UNIVERSITI SAINS MALAYSIA

Peperiksaan Semester Pertama
Sidang Akademik 2011/2012

Januari 2012

EEE 241 – ANALOG I

Masa : 3 jam

ARAHAN KEPADA CALON:

Sila pastikan bahawa kertas peperiksaan ini mengandungi LAPAN muka surat beserta Lampiran DUA mukasurat bercetak sebelum anda memulakan peperiksaan ini.

Kertas soalan ini mengandungi ENAM soalan

Jawab **LIMA** soalan.

Mulakan jawapan anda untuk setiap soalan pada muka surat yang baru.

Agihan markah bagi soalan diberikan disudut sebelah kanan soalan berkenaan.

Jawab semua soalan di dalam Bahasa Malaysia atau Bahasa Inggeris atau kombinasi kedua-duanya.

"Sekiranya terdapat sebarang percanggahan pada soalan peperiksaan, versi Bahasa Inggeris hendaklah diguna pakai."

"In the event of any discrepancies, the English version shall be used."

…2/-

1. (a) Terangkan fenomena berikut:
Explain the following phenomenon:

(i) pemodulatan panjang-saluran dalam MOSFET
channel-length modulation in MOSFETs

(4 markah/*marks*)

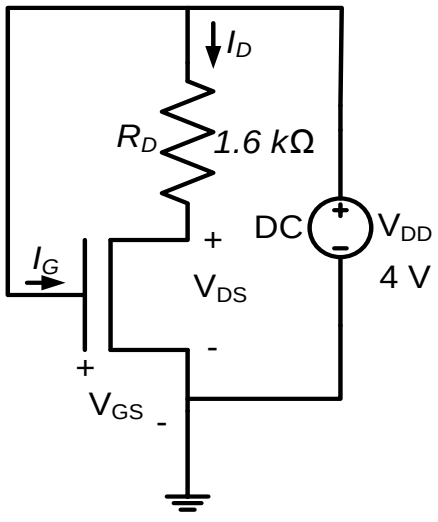
(ii) kesan badan dalam MOSFET
body effect in MOSFETs

(4 markah/*marks*)

(b) Tentukan mod operasi NMOSFET dalam Rajah 1. Seterusnya, tentukan titik-Q (I_D dan V_{DS}) bagi NMOS yang sama. $K_n = \mu_n C_{ox} W/L = 250\ \mu A/V^2$ dan voltan ambang, $V_t = 1$ V.

Determine the mode of operation of the NMOSFET in Figure 1. Subsequently, determine the Q-point (ID and VDS) for the same NMOS. $K_n = \mu_n C_{ox} W/L = 250\ \mu A/V^2$ *and the threshold voltage,* $V_t = 1$ *V.*

(12 markah/*marks*)



Rajah 1
Figure 1

2. (a) Merujuk kepada Rajah 2, nyatakan sama ada C_1,C_2 dan C_3 adalah kapasitor gandingan atau pirau. Apakah kegunaan kapasitor-kapasitor ini?

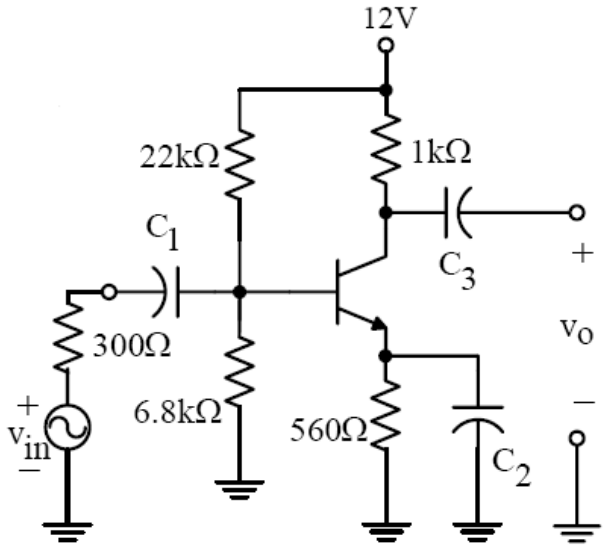
Referring to Figure 2, state whether C_1, C_2 and C_3 are coupling or bypass capacitors. What are the applications of these capacitors?

