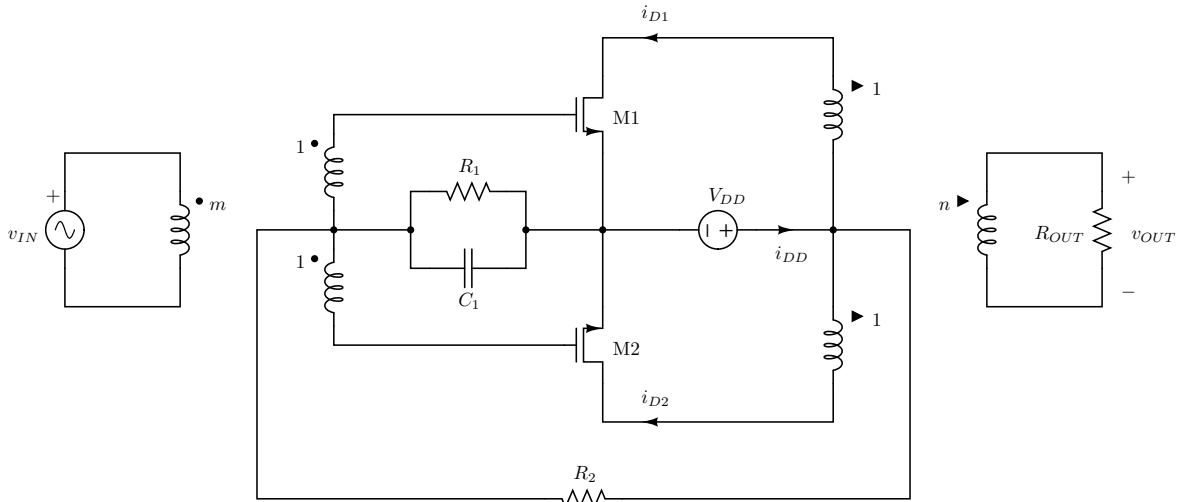


1. Na slici 1 je prikazan pojačavač snage u klasi A kod koga je $V_{DD} = 20 \text{ V}$, $m = 1$, $R_1 = 10 \text{ k}\Omega$, $R_2 = 30 \text{ k}\Omega$, $C_1 \rightarrow \infty$, $n = 2$, $R_{OUT} = 100 \Omega$, tranzistori su sa $B = 200 \text{ mA/V}^2$, $V_T = 4 \text{ V}$.

- a) [1] Odrediti disipacije na tranzistorima u mirnoj radnoj tački, P_{D1Q} i P_{D2Q} .
 b) [2] Odrediti prenosnu funkciju $v_{OUT}(v_{IN})$ pod pretpostavkom da su tranzistori u zasićenju.
 c) [2] Odrediti maksimalnu amplitudu V_m ulaznog napona pri kojoj izlazni napon nije izobličen.

Za $v_{IN} = 1 \text{ V} \cos(\omega t)$:

- d) [2] Odrediti vremenske dijagrame v_{GS1} , v_{GS2} , v_{DS1} , v_{DS2} i v_{OUT} .
 e) [2] Odrediti vremenske dijagrame i_{D1} , i_{D2} , i i_{DD} .
 f) [1] Odrediti koeficijent korisnog dejstva η .



Slika 1.

a) [1]

$$V_{GG} = \frac{R_1}{R_1 + R_2} V_{DD} = 5 \text{ V}$$

$$I_{D1Q} = I_{D2Q} = I_{DQ} = \frac{B}{2} (V_{GG} - V_T)^2 = 100 \text{ mA}$$

$$P_{D1Q} = P_{D2Q} = P_{DQ} = V_{DD} I_{DQ} = 2 \text{ W}$$

b) [2]

$$v_{GS1} = V_{GG} + \frac{v_{IN}}{m}$$

$$v_{GS2} = V_{GG} - \frac{v_{IN}}{m}$$

$$i_{D1} = \frac{B}{2} (v_{GS1} - V_T)^2 = \frac{B}{2} \left((V_{GG} - V_T) + \frac{v_{IN}}{m} \right)^2$$

$$i_{D2} = \frac{B}{2} (v_{GS2} - V_T)^2 = \frac{B}{2} \left((V_{GG} - V_T) - \frac{v_{IN}}{m} \right)^2$$

