
UNIVERSITI MALAYSIA PERLIS

Peperiksaan Semester Pertama
Sidang Akademik 2012/2013

12 Oktober 2012

DMT 231 – Analogue Electronics [Elektronik Analog]

Masa: 3 Jam

Please make sure that this question paper has **TEN (10)** printed pages including the front page before you start the examination.

*[Sila pastikan kertas soalan ini mengandungi **SEPULUH (10)** muka surat yang bercetak termasuk muka hadapan sebelum anda memulakan peperiksaan.]*

This question paper has **SIX (6)** questions. Answer **THREE (3)** questions in Part A and all questions in Part B.

*[Kertas soalan ini mengandungi **ENAM (6)** soalan. Jawab **TIGA (3)** soalan dalam Bahagian A dan semua soalan dalam Bahagian B.]*

SULIT

Part A
[Bahagian A]

Question 1
[Soalan 1]

- (a) State **THREE (3)** basic configurations of Bipolar Junction Transistor (BJT) amplifiers.
[Nyatakan **TIGA (3)** konfigurasi asas bagi penguat Transistor Simpang Dwikutub (BJT).]
[3 Marks / Markah]
- (b) Compare **THREE (3)** basic amplifiers in terms of the voltage and current gains.
[Bandingkan **TIGA(3)** penguat asas dari segi gandaan voltan dan arus.] [3 Marks / Markah]
- (c) For the Common-Emitter amplifier circuit shown in **Figure 1**, let $\beta = 150$, $V_A = 150$ V, $V_T = 26$ mV and $V_{BE} = 0.7$ V.
[Untuk litar penguat pemancar-sepunya yang ditunjukkan di **Rajah 1**, Biar $\beta = 150$, $V_A = 150$ V, $V_T = 26$ mV and $V_{BE} = 0.7$ V.]

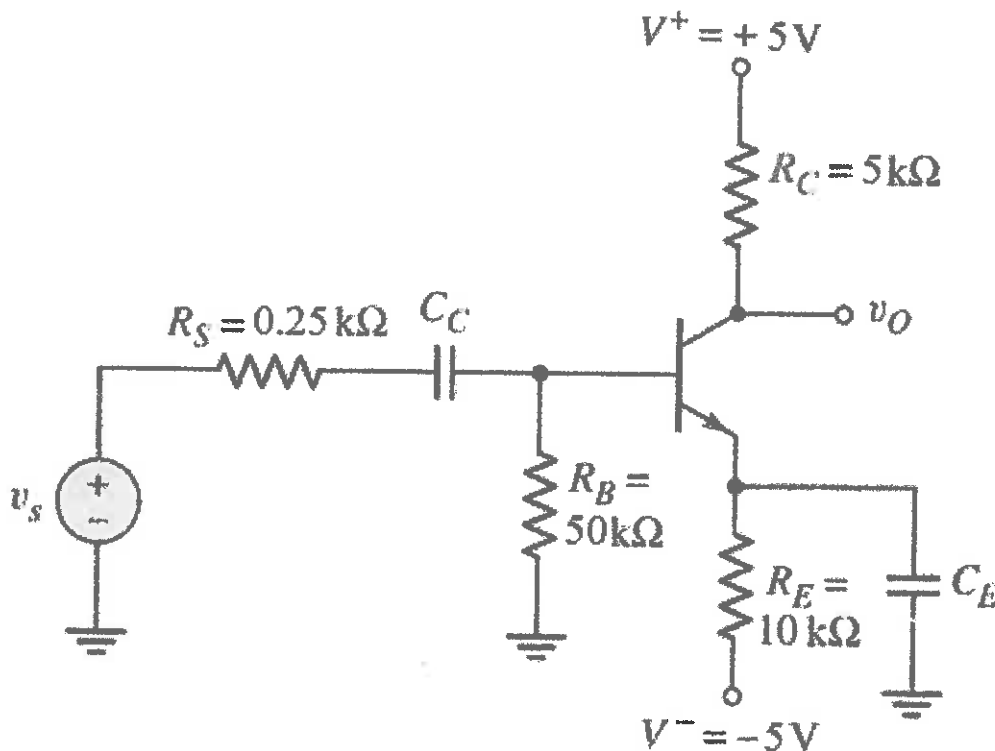


Figure 1
[Rajah 1]

.../3-

SULIT

Determine the values of;
[Tentukan nilai bagi:]

