**UNIVERSITI SAINS MALAYSIA**

Second Semester Examination

2012/2013 Academic Session

June 2013

**EEE 270 – ANALOGUE ELECTRONIC II**

***[ELEKTRONIK ANALOG II]***

Duration : 3 hours

*[Masa : 3 jam]*

Please check that this examination paper consists of **SEVEN (7)** pages printed material and **TWO (2)** pages of Appendices before you begin the examination.

*[Sila pastikan bahawa kertas peperiksaan ini mengandungi **SEVEN (7)** mukasurat bercetak beserta Lampiran **DUA (2)** muka surat bercetak sebelum anda memulakan peperiksaan ini.]*

**Instructions:** Answer **FIVE (5)** questions. Answer **TWO (2)** questions in Section A and **TWO (2)** questions from Section B and **ONE (1)** question from any section.

*[**Arahan:** Jawab **LIMA (5)** soalan. Jawab **DUA (2)** soalan dalam Bahagian A dan **DUA (2)** soalan dalam Bahagian B dan **SATU (1)** soalan daripada mana-mana Bahagian.]*

Use separate answer booklets for **Section A** and **Section B**.
*[Gunakan dua buku jawapan yang berasingan bagi **Bahagian A** dan **Bahagian B**.]*

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

*[Sekiranya terdapat sebarang percanggahan pada soalan peperiksaan, versi Bahasa Inggeris hendaklah digunapakai.]*

**BAHAGIAN A**

***PART A***

1. Rekabentuk satu litar aktif kutub-tunggal penapis jalur-rendah menggunakan op amp dengan nilai $f_H$ = 2 kHz, $R_{in}$ = 5 kΩ dan $A_v$ = 40 dB. Kemudian pilih nilai R dan C yang terdekat daripada Appendik A dan kira nilai akhir $f_H$. Lukiskan dan nyatakan rumus untuk nilai $A_V(s)$ litar berkenaan.

   *Design an active single-pole low-pass filter using an op amp with $f_H$ = 2 kHz, $R_{in}$ = 5 kΩ and $A_v$ = 40 dB. Then pick the closest values for R and C from the Appendix A and recalculate the final $f_H$. Draw and give the expression of $A_V(s)$ for the mentioned circuit.*

   (20 markah/*marks*)

2. Rajah 2(a)(b) menunjukkan penguat kendalian (op amp) tidak menyongsang dan juga rangkaian dua-terminal setara bagi pengiraan rintangan keluaran. Buktikan bahawa:

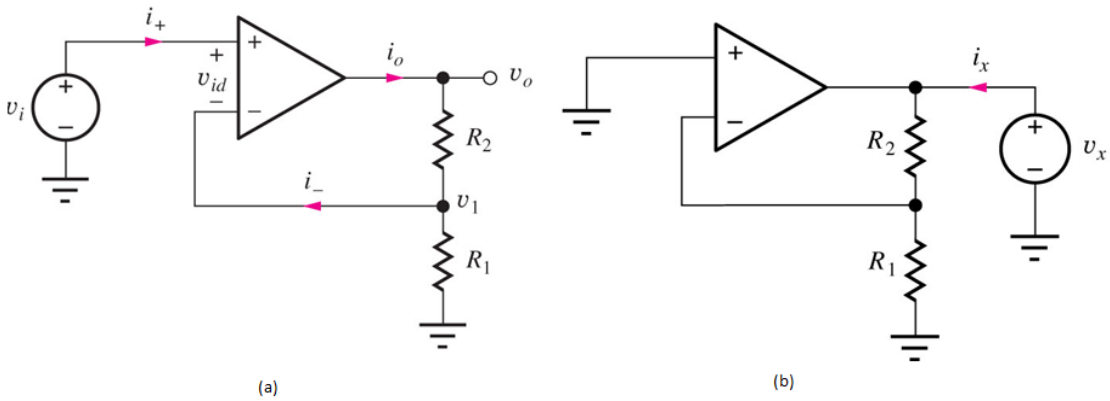
   *Figure 2(a)(b) shows the non-inverting operational amplifier (op amp) and its equivalent two-port network to find the output resistance. Prove that:*

   (a) Bagi kes op amp yang ideal, rintangan keluaran adalah kosong, dan
   *For ideal op amp, the output resistance is zero, and*

   (b) Bagi kes op amp yang tidak ideal, rintangan keluaran mempunyai nilai tertentu.
   *For non-ideal op amp, the output resistance is having a value.*