(6 markah/*marks*)

(b) Kirakan gandaan voltan bagi penguat pemancar- sepunya dalam Rajah 2 dengan dan tanpa kapasitor C_2, jika transistor mempunyai β_o = 150, β_F = 160, V_T = 26 mV dan V_{BE} = 0.7 V.

Calculate the voltage gain of the common-emitter amplifier in Figure 2 with and without capacitor C_2, if the transistor has β_o = 150, β_F = 160, V_T = 26 mV and V_{BE} = 0.7 V.

(14 markah/*marks*)

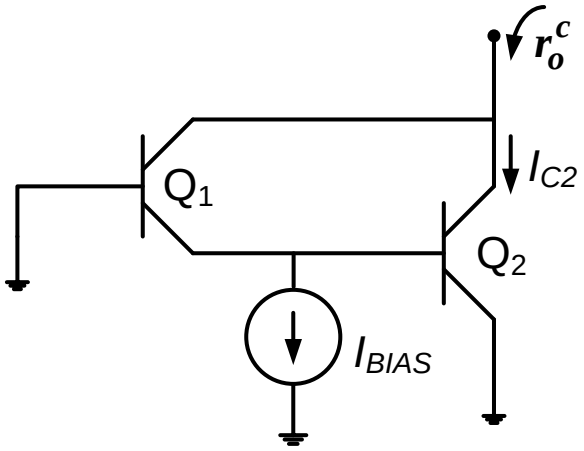


Rajah 2
Figure 2

3. (a) Kirakan rintangan luar r_o^c bagi litar pemancar-sepunya Darlington seperti di dalam Rajah 3(a) dengan fungsi I_{BIAS}. Jangan abaikan nilai bagi r_{o1} atau r_{o2} di dalam pengiraan ini, tetapi nilai r_b dan r_μ boleh diabaikan. Jika I_{C2} = 1 mA, cari nilai r_o^c untuk I_{BIAS} = 1 mA, dan I_{BIAS} = 0.

Calculate the output resistance r_o^c of the common-emitter Darlington transistor of Figure 3(a) as a function of I_{BIAS}. Do not neglect either r_{o1} or r_{o2} in this calculation, but you can ignore r_b and r_μ . If I_{C2} = 1 mA, find r_o^c for I_{BIAS} = 1 mA, and I_{BIAS} = 0.

(14 markah/*marks*)

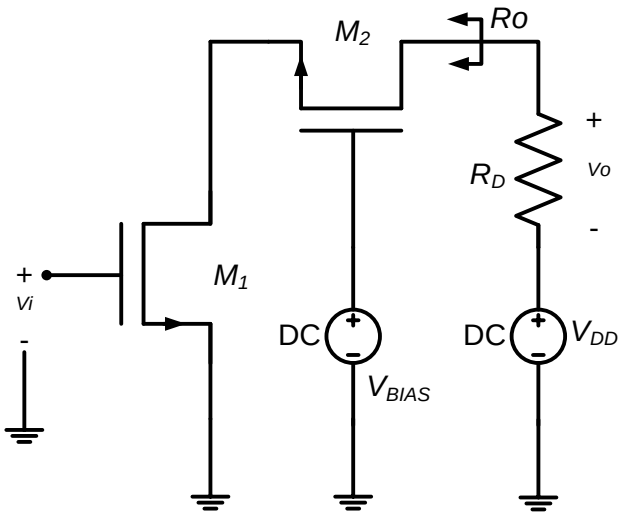


Rajah 3(a)
Figure 3(a)

(b) Lukiskan litar setara isyarat kecil bagi penguat berbilang peringkat seperti di dalam Rajah 3(b). Buktikan bahawa transkonduktan, G_M litar tersebut adalah kurang atau bersamaan dengan transkonduktan, g_{m1} bagi transistor M_1.