$$n \frac{v_{OUT}}{R_{OUT}} + i_{D1} - i_{D2} = 0$$

$$v_{OUT} = \frac{R_{OUT}}{n} (i_{D2} - i_{D1})$$

$$i_{D2} - i_{D1} = -2B (V_{GG} - V_T) \frac{v_{IN}}{m}$$

$$v_{OUT} = -2B \frac{R_{OUT}}{n} (V_{GG} - V_T) \frac{v_{IN}}{m}$$

$$v_{OUT} = -20 v_{IN}$$

c) [2] Da počnemo sa zakočenjem:

$$v_{GS1} = V_{GG} + \frac{v_{IN}}{m} = V_T$$

$$v_{IN} = m (V_T - V_{GG}) = -1 \text{ V}$$

$$v_{GS2} = V_{GG} - \frac{v_{IN}}{m} = 6 \text{ V}$$

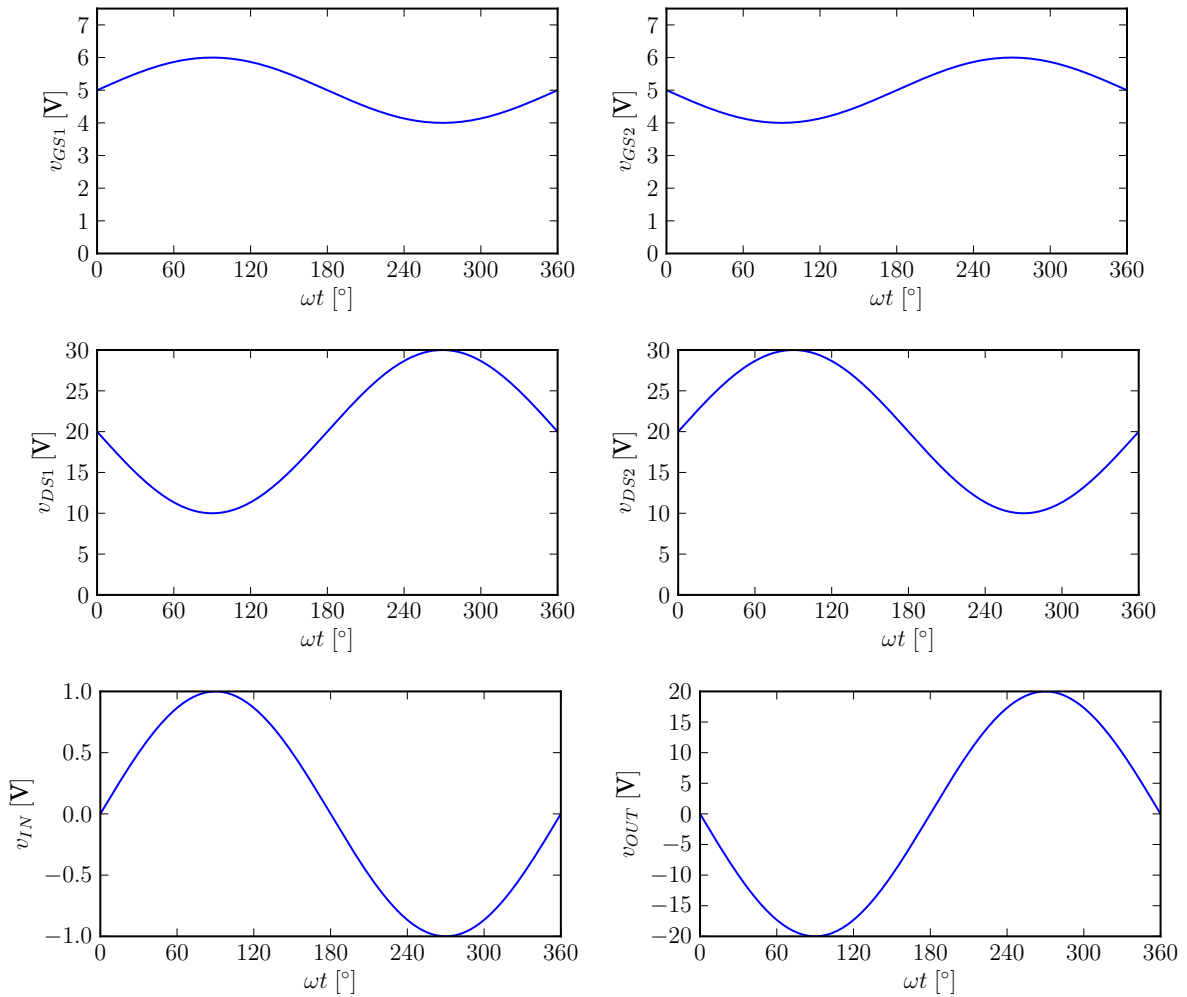
$$i_{D2} = \frac{B}{2} (v_{GS2} - V_T)^2 = 400 \text{ mA}$$