- (i) quiescent base current, I_{BQ} and collector current, I_{CQ} .
[arus tapak quiescent, I_{BQ} dan arus pemungut quiescent, I_{CQ}] [4 Marks / Markah]
- (ii) transconductance, g_m .
[kealiran-pindah, g_m] [1 Mark / Markah]
- (iii) diffusion resistance, r_π and small-signal transistor output resistance, r_o .
[rintangan resapan, r_π and rintangan keluaran isyarat kecil transistor, r_o] [2 Marks / Markah]
- (iv) sketch and label the small-signal equivalent circuit of the circuit shown in Figure 1.
[lakar dan labelkan litar setara isyarat-kecil untuk litar yang ditunjukkan di Rajah 1.] [2 Marks / Markah]
- (v) input resistance, R_i and output resistance, R_o .
[rintangan masukan, R_i dan rintangan keluaran, R_o] [3 Marks / Markah]
- (vi) small-signal voltage gain, A_v .
[gandaan voltan isyarat-kecil, A_v] [2 Marks / Markah]

SULIT

Question 2

[Soalan 2]

- (a) Describe the operation of Bipolar Junction Transistor (BJT) amplifier.
[Huraikan operasi bagi Transistor Simpang Dwikutub (BJT).] [3 Marks/ Markah]
- (b) The parameters of the transistor in the Emitter-Follower amplifier circuit in **Figure 2** are $\beta = 200$, $V_{BE} = 0.7 \text{ V}$, $V_T = 26 \text{ mV}$ and $V_A = \infty$. Given $V_{CC} = 8 \text{ V}$, $R_s = 200 \Omega$, $R_1 = 3 \text{ k}\Omega$, $R_2 = 4.7 \text{ k}\Omega$, $R_E = 390 \Omega$ and $C_c = 2.2 \mu\text{F}$.
[Parameter-parameter bagi transistor dalam penguat Pengikut-Pemancar dalam Rajah 2 ialah $\beta = 200$, $V_{BE} = 0.7 \text{ V}$, $V_T = 26 \text{ mV}$ and $V_A = \infty$. Given $V_{CC} = 8 \text{ V}$, $R_s = 200 \Omega$, $R_1 = 3 \text{ k}\Omega$, $R_2 = 4.7 \text{ k}\Omega$, $R_E = 390 \Omega$ dan $C_c = 2.2 \mu\text{F}$.]
- (i) Calculate the Thevenin resistance, R_{TH} and voltage, V_{TH} .
[Kirakan rintangan Thevenin, R_{TH} dan voltan, V_{TH} .] [4 Marks/ Markah]
- (ii) Determine the quiescent collector current, I_{CQ} and voltage collector to emitter, V_{CEQ} .
[Tentukan arus pemungut quiescent, I_{CQ} and voltan pemungut ke pemancar, V_{CEQ} .] [3 Marks/ Markah]
- (iii) Based on (ii), sketch and label the DC load line for the amplifier circuit.
[Berdasarkan (ii), lakar dan labelkan garis beban untuk litar penguat tersebut.] [2 Marks/ Markah]
- (iv) Determine the diffusion resistance, r_π and transconductance, g_m .
[Tentukan rintangan resapan, r_π dan kealiran-pindah, g_m .] [2 Marks/ Markah]
- (v) With the aid of a suitable diagram, determine the small-signal voltage gain, A_v .
[Dengan bantuan gambarajah yang sesuai, tentukan gandaan voltan, A_v , isyarat-kecil.] [6 Marks/ Markah]

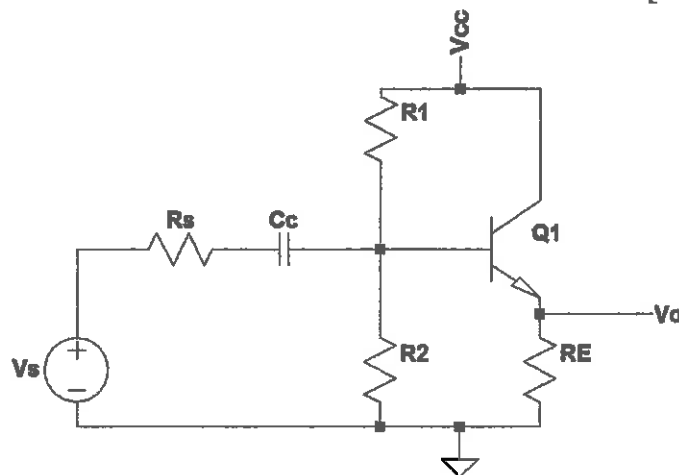


Figure 4
[Rajah 4]