Draw the small-signal equivalent circuit for the MOS cascode circuit of Figure 3(b).Prove that the transconductance, G_M of that circuit is less than or equal to transconductance, g_{m1} of transistor M_1.

(6 markah/*marks*)



Rajah 3(b)
Figure 3(b)

4. Gandaan transonduktan ditunjukkan di Rajah 4. Parameter litar adalah C = 0.1 µF , Rs = 5 kΩ , Gvi = 20 mA/V , Ri = 500 kΩ dan Ro = 50 kΩ. Hitungkan.

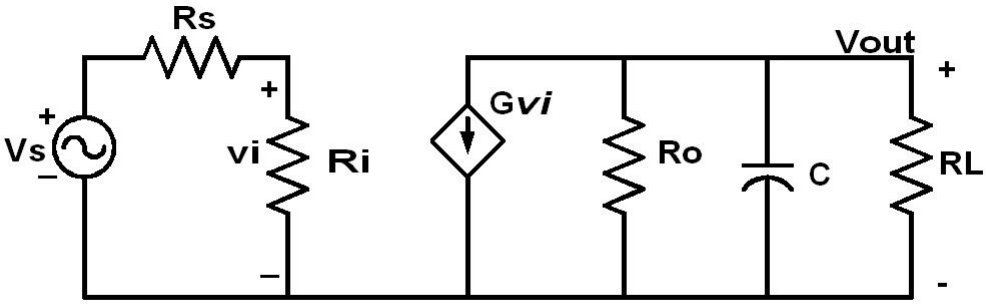
A low pass transconductance amplifier is shown in Figure 4 . The circuit parameters are C = 0.1 µF , Rs = 5 kΩ , Gvi = 20 mA/V , Ri = 500 kΩ and Ro = 50 kΩ. Calculate :

(a) Kadar gandaan satu jika RL = 1 kΩ.
Unity Gain Bandwidth for RL = 1 kΩ.

(10 markah/*marks*)

(b) Kadar gandaan satu jika RL = 10 kΩ.
Unity Gain Bandwidth for RL = 10 kΩ.

(10 markah/*marks*)



Rajah 4
Figure 4

5. Gandaan terbalik di Rajah 5 mempunyai R1 = 50 kΩ and R2 = R3 = 20 kΩ . Gandaan satu untuk operasi gandaan adalah fu = 1MHz dan kadar SR = 6 V/µs.

The inverting amplifier shown in Figure 5 has R1 = 50 kΩ and R2 = R3 = 20 kΩ . The unity gain bandwidth of the op-amps is fu = 1MHz and the slew rate is SR = 6 V/µs.

(a) Hitung nilai Rx yang memberi nilai ganda voltan *Af = vo/vi = -10 V/V*.

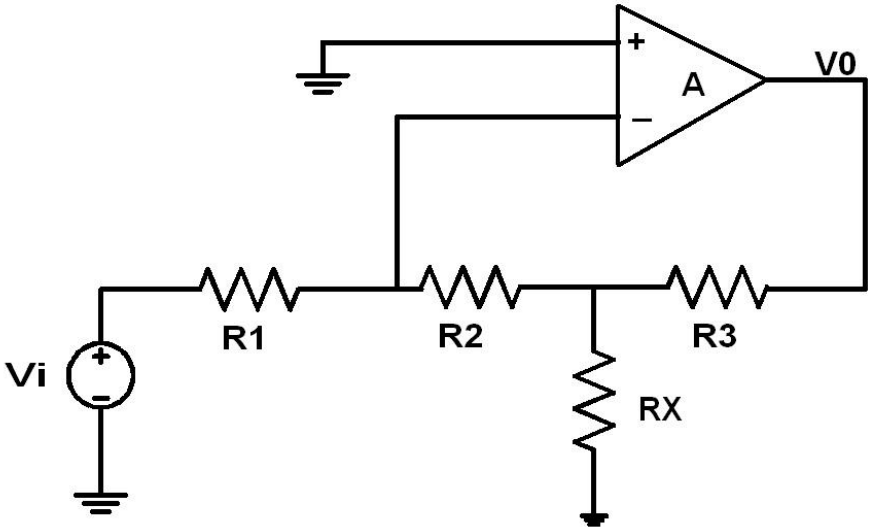
Determine the value of Rx that will give a voltage gain of Af = vo/vi = -10 V/V.

