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MST-1 Analog Electronics

Q3 $f_{LC_1} = 50\,Hz$ $f_{LC_2} = 10\,Hz$ $f_{LC_S} = 3Hz$
$g_m = 8\,mA/V$ $R_{sig} = 0.5M\Omega$ $R_G = 2M\Omega$
$R_D = 20K\Omega$ $R_L = 10K\Omega$

(i) $f_{LC_S} = \frac{g_m}{2\pi C_S}$ $\Rightarrow$ $C_S = \frac{g_m}{2\pi f_{LC_S}}$

$C_S = \frac{8\times10^{-3}}{2\times\pi\times8} \Rightarrow 0.159\times10^{-3}$ $\boxed{C_S = 159\,\mu F}$

(ii) $f_{LC_1} = \frac{1}{2\pi(R_G+R_{sig})C_{C_1}}$ $C_{C_1} = \frac{1}{f_{LC_1}\times2\pi(2.5)\times10^6}$

$C_{C_1} = \frac{1}{2\pi\times2.5\times10^6\times50} \Rightarrow 1.27\times10^{-9}$

$\boxed{C_{C_1} = 1.27\times10^{-9}\,nF}$

(iii) $f_{LC_2} = \frac{1}{2\pi(R_D+R_L)C_{C_2}}$ $C_{C_2} = \frac{1}{2\pi(R_D+R_L)f_{LC_2}}$

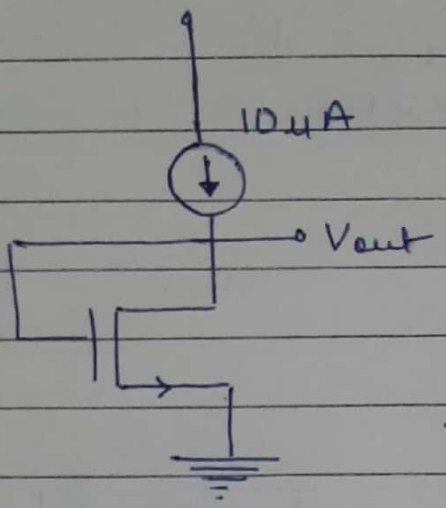
$C_{C_2} = \frac{1}{2\pi\times30\times10^3\times10}$ $C_{C_2} = 5.30\times10^{-7}F$

$\boxed{C_{C_2} = 0.53\,\mu F}$

Voltage gain $= -g_m(R_D \| R_L)$
$= -3\times10^{-3}(6.66\times10^3)$

$\boxed{A_V = -19.98}$

Q2



$\mu_n C_o \left(\frac{W}{L}\right) = 0.4\,mA/V^2$

$V_t = 1V \quad \lambda = 0$

We know that

$$I_D = \left(\frac{\mu_n}{2}\right) C_o \times \left(\frac{W}{L}\right) [V_{GS} - V_t]^2$$

$$10 \times 10^{-6} = \frac{1}{2} \times 0.4 \times 10^{-3} [V_{GS} - 1]^2$$

$$10^{-5} = 0.2 \times 10^{-3} [V_{GS} - 1]^2$$

$$\frac{103 \times 10^{-5}}{0.2} = (V_{GS} - 1)^2$$

$$5 \times 10^{-2} = (V_{GS} - 1)^2$$

$$\sqrt{5 \times 10^{-2}} = V_{GS} - 1$$

$$V_{GS} = 1 + \sqrt{5} \times 10^{-1}$$

$$\boxed{V_{GS} = 1.023V}$$

$V_{GS} = V_G - V_S^{\nearrow 0}$ $\quad \boxed{V_G = 1.023V}$

$\boxed{V_G = V_{out} = 1.023V}$ Ans

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