SULIT

Question 3

[Soalan 3]

- (a) Describe **FOUR (4)** advantages of Field Effect Transistor (FET).
[Terangkan **EMPAT (4)** kebaikan Transistor Kesan Medan (FET).] [4 Marks/ Markah]
- (b) With the aid of a suitable diagram, demonstrate the operation of NMOS transistor.
[Dengan bantuan suatu gambarajah, tunjukkan operasi suatu transistor NMOS.] [6 Marks/ Markah]
- (c) The NMOS transistor in the **Figure 3** has parameters: $K_n = 4 \text{ mA/V}^2$, $V_{TN} = 1.5 \text{ V}$ and $\lambda = 0$. Given $V_{DD} = 12 \text{ V}$, $V_{GS} = 2.91 \text{ V}$, $R_{si} = 2 \text{ k}\Omega$, $R_1 = 162 \text{ k}\Omega$, $R_2 = 463 \text{ k}\Omega$, $R_S = 0.75 \text{ k}\Omega$ and $R_L = 2 \text{ k}\Omega$.
[Transistor dalam **Rajah 3** mempunyai parameter: $K_n = 4 \text{ mA/V}^2$, $V_{TN} = 1.5 \text{ V}$ dan $\lambda = 0$. Diberi $V_{DD} = 12 \text{ V}$, $V_{GS} = 2.91 \text{ V}$, $R_{si} = 2 \text{ k}\Omega$, $R_1 = 162 \text{ k}\Omega$, $R_2 = 463 \text{ k}\Omega$, $R_S = 0.75 \text{ k}\Omega$ dan $R_L = 2 \text{ k}\Omega$.]
- (i) State the type of the configuration as shown in **Figure 3**.
[Nyatakan jenis tatarajah seperti yang ditunjukkan dalam **Rajah 3**.] [1 Mark/ Markah]
- (ii) Determine the value of the quiescent point for the drain current, I_{DQ} and the drain source voltage, V_{DSQ} .
[Tentukan nilai bagi titik quiescent untuk arus saluran, I_{DQ} dan voltan saluran punca, V_{SDQ} .] [2 Marks/ Markah]
- (iii) Sketch and label the small-signal equivalent hybrid- π circuit.
[Lakar dan labelkan litar setara hibrid- π isyarat-kecil.] [2 Marks/ Markah]
- (iv) Determine the small-signal voltage gain, A_v .
[Tentukan gandaan voltan isyarat-kecil, A_v .] [5 Marks/ Markah]

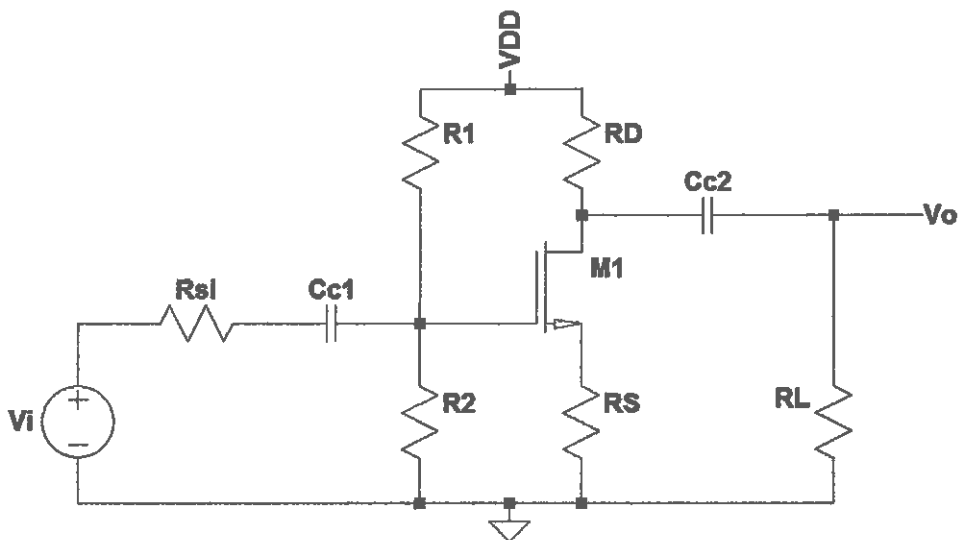


Figure 3
[Rajah 3]

SULIT

Question 4

[Soalan 4]

- (a) Illustrate the structure of N-channel and P-channel for Junction Field Effect Transistor (JFET).

