_E}$$

$$= \frac{V_{cc}}{R_c + R_E} = \frac{12}{2000+3000}$$

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

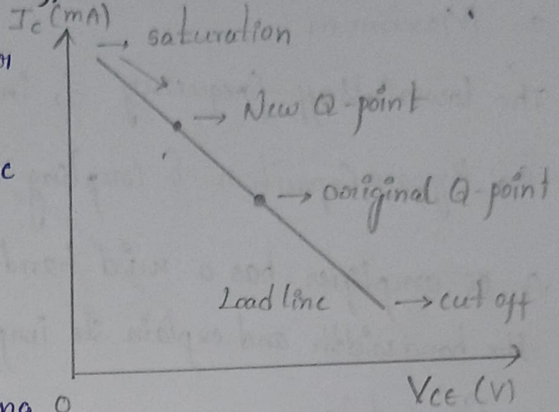
Quiscent operating point $(V_{CEQ}, I_{CQ}) = (6V, 2mA)$

→ sketching a Dc load line:



4) If base bias is increased, show the Q-point shifts on the load line, indicate weather moves towards staturation or Cutt-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** :→

increasing the base bias mean increasing the base Current (I_B) following to the BJT.

2) **Effect on Collector Current** :→

Since Collector Current is a function of the base-Current ($I_C = \beta \times I_B$), an increase I_B directly Cause increase in I_C

3) **Effect on Colletor-Emitter Voltage** :→

The dc load line equation $V_{CE} = V_{CC} - I_C R_C$. as I_C increase, the Voltage drop across Collector resistor (R_C) increase.

∴ therefore Quiscent operating lies in 'Satuaration region'.

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

stabilizing the Q-point is Crucial beacuse it ensure the amplifier operates Correctly and Consistently. if the Q-point shifts, the Output may distort or the transistor may go into Cuttoff or Saturation. Temperature changes and transistor Variation Can move the Q-point. A stable Q-point keeps the signal with active region. this result is clean, undistored amplification.

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ALM-3 Quiz / Test

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

Ans. a) Maximum

2) The lower Cuttoff frequency f_L in CE amplifier is mainly due to ?

a) Bypass Capacitor & Coupling Capacitor.

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

Ans

Given data

1) mid-band gain = 100

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

$$\text{Bandwidth} = f_H - f_L \longrightarrow (1)$$

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

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

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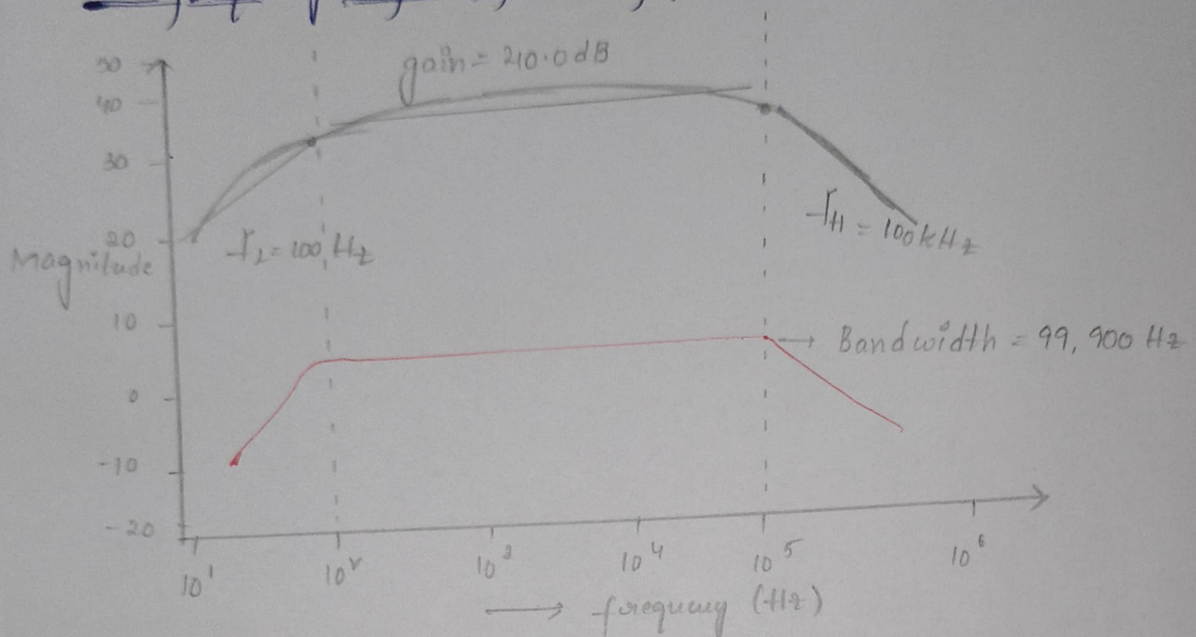
Importance of band width

→ bandwidth is important it ranges the frequency an amplifier. Can effectively process, it's the difference the 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.

b) 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 whats happens to amplifier performance if band width 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 terebel making it unclear or flat
- The orginal shape of the signal might change, Causing distortion.
- Narrow band with make the amplifier unsuitable for wide range signals like music, Vedio, or Complex data.