Unit 2
BJT

Biasing of Transistor

1) Operating point

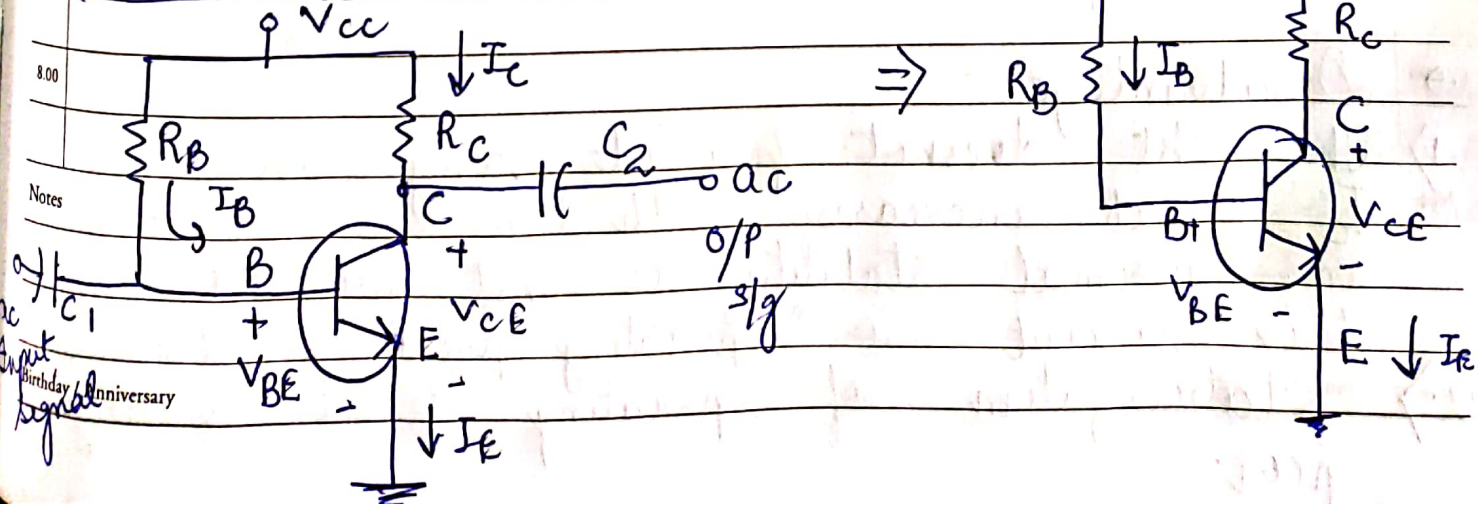
Region of operation.	Emitter base Junⁿ	Collector Base Junⁿ
Cut off	RB	RB
Active	FB	RB
Saturation	FB	FB

→ When we bias a t/s, we establish a certain current & voltage conditions for the t/s. These conditions are known as d.c. operating point or quiescent point.

2) Need for biasing BJT.

Inorder to have amplification property, we need proper supply of external d.c. biasing of correct polarity and magnitude of the t/s to operate in desired region.

Fixed Bias Circuit -

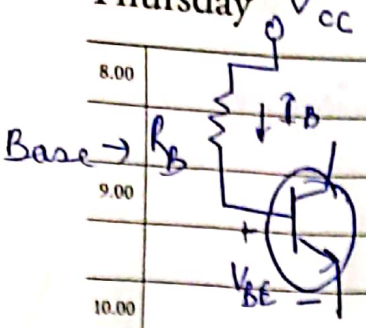


13 September 2018
Week 37
Day 256 • 109
Date 13 • 09 • 2018
Thursday

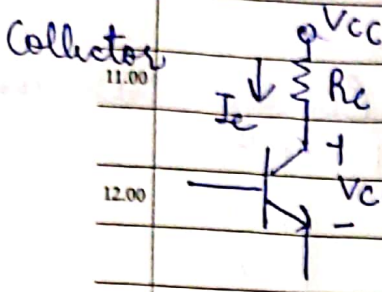
SEP'18

M	T	W	T	F	S	S
					1	2
3	4	5	6	7	8	9
10	11	12	13	14	15	16
17	18	19	20	21	22	23
24	25	26	27	28	29	30

Analysis -



$$V_{CC} - I_B R_B - V_{BE} = 0$$
$$I_B = \frac{V_{CC} - V_{BE}}{R_B}$$



$$V_{CC} - I_C R_C - V_{CE} = 0$$
$$V_{CE} = V_{CC} - I_C R_C$$
$$I_C = \beta I_B.$$
$$I_C = \frac{V_{CC} - V_{CE}}{R_C}.$$

→ Base current is controlled by the value of R_B and I_C is related to I_B by a constant β, the magnitude of I_C is not a function of the resistance R_C.