[Ilustrasikan struktur bagi saluran-N dan saluran-P untuk Transistor Simpang Kesan Medan (JFET).]

[4 Marks/ Markah]

- (b) With the aid of a suitable diagram, demonstrate the operation of N-channel JFET.

[Dengan bantuan suatu gambarajah, tunjukkan operasi suatu transistor saluran-N JFET.]

[6 Marks/ Markah]

- (c) Figure 4 shows a common-source circuit. The N-channel JFET parameters are: $I_{DSS} = 2 \text{ mA}$, $V_P = -2 \text{ V}$ and $\lambda = 0$. Given $V_{DD} = 15 \text{ V}$, $R_G = 50 \text{ k}\Omega$, $R_S = 200 \Omega$, $R_D = 8 \text{ k}\Omega$ and $R_L = 2 \text{ k}\Omega$.

[Rajah 4 menunjukkan litar punca-sepunya. Parameter JFET saluran-N ialah: $I_{DSS} = 2 \text{ mA}$, $V_P = -2 \text{ V}$ dan $\lambda = 0$. Diberi $V_{DD} = 15 \text{ V}$, $R_G = 50 \text{ k}\Omega$, $R_S = 200 \Omega$, $R_D = 8 \text{ k}\Omega$ dan $R_L = 2 \text{ k}\Omega$.]

- (i) State the function of capacitors, C1 and C2.

[Nyatakan fungsi pemuat, C1 dan C2.]

[2 Marks/ Markah]

- (ii) Determine the value of the quiescent point for the drain current, I_{DQ} and the drain source voltage, V_{DSQ} .

[Tentukan nilai bagi titik quiescent untuk arus saliran, I_{DQ} dan voltan saliran punca, V_{SDQ} .]

[8 Marks/ Markah]

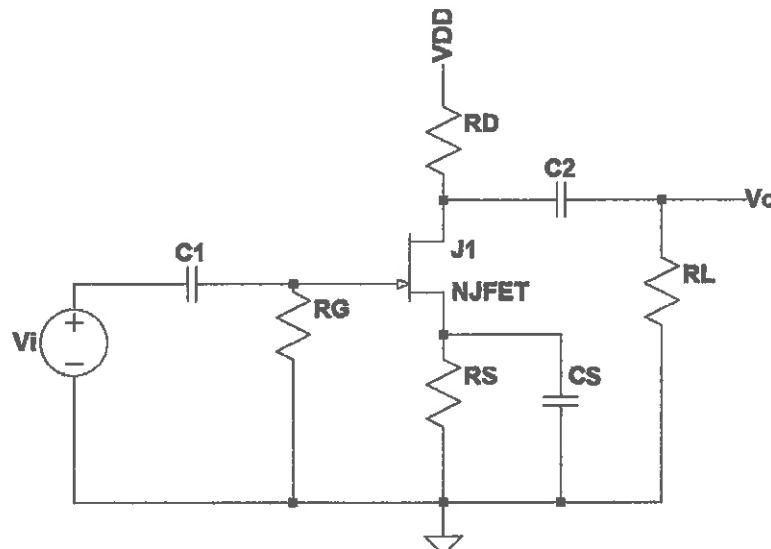


Figure 4
[Rajah 4]

SULIT

Part B
[Bahagian B]

Question 5
[Soalan 5]

Figure 5 shows the Darlington of a multistage amplifier. The circuit elements are $V_{CC} = 20V$, $R_1 = 370\text{ k}\Omega$, $R_2 = 150\text{ k}\Omega$, $R_C = 2.2\text{ k}\Omega$ and $R_{E2} = 1\text{ k}\Omega$.

[Rajah 5 menunjukkan tatarajah Darlington bagi penguat berbilang tahap. Elemen-elemen litar adalah $V_{CC} = 20V$, $R_1 = 370\text{ k}\Omega$, $R_2 = 150\text{ k}\Omega$, $R_C = 2.2\text{ k}\Omega$ dan $R_{E2} = 1\text{ k}\Omega$.]