   Gunakan andaian-andaian yang bersesuaian bagi kedua-dua kes.
   *Apply suitable assumptions for both cases.*

   (20 markah/*marks*)




Rajah 2(a): Penguat kendalian tidak menyongsang

Rajah 2(b): Rangkaian dua-terminal setara untuk pengiraan $R_{out}$

*Figure 2(a): Non-inverting amplifier*

*Figure 2(b): Equivalent two-port network to calculate $R_{out}$*

3. Untuk op amp dengan gandaan dc bernilai 200,000 dan frekuensi gandaan-tunggal bernilai 500 kHz, cari:

*For an op amp with a dc gain of 200,000 and unity-gain frequency of 500 kHz, find:*

(a) Apakah frekuensi potong bagi op amp tersebut?
*What is the cut-off frequency of op amp?*

(b) Jika op amp digunakan untuk merekabentuk litar penguat penyongsang dengan gandaan gelung-tertutup bernilai 40 dB, apakah lebar jalur penguat penyongsang tersebut?

*If the op amp is used to build an inverting amplifier with a closed-loop gain of 40 dB, what is the bandwidth of the feedback amp?*

(c) Berikan ungkapan fungsi pindah bagi op amp.
*Write an expression for the transfer function of the op amp.*

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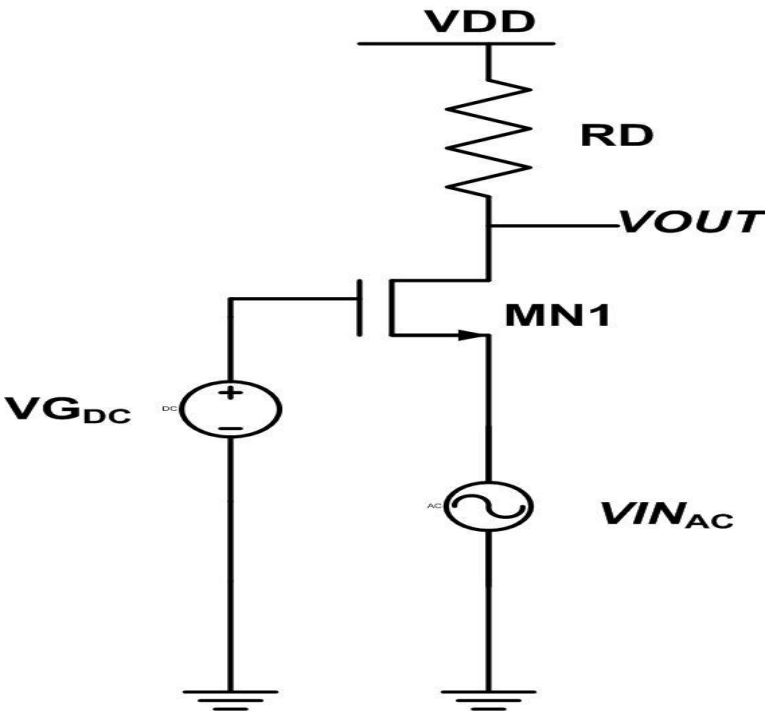
(d) Berikan ungkapan fungsi pindah litar penguat penyongsang.
*Write an expression for the transfer function of the inverting amplifier.*

(20 markah/*marks*)

**BAHAGIAN B**
***PART B***




Rajah 4

*Figure 4*

4. (a) Cari persamaan masukan rintangan dalam Rajah 4.

