Tutorial-4

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① A JEFT has following parameters $I_{DSS} = 32\ mA$, $V_{GS(off)} = -8V$, $V_{GS} = -4.5V$, $I_D = (?)$

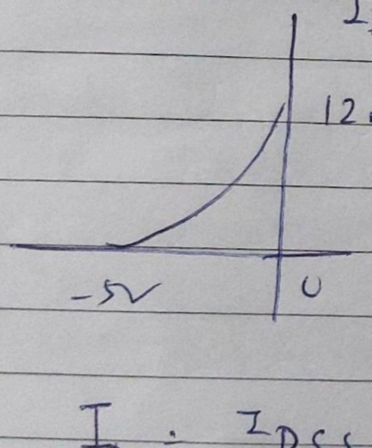
→

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

$$= 32\left[1 - \frac{(-4.5)}{(-8)}\right]^2 mA$$

$$= \underline{6.12\ mA}$$

② $I_{DSS} = 12\ mA$
$V_{GS(off)} = -5V$



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

$$= 12\left[1 + \left(\frac{V_{GS}}{5}\right)^2\right] mA$$

(3) A JFET has a drain current of 5 mA.
$I_{DSS} = 10$, $V_{GS(off)} = -6V$

$V_{GS} = (2)$
$V_P = (1)$

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

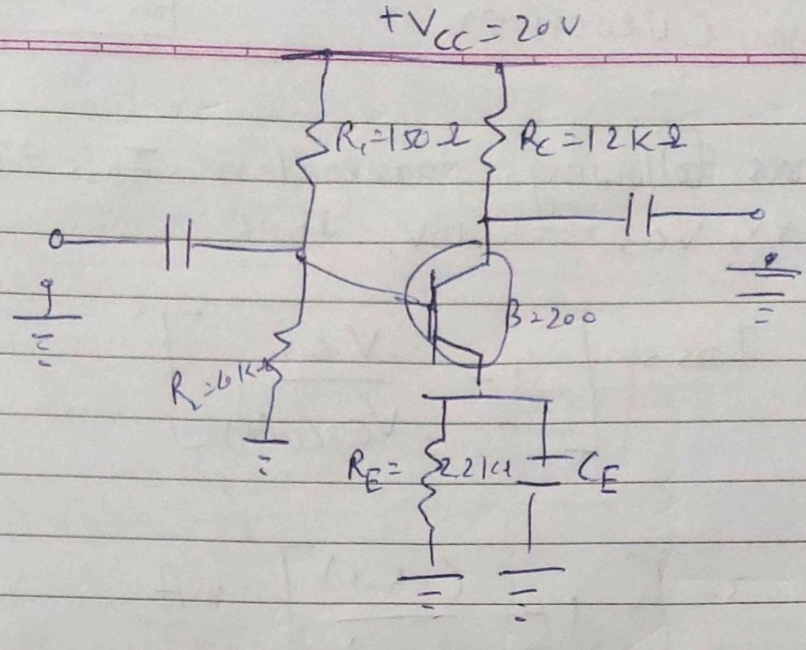
$$5 = 10\left[1 + \frac{V_{GS}}{6}\right]^2$$

$$1 + \frac{V_{GS}}{6} = \sqrt{2} = 0.707$$

$$\rightarrow V_{GS} = 6 \times (-0.293)$$
$$= \underline{-1.76\ V}$$

$$\rightarrow V_P = -V_{GS(off)}$$
$$= -(-6) = \underline{6\ V}$$

(4)



Voltage gain with CE, without CE.

→ So, $V_{R_2} = \frac{V_{CC}}{R_1 + R_2} \times R_2$

$= \frac{20}{170} \times 20$

$= \underline{2.35\ V}$

→ So, $V_E = V_2 - V_{BE}$

$= 2.35 - 0.7$

$= \underline{1.65\ V}$

→ Now Current in emitter $I_E = \frac{V_E}{R_E}$

$= \frac{1.65}{2.2K\Omega} = \underline{0.75\ mA}$

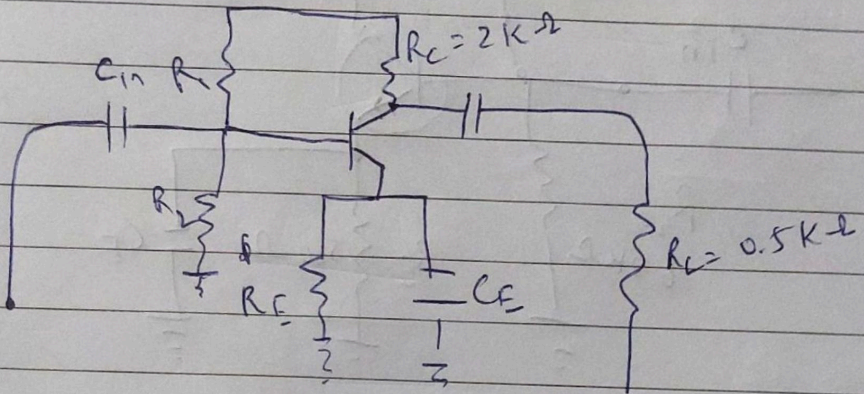
Resistan of the emitter

→ So $r = \frac{25 \times 10^{-3} V}{0.75 \times 10^{-3} A} = \underline{33.3\ \Omega}$

