CIE - 3

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1)

=) Given,

$I_{DQ} = 0.3\,mA$

$V_D = 3\,V$

$K = 0.24\,mA/V^2$

$V_{th} = 1V$

$V_{GS} = ?$

$I_D = \frac{1}{2} k_n V_{ov}^2$

$0.3\times10^{-3} = \frac{1}{2} \times 0.24\times10^{-3}\times V_o^2$

$\boxed{V_o = 1.581\,V}$

$I_{DQ} = \frac{1}{2} k_n (V_{GS} - V_{th})^2$

$V_{GS} = V_{in} + V_o$

$= \frac{1}{2} 0.24 (\quad)$

$V_{GS} = 1 + 1.581$

$\boxed{V_{GS} = 2.581V}$

2)

=) $k_n = 1mA/V^2$, $V_{GS} = 0.99\,V$, $V_{th} = 0.4\,V$

$I_{DQ} = ?$

$I_{DQ} = \frac{1}{2} K (V_{GS} - V_{th})^2$

$= \frac{1}{2} 1 (0.99 - 0.4)^2$

$I_{DQ} = \frac{1}{2} (0.99 - 0.4)^2$

$\boxed{I_{DQ} = 0.174\,mA}$

3)

⇒ $\lambda = 0.02 \quad I_{DQ} = 0.174\,mA$

$r_o = ?$

$$r_o = \frac{1}{\lambda I_D} = \frac{1}{0.02 \times 0.174 \times 10^{-3}}$$

$$r_o = 287356.3218$$

$$\boxed{r_o = 287\ k\Omega hm}$$

4)

⇒ $A_v = -100, \quad R_1 = 15\,k\Omega, \quad R_o = 20\,k\Omega, \quad \beta = -0.25$

$$A_f = \frac{A}{1 + \beta A} = \frac{-100}{1 + (-0.25)(-100)}$$

$$\boxed{A_f = -3.84}$$

5)

⇒ $A_v = 100, \quad BW = 200\,kHz \quad \beta = 0.05 \quad BW_f = ?$

$$BW_f = BW\,(1 + \beta A_{vf})$$

$$= 200\,kHz\,[1 + (0.05)(100)]$$

$$BW_f = 1200\,kHz$$

$$\boxed{BW_f = 1.2\,MHz}$$

$A = -100$, $R_1 = 15\,k\Omega$, $R_o = 20\,k\Omega$, $\beta = -0.25$

$$Z_{if} = Z_i(1+\beta A)$$
$$= 15\,k\Omega(1+100 \cdot 15\,k\Omega[1+(-0.25)(-100)]$$

$$Z_i = 390000$$

$$\boxed{Z_i = 390\,k\Omega}$$

)
=) $f = 500\,Hz$, $R = 7.5\,k\Omega$ $C = ?$

$$f = \frac{1}{2\pi RC\sqrt{2N}} = \frac{1}{2\pi\sqrt{6}CR} \quad f = \frac{1}{2\pi RC\sqrt{6}}$$

$$C = \frac{1}{2\times3.14\times\sqrt{6}\times7.5\times10^3} \quad C = \frac{1}{2\times3.14\times7.5\times10^3\times500\times\sqrt{6}}$$

$$C = 1.73\times10^{-8} = 0.01\times10$$
$$= \underline{0.01\,mF}$$

.0001.73

8)
=) $V_{DD} = 5V$, $R_D = 7\,k\Omega$, $V_{th} = 0.8V$, $k_n = 2\,mA/V^2$
$I_{DQ} = 0.5\,mA$ $\lambda = 0$

$$g_m = \sqrt{2k_nI_D} = \sqrt{2\times2\times0.5\times1} = \underline{1.41}$$

$$A_1 = -g_mR_D = -1.4\times7 = \underline{-9.87}$$