→ Advantages of a fixed biased Circuits -

1) Simple circuit which uses very few components.
2) The operating point can be fixed anywhere in the active region of the characteristics by simply changing the value of R_B. Thus, it provides maximum flexibility in the design.

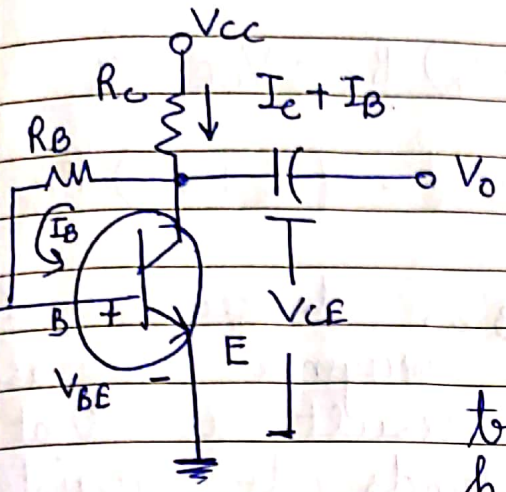
→ Disadvantage -

1) The ckt doesnot provide any check on the I_C which increases with the rise in temperature i.e. thermal stability is not provided by this circuit. So "Operating point is not maintained".
2) Stabilization of operating point is very poor.

Notes

Birthday / Anniversary

Collector to Base bias circuit -

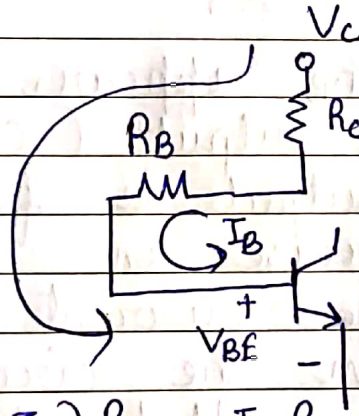


- Voltage feedback as shown in the diagram.
- Improvement over fixed bias circuit.
- Biasing resistor is connected b/w Collector & base of the transistor to provide a feedback path.

Thus I_B flows through R_B & $(I_B + I_C)$ flows through the R_C.

Analysis :

Base Circuit →



$$V_{CC} - (I_B + I_C) R_C - I_B R_B - V_{BE} = 0$$

$$I_B = \frac{V_{CC} - V_{BE}}{R_B + \beta R_C}$$

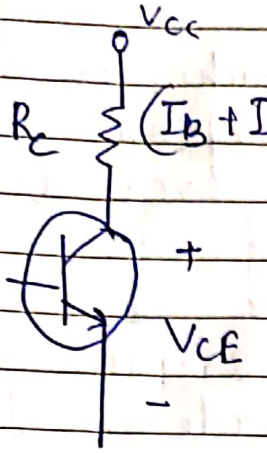
The only difference between the equation for I_B and that obtained for the fixed bias is the term βR_C. Thus, we can say that feedback path results in a reflection of resistance R_C to the input circuit.

Notes

Birthday / Anniversary

8.00

Collector Circuit –



9.00

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

10.00

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

11.00

- As $I_C \propto I_B$, decrease in I_B reduces the original increase in I_C. The result is that the circuit tends to maintain a stable value of Collector current keeping Q point fixed.

12.00

1.00

2.00

In this circuit, R_B appears directly across input (base) & output (collector). A part of the output is feedback to the input and increase in collector current decreases the base current. Thus, negative feedback enters in the circuit, so this circuit is also called Voltage feedback bias circuit.