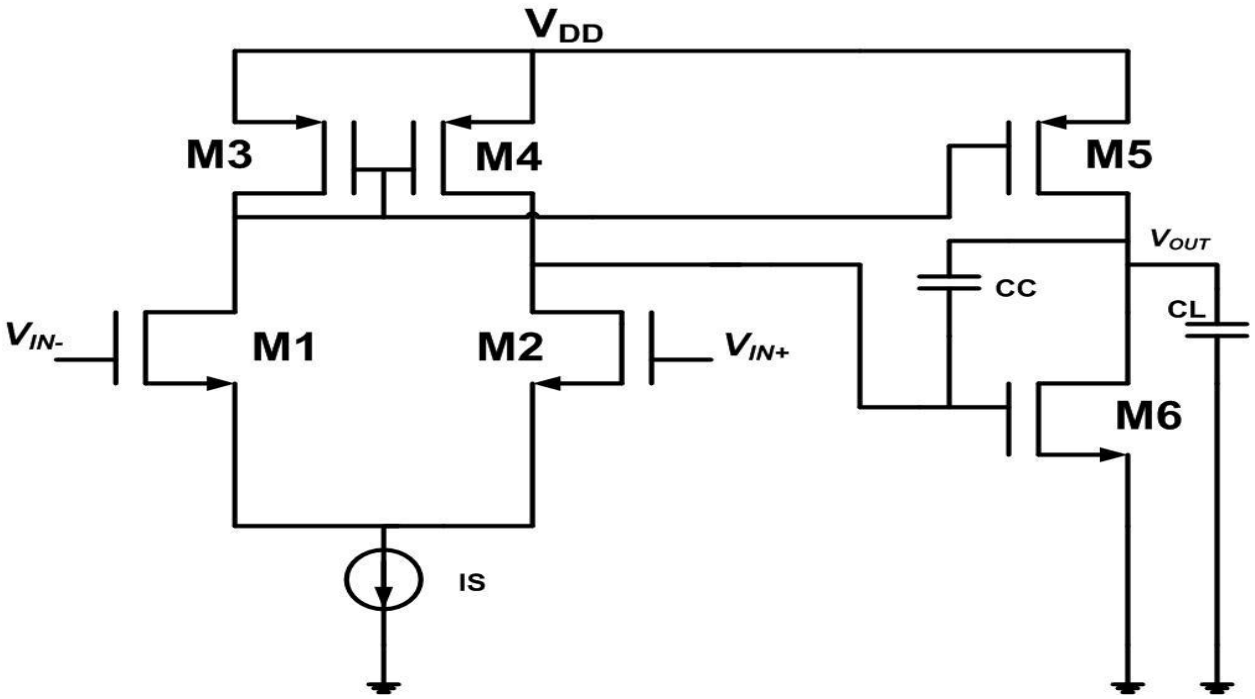
*Derive input resistance in Figure 4.*

(10 markah/*marks*)

(b) Terbitkan persamaan jumlah gandaan.

*Derive Total gain expression.*

(10 markah/*marks*)




Rajah 5

*Figure 5*

5. Rajah 5 diatas menunjukkan konfigurasi gandaan 2 peringkat.

*Figure 5 shows a 2 gain configuration stape.*

(a) Terbitkan gandaan lebarjalur

Derive gainbandwidth (GBW)

(5 markah/*marks*)

(b) Kira nisbah gm1 dan gm6 jika fasa julat adalah 75 darjah.

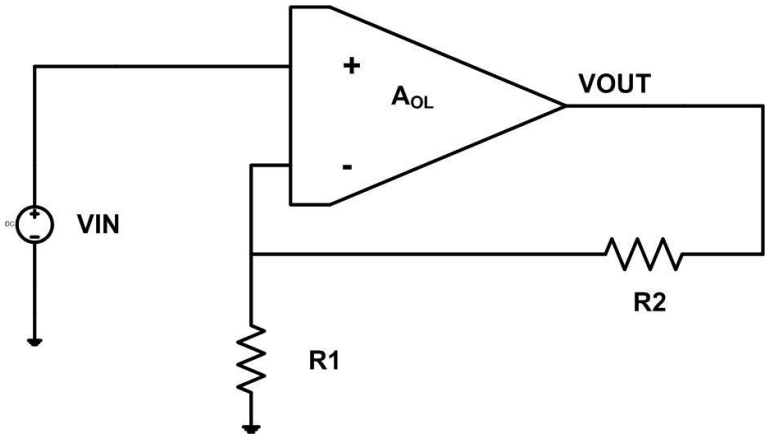
Calculate the ratio gm1 and gm6 if the phase margin is 75 degrees.

(5 markah/*marks*)

(c) Kira gm1 jika VDD=5V , ID2 = 1mA.

Calculate gm1 if VDD=5V , ID2 = 1mA.

(10 markah/*marks*)




Rajah 6

*Figure 6*

6. Rajah 6 diatas menunjukkan konfigurasi gandaan tak menyongsang.

*Figure 6 shows the noninverting configuration.*

(a) Kira nilai gandaan tertutup jika R2 = 9 kohm , R1 = 1 kohm dan gandaan terbuka = 1000 .