(i) With CE ⇒ Voltage gain $A_V = \frac{R_C}{r_e'} = \frac{12 \times 10^3 \Omega}{33.3 \Omega} = \underline{360}$

(ii) Without CE → Voltage gain $A_V = \frac{R_C}{r_e' + R_E} = \frac{12 \times 10^3}{2.2 \times 10^3 + 33.3} = \underline{5.38}$

(5) Find Voltage gain, $\beta = 60$, $R_{in} = 1 K\Omega$



→ $R_{AC} = R_C \parallel R_L$

$$\frac{1}{R_{AC}} = \frac{1}{R_C} + \frac{1}{R_L}$$

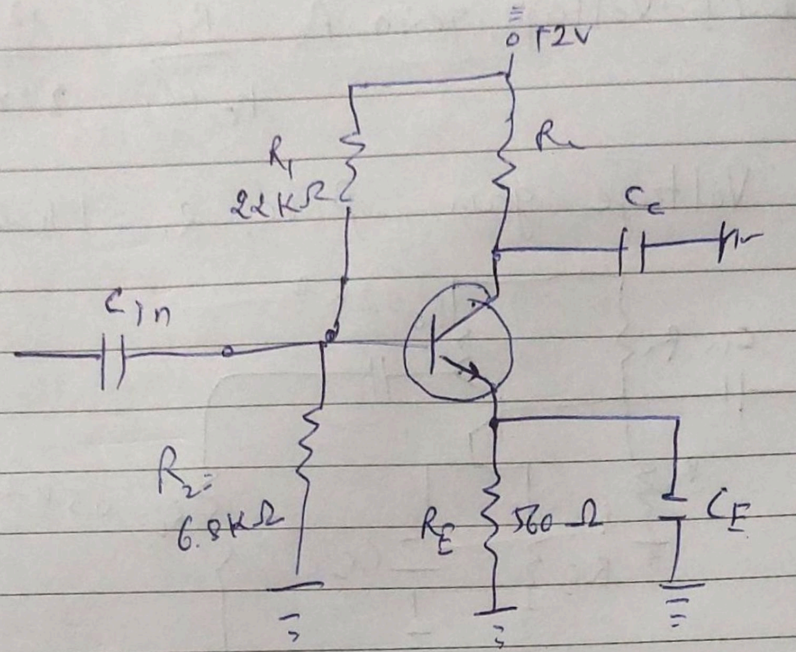
$$\frac{1}{R_{AC}} = \frac{1}{2} + \frac{1}{0.5}$$

$$R_{AC} = \frac{2 \times 0.5}{2 + 0.5}$$

$$= \underline{0.4 K\Omega}$$

— Voltage gain $= \beta \times \frac{R_{AC}}{R_{in}} = \frac{60 \times 0.4 K\Omega}{1 K\Omega} = \underline{24.}$

(6) Select a suitable value for emitter bypass capacitor in Fig shown if Amp. freq. range over 2 KHz to 10 KHz



$$X_{C_E} = \frac{R_E}{10}$$

$f_{min} = 2\,kHz$, $R_E = 560\ \Omega$

$\therefore X_{C_E} = 56\ \Omega$

$$\therefore \frac{1}{2\omega C_E} = 56$$

$$\therefore C_E = \frac{1}{2 \times \pi \times f_{min} \times 56}$$

$$= \frac{1}{2 \times 3.14 \times 2 \times 10^3 \times 56} = 1.43 \times 10^{-6}\ F$$