3.00

4.00

5.00

6.00

7.00

8.00

Notes

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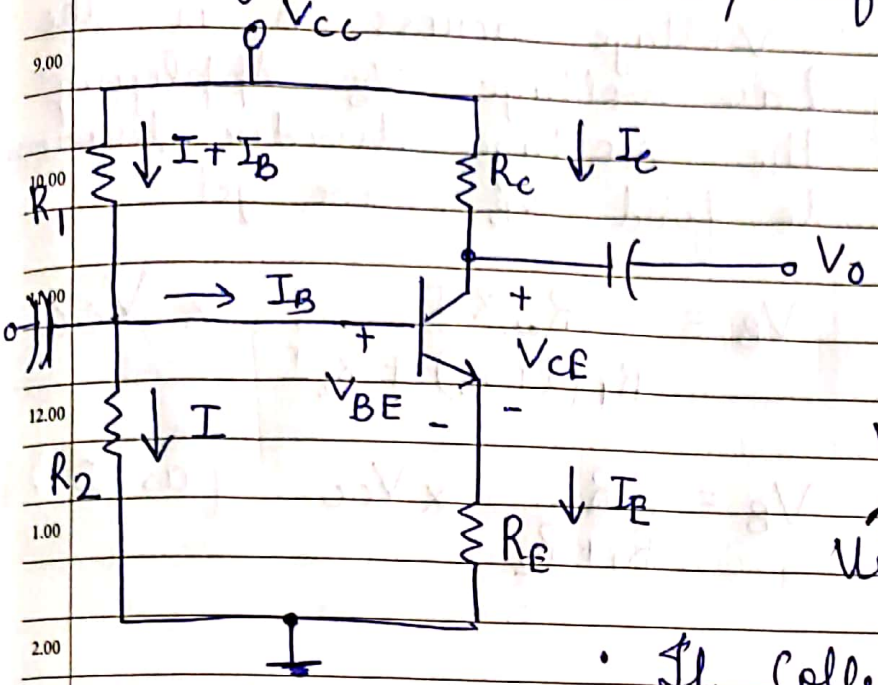
Voltage Divider bias / Self Bias Circuit -



- Biasing is provided by three resistors R_1, R_2 and R_E.
- R_1, R_2 act as a potential divider / Voltage divider giving a fixed Voltage to base.
- If Collector current increases due to change in temperature or change in β, the emitter current I_E also increases & Voltage drop across R_E ↑ses, reducing the voltage difference between base & emitter (V_{BE}).
- As V_{BE} is reduced, base current I_B & I_C also reduces → hence negative feedback exists in the emitter ~~base~~ bias circuit

Circuit Analysis -

Notes

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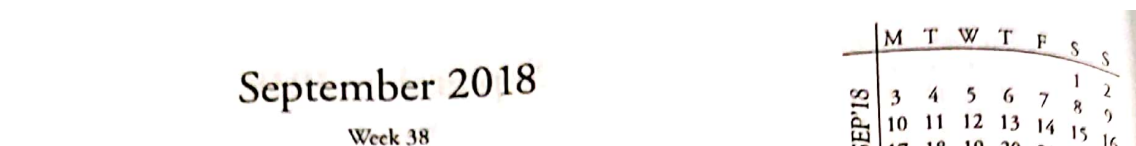
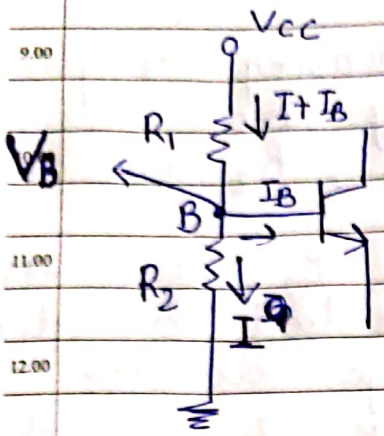


Base Circuit -

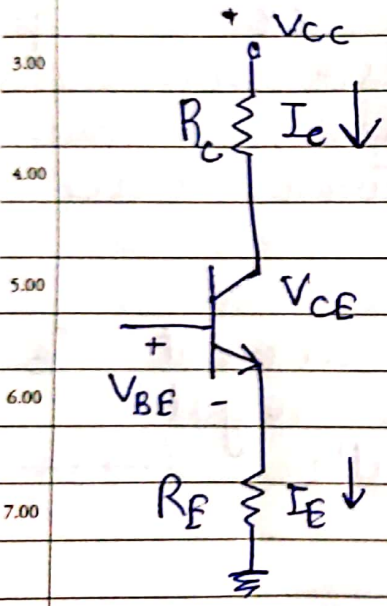


• Voltage across R_2 is the base voltage V_B. Applying the voltage divider theorem to find V_B, we get

$$V_B = \frac{R_2 \times I}{R_1(I + I_B) + R_2 I} \times V_{CC}$$

$$V_B = \frac{R_2}{R_1 + R_2} \times V_{CC} \quad (\text{as } I \gg I_B)$$

Collector Circuit



Since, Voltage across R_E (V_E)

$$V_E = I_E R_E = V_B - V_{BE}$$

as $(V_{BE} = V_B - V_E)$

$$I_E = \frac{V_B - V_{BE}}{R_E}$$

Applying KVL to collector

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

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

Notes

Advantage -

• Stability factor S for this bias is less as compared to other biasing circuit.
More stable & hence commonly used.

Birthday / Anniversary

Comparison of Biasing circuit –

Parameter	Fixed Bias	Collector to Base Bias	Self Bias / Voltage divider
1) Resistors required	1	1	3
2) Stability provided	Poor	Medium	More
3) Simplicity of the circuit	More	More	Less
4) Feedback provided	No	Negative (Voltage Shunt)	Negative (Current Series)

Notes

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