(10 markah/*marks*)

(b) Hitung frekuensi maksima masukan V1 jika voltan keluaran terhad kepada 10 V

Determine the maximum frequency fmax of the input V1 if the amplitude of the output voltage is limited 10 V.

(10 markah/*marks*)



Rajah 5
Figure 5

6. Gandaan CMOS ditunjukkan di Rajah 6. Parameter Vt = +2 V , VM = - 40V, dan VGS = + 4 V pada ID = 1 mA ; parameter PMOS are Vt = - 3V , VM = 40 V and VGS = -6V at ID = 1 mA. Hitungan

A CMOS amplifier is shown in Figure 6. The parameters for the NMOS are Vt = +2 V , VM = - 40V, and VGS = + 4 V at ID = 1 mA ; the parameters for the PMOS are Vt = - 3V , VM = 40 V and VGS = -6V at ID = 1 mA . Calculate:

(a) Gandaan perbezaan.
Differential Gain bagi NMOS

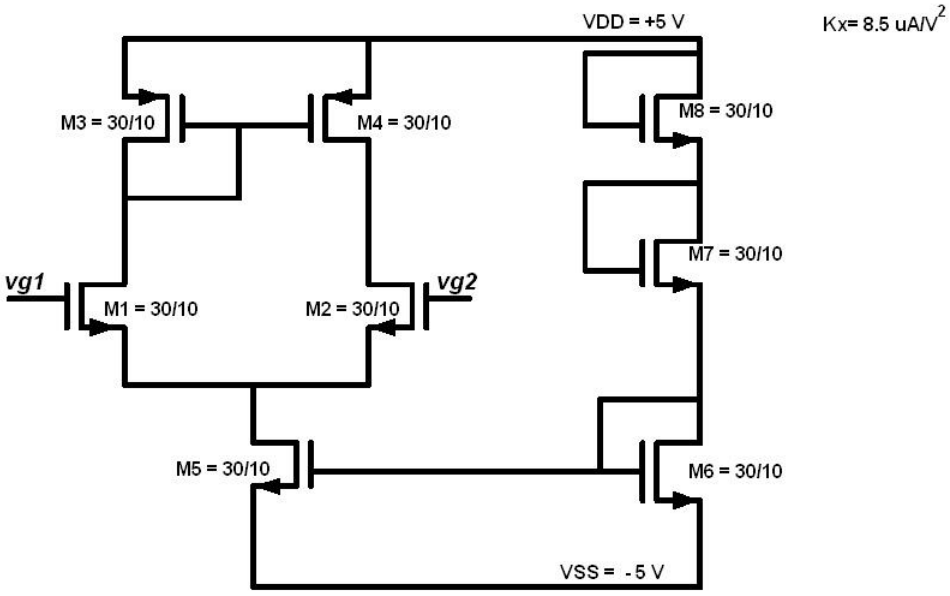
(5 markah/*marks)*

(b) Gandaan mod sepunya.
Commonmode Gain.

(5 markah/*marks)*

(c) Mod sepunya nisbah penolakan.
Common mode Rejection Ratio (CMRR).

(10 markah/*marks)*



Rajah 6
Figure 6

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