$$v_{OUT} = \frac{R_{OUT}}{n} i_{D2} = 20 \text{ V}$$

$$v_{DS2} = V_{DD} - \frac{v_{OUT}}{n} = 10 \text{ V}$$

Ovo je vrlo daleko od triodne oblasti ($10 \text{ V} > 2 \text{ V}$), nema potrebe da se ispituje ograničenje usled izlaska tranzistora iz zasićenja. Zaključak: $V_m < 1 \text{ V}$.

d) [2]



$$v_{GS1} = (4 + \cos(\omega t)) \text{ V}$$

$$v_{GS2} = (4 - \cos(\omega t)) \text{ V}$$

$$v_{DS1} = (20 - 10 \cos(\omega t)) \text{ V}$$

$$v_{DS2} = (20 + 10 \cos(\omega t)) \text{ V}$$

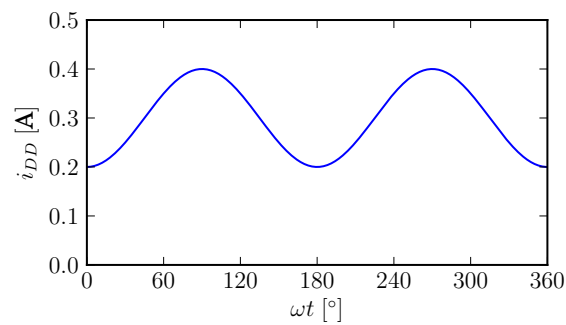
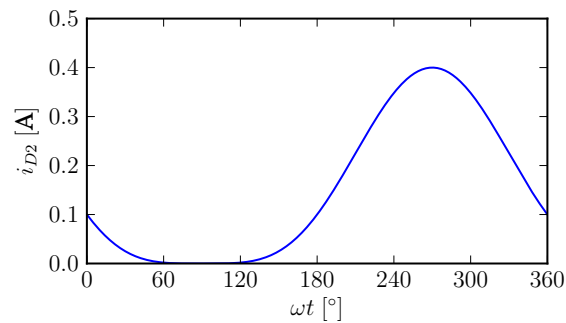
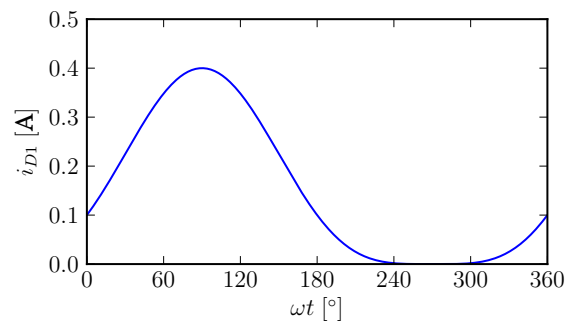
$$v_{OUT} = -20 \text{ V} \cos(\omega t)$$

e) [2]

$$i_{D1} = 100 \text{ mA} (1 - \cos(\omega t))^2$$

$$i_{D2} = 100 \text{ mA} (1 + \cos(\omega t))^2$$

$$i_{DD} = i_{D1} + i_{D2} = 200 \text{ mA} (1 + \cos^2(\omega t)) = 100 \text{ mA} (3 + \cos(2\omega t))$$



f) [1]

$$\eta = \frac{P_{OUT}}{P_{DD}} = \frac{\frac{1}{2} \times 20 \text{ V} \times 0.2 \text{ A}}{20 \text{ V} \times 0.3 \text{ A}} = \frac{1}{3} \approx 33.33\%$$