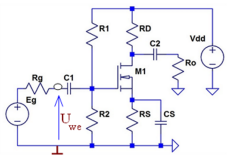
Zadanie 10 Paweł Gryka 303697

Projekt UKEL 2021L

Zad.10. W układzie wzmacniacza WS, obliczyć wzmocnienie napięciowe Ku= Uo/Uwe i Kus=Uo/eg, rezystancję wejściową i wyjściową, częstotliwość górną i dolną wzmacniacza z Rys. 1 Wartości elementów należy wybrać z tabelki 1 (wybór zależny od nr indeksu)



Rys.1. Układ

Nr w tabeli 1 to reszta z dzielenia przez 3 ostatniej cyfry indeksu 303697

Tabela 1. Dane do zadania 7%3=1

Nr	0	1	2
R1 [kΩ]	1000M	470	680
R2 [kΩ]	330	180	150
RS [Ω]	470	330	220
RD [kΩ]	2.2	1	1.5
Ro [kΩ]	4.7	2.2	1.8
Rg [kΩ]	1	2	3
rwe [kΩ]	2	3	2
gm [S]	0.12	0.15	0.1
gds [uS]	30	100	150
Cgs [pF]	220	180	300
Css [pF]	100	90	150
Cdg [pF]	50	30	40
C1 [uF]	1	2.2	3.3
C2 [uF]	3.3	2.2	2.2
CS [uF]	33	47	100

$$R_{GS} = \frac{R_1 \cdot R_2}{R_1 + R_2} = \frac{470\,k\Omega \cdot 180\,k\Omega}{470\,k\Omega + 180\,k\Omega} = 130{,}2\,k\Omega$$

$$R_L = \frac{R_o R_D}{R_o + R_D} = \frac{2{,}2k\Omega \cdot 1k\Omega}{2{,}2k\Omega + 1k\Omega} = 687{,}5\,\Omega$$

$$R_{we} = R_{GS} = 130{,}2\,k\Omega$$

$$r_{ds} = \frac{1}{g_{ds}} = \frac{1}{100\mu S} = 10k\Omega \Rightarrow R_{wy} = r_{ds} \parallel R_D =$$

$$= 10k\Omega \parallel 1k\Omega \approx 909{,}09\,\Omega$$

$$K_u = \frac{u_o}{u_{gs}} = -\frac{g_m \cdot u_{gs}}{\left(g_{ds} + \frac{1}{R_L}\right)} \cdot \frac{1}{u_{gs}} =$$

$$= -\frac{g_m}{g_{ds} + \frac{1}{R_L}} = \frac{-0{,}15}{100\mu S + \frac{1}{687{,}5\,\Omega}} = -96{,}49\left[\frac{V}{V}\right] =$$

$$= 39{,}7\,dB$$

$$K_{us} = \frac{u_o}{e_g} = \frac{R_{we}}{R_{we} + R_g} K_u = \frac{130{,}2\,k\Omega}{130{,}2k\Omega + 2\Omega} \cdot (-96{,}49) =$$

$$= -95{,}03\left[\frac{V}{V}\right] = 39{,}6\,dB$$

$$C_{we} = C_{gs} + C_{miller\,we} = C_{gs} + C_{dg}\,(1 + |K_u|) =$$

$$= 180pF + 30pF\,(1 + 96{,}49) = 3104{,}7pF$$

$$C_{wy} = C_{ss} + \frac{1 + |K_u|}{|K_u|} C_{dg} = 90pF + \frac{1 + 96{,}49}{96{,}49} \cdot 30pF =$$

$$\approx 120{,}31\,pF$$

$$f_{g_1} = \frac{1}{2\pi R_{GS} \parallel R_g \cdot C_{we}} = \frac{1}{2\pi\,(130{,}2k\Omega \parallel 2k\Omega) \cdot 3104{,}7pF} =$$

$$= 26{,}02\,kHz \leftarrow f_g \text{ bo } f_{g_1} << f_{g_2}$$

$$f_{g_2} = \frac{1}{2\pi\left(R_L \parallel \frac{1}{g_{ds}}\right) \cdot C_{wy}} = \frac{1}{2\pi\left(687{,}5\Omega \parallel \frac{1}{100\mu S}\right) \cdot 120{,}31pF} =$$

$$\approx 2{,}056\,MHz$$

$$f_{d_1} = \frac{1}{2\pi\left(R_g + R_{we}\right) \cdot C_1} = \frac{1}{2\pi\,(2\Omega + 130{,}2k\Omega) \cdot 2{,}2\mu F} =$$

$$= 0{,}5472\,Hz$$

$$f_{d_2} = \frac{1}{2\pi\,(R_o + R_{wy}) \cdot C_2} = \frac{1}{2\pi\left(2{,}2k\Omega + 909{,}09\Omega\right) \cdot 2{,}2\mu F} =$$

$$= 23{,}27\,Hz$$

$$f_{ds} = \frac{1}{2\pi R_{os} C_s} \quad R_{os}$$

$$R_z = \frac{-U_{GS}}{-g_m U_{GS} \frac{r_{ds}}{r_{ds} + R_2}} = \frac{r_{ds} + R_2}{g_m r_{ds}} = \frac{10k\Omega + 687{,}5\Omega}{0{,}15S \cdot 10k\Omega} =$$

$$= 7{,}125\Omega$$

$$R_{os} = \frac{7{,}125\Omega \cdot 330\Omega}{7{,}125\Omega + 330\Omega} = 6{,}97\,\Omega$$

$$f_{ds} = \frac{1}{2\pi R_{os} C_s} = \frac{1}{2\pi \cdot 6{,}97\Omega \cdot 47\mu F} = 485{,}6Hz$$

$$f_d = 1{,}1\sqrt{f_{d_1}^2 + f_{d_2}^2 + f_{ds}^2} =$$

$$= 1{,}1\sqrt{(0{,}5472Hz)^2 + (23{,}27Hz)^2 + (485{,}6Hz)^2} =$$

$$= 534{,}773\,Hz$$