$$= \underline{1.43\ \mu F}$$

(7) $V_{CC} = 20\,V$

$R_C = 2\,k\Omega$

$\beta = 50$

$V_{BB} = 0.2\,V$

$R_1 = 100\,k\Omega$

$R_E = 100\,\Omega$

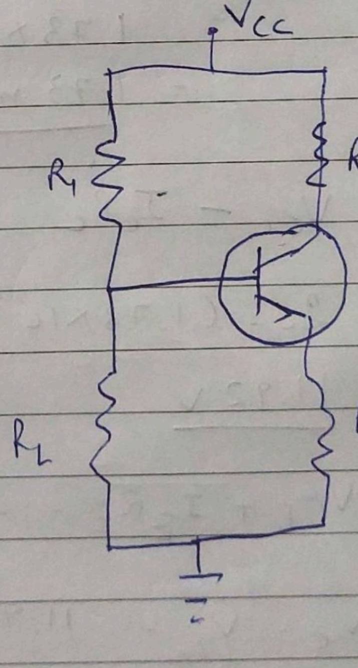
$$V_2 = \frac{V_{CC}}{R_1 + R_2}$$

$$I_E = \frac{V_2 - V_{BE}}{R_E}$$

$$I_C \approx I_E$$

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

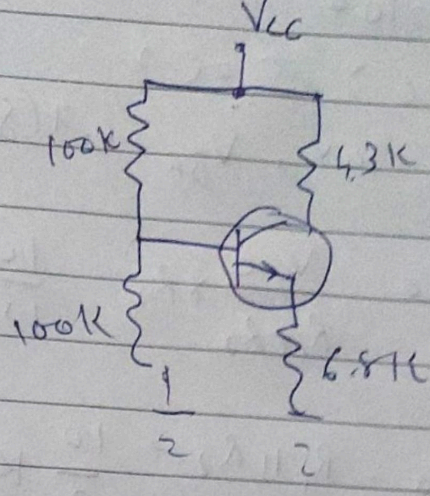
as R_2 is not given, so we can't find.



(8) $V_{CC} = 15V$

$V_{BE} = 0.7V$

$\beta = 100$



$V_{CB} = ?$

$$V_2 = \left(\frac{V_{CC}}{R_1 + R_2}\right) \times R_2$$

$$= \frac{15}{200} \times 100$$

$$= 7.5V$$

$V_2 = V_{BE} + I_E R_E$

$$I_E = \frac{7.5 - 0.7}{R_E}$$

$$= \frac{6.8}{6.8 \times 10^{-8}} = \frac{1}{8}$$

$$= 1 \simeq I_C$$

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

$$= 15 - 10^{-3} (11.1) \times 10^{3}$$

$$= 15 - 11.1$$

$$= \underline{3.9V}$$

(9) $\beta = 100$

V_{CE} ? I_C = ?

$V_{CC} = 10V$, $V_{BE} = 0.7$ (Silicon)

$$E_0 = \frac{V_{CC}}{R_1 + R_2} \times R_2 = \frac{10}{15} \times 5 = \frac{10}{3}$$

$$R_0 = R_1 \parallel R_2 = \frac{10}{3} k\Omega$$

$$I_B = \frac{E_B - V_{BE}}{R_0 + \beta x} = \frac{10/3 - 0.7}{\frac{10}{3} + 100 \times 0.5 k\Omega}$$

$$= \frac{2.6}{53.3 k\Omega}$$

$$= \frac{26}{533} \times 10^{-3}$$

$$I_B = 0.048 \text{ mA}$$

$$I_C = 100 \times 0.048 = 4.8 \text{ mA}$$

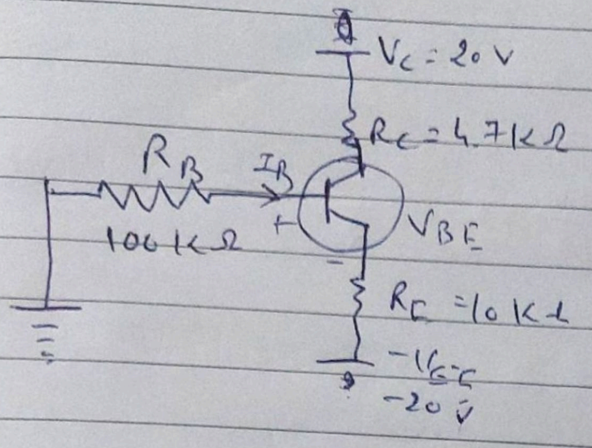
$$V_{CE} = V_{CC} - I_C (R_C + R_E)$$

$$= 10 - 4.8 \times 10^{-3} (0.5 \times 10^3)$$

$$= 10 - 7.2$$

$$= \underline{2.8 \text{ V}}$$

(10) For the emitter biased circuit, $\beta = 85$, $V_{BE} = 0.7V$



→ $I_C \simeq I_E = \dfrac{V_{EE} - V_{BE}}{R_E + R_B/\beta}$

$= \dfrac{20 - 0.7}{10^4 + 10^5/85}$

$= \dfrac{13 \times 10^{-3}}{10 + 100/85}$

$= 1.73 \times 10^{-3} A$

$= \underline{1.73 \text{ mA}}$

→ $V_C = V_{CC} - I_C R_C$

$= 20 - (1.73 \times 10^{-3})(4.7 \times 10^{3})$

$= \underline{11.92 V}$

→ $V_E = -V_{EE} + I_E R_E = -20 + (1.73 \times 10^{-3})(10 \times 10^{3}) = -2.7V$

→ $V_{CE} = V_C - V_E = 11.92 - (-2.7)$

$= \underline{14.62 V}$

Q point → $\boxed{14.62V, 1.73 mA}$