*Calculate closed loop gain if R2 = 9 kohm and R1 = 1 kohm and openloop gain = 1000.*

(10 markah/*marks*)

(b) Kira masa selesai jika konfigurasi tak menyongsang ini diubah kepada konfigurasi gandaan satu.

*Calculate the settling time if noniverting configuration change to unity gain configuration.*

(10 markah/*marks*)

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**Lampiran A** [EEE 270]

***Appendix A***

The following are the standard resistor values available in carbon film with a 2 or 5percent tolerance. Values are in Ohms with K = 1,000 and M = 1,000,000.

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 1.0 | 10 | 100 | 1.0K | 10K | 100K | 1.0M | 10M |
| 1.1 | 11 | 110 | 1.1K | 11K | 110K | 1.1M | 11M |
| 1.2 | 12 | 120 | 1.2K | 12K | 120K | 1.2M | 12M |
| 1.3 | 13 | 130 | 1.3K | 13K | 130K | 1.3M | 13M |
| 1.5 | 15 | 150 | 1.5K | 15K | 150K | 1.5M | 15M |
| 1.6 | 16 | 160 | 1.6K | 16K | 160K | 1.6M | 16M |
| 1.8 | 18 | 180 | 1.8K | 18K | 180K | 1.8M | 18M |
| 2.0 | 20 | 200 | 2.0K | 20K | 200K | 2.0M | 20M |
| 2.2 | 22 | 220 | 2.2K | 22K | 220K | 2.2M | 22M |
| 2.4 | 24 | 240 | 2.4K | 24K | 240K | 2.4M | |
| 2.7 | 27 | 270 | 2.7K | 27K | 270K | 2.7M | |
| 3.0 | 30 | 300 | 3.0K | 30K | 300K | 3.0M | |
| 3.3 | 33 | 330 | 3.3K | 33K | 330K | 3.3M | |
| 3.6 | 36 | 360 | 3.6K | 36K | 360K | 3.6M | |
| 3.9 | 39 | 390 | 3.9K | 39K | 390K | 3.9M | |
| 4.3 | 43 | 430 | 4.3K | 43K | 430K | 4.3M | |
| 4.7 | 47 | 470 | 4.7K | 47K | 470K | 4.7M | |
| 5.1 | 51 | 510 | 5.1K | 51K | 510K | 5.1M | |
| 5.6 | 56 | 560 | 5.6K | 56K | 560K | 5.6M | |
| 6.2 | 62 | 620 | 6.2K | 62K | 620K | 6.2M | |
| 6.8 | 68 | 680 | 6.8K | 68K | 680K | 6.8M | |
| 7.5 | 75 | 750 | 7.5K | 75K | 750K | 7.5M | |
| 8.2 | 82 | 820 | 8.2K | 82K | 820K | 8.2M | |
| 9.1 | 91 | 910 | 9.1K | 91K | 910K | 9.1M | |

The following are standard capacitor values. Values below 1 uF are generally availablewith a 5 or 10 percent tolerance. Values over 1 uF are generally available with a 10 or 20percent tolerance. Values are in Farads with p = pico, n = nano, u = micro, and m = milli.

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| 1p | 10p | 100p | 1.0n | 10n | 100n | 1.0u | 10u | 100u | 1.0m | 10m |
| | 12p | 120p | 1.2n | 12n | 120n | 1.2u | | | | |
| 1.5p | 15p | 150p | 1.5n | 15n | 150n | 1.5u | 15u | 150u | 1.5m | 15m |
| | 18p | 180p | 1.8n | 18n | 180n | 1.8u | | | | |
| 2.2p | 22p | 220p | 2.2n | 22n | 220n | 2.2u | 22u | 220u | 2.2m | 22m |
| | 27p | 270p | 2.7n | 27n | 270n | 2.7u | | | | |
| 3.3p | 33p | 330p | 3.3n | 33n | 330n | 3.3u | 33u | 330u | 3.3m | 33m |
| | 39p | 390p | 3.9n | 39n | 390n | 3.9u | | | | |
| 4.7p | 47p | 470p | 4.7n | 47n | 470n | 4.7u | 47u | 470u | 4.7m | 47m |
| | 56p | 560p | 5.6n | 56n | 560n | 5.6u | | | | |
| 6.8p | 68p | 680p | 6.8n | 68n | 680n | 6.8u | 68u | 680u | 6.8m | 68m |
| | 82p | 820p | 8.2n | 82n | 820n | 8.2u | | | | |