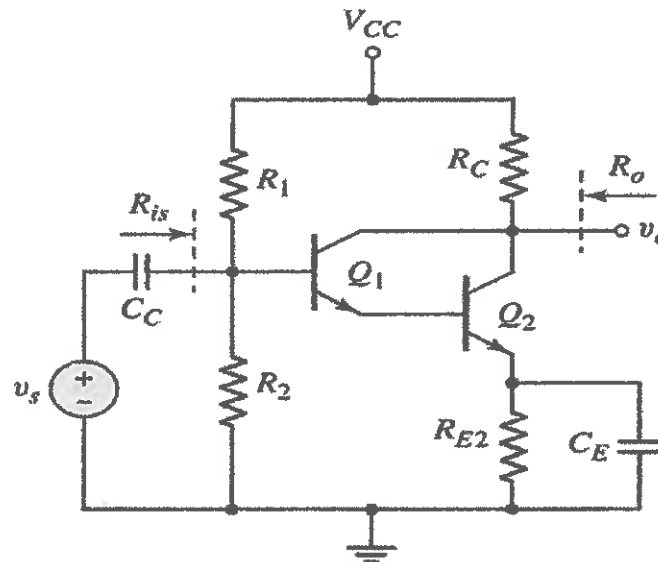


Figure 5
[Rajah 5]

- (a) State the advantages of Darlington multistage amplifier in terms of current gain.
[Nyatakan kelebihan bagi penguat berbilang tahap Darlington dalam terma gandaan arus.]
[1 Mark / Markah]
- (b) Given that early voltages, $V_{A1} = V_{A2} = \infty$, common emitter current gains, $\beta_1 = \beta_2 = 100$, $V_{T1} = V_{T2} = 0.026V$, base-emitter voltages, $V_{BE(ON)1} = V_{BE(ON)2} = 0.7V$ and Q point values of base currents, $I_{BQ1} = 0.138\mu A$ and $I_{BQ2} = 13.93\mu A$. Determine:
[Diberikan voltan-voltan awal $V_{A1} = V_{A2} = \infty$, gandaan-gandaan arus pemancar sepunya, $\beta_1 = \beta_2 = 100$, voltan-voltan terma, $V_{T1} = V_{T2} = 0.026V$, voltan-voltan tapak pemancar, $V_{BE(ON)1} = V_{BE(ON)2} = 0.7V$ dan nilai-nilai arus tapak titik-Q, $I_{BQ1} = 0.138\mu A$ dan $I_{BQ2} = 13.93\mu A$. Tentukan:]
- (i) the quiescent point values (I_{CQ1} , I_{CQ2} , V_{CEQ1} and V_{CEQ2}) for both transistor Q_1 and Q_2 .
[nilai quiescent (I_{CQ1} , I_{CQ2} , V_{CEQ1} dan V_{CEQ2}) bagi kedua-dua transistor Q_1 dan Q_2 .]
[4 Marks / Markah]

.../8-
SULIT

- (ii) transconductances, g_{m1} and g_{m2} .
[kealiran-pindah, g_{m1} dan g_{m2} .] [2 Marks / Markah]
- (iii) diffusion resistance, $r_{\pi 1}$ and $r_{\pi 2}$.
[rintangan masukan tapak pemancar, $r_{\pi 1}$ and $r_{\pi 2}$.] [2 Marks / Markah]
- (c) Sketch and label the AC equivalent circuit for multistage amplifier circuit shown in **Figure 5**.
[Lakar dan labelkan litar setara A.U untuk litar penguat berbilang tahap dalam Rajah 5.] [4 Marks / Markah]
- (d) Derive and determine the value of small-signal voltage gain, A_v for multistage amplifier circuit in **Figure 5**.
[Terbit dan tentukan nilai gandaan isyarat-kecil, A_v , untuk litar penguat berbilang tahap dalam Rajah 5.] [6 Marks / Markah]

Question 6

[Soalan 6]

- (a) With the aid of diagram, sketch and label the collector current, I_c versus time, ωt characteristics for Class A, B, AB and C power amplifiers.

[Dengan bantuan gambarajah, lakar dan labelkan ciri arus pemungut, i_c melawan masa, ωt . untuk penguat kuasa kelas A, B, AB dan C.] [8 Marks / Markah]

- (b) Figure 6 shows a power amplifier configuration composed of complementary transistor pair Q_3 and Q_4 . All transistor are assumed to be matched with $\beta = 100$ and $V_{BE}(npn) = V_{EB}(pnp) = 0.6V$.

[Rajah 6 menunjukkan konfigurasi penguat kuasa yang terdiri daripada pasangan pelengkap transistor Q_3 dan Q_4 . Kesemua transistor adalah dianggap sepadan dengan $\beta = 100$ dan $V_{BE}(npn) = V_{EB}(pnp) = 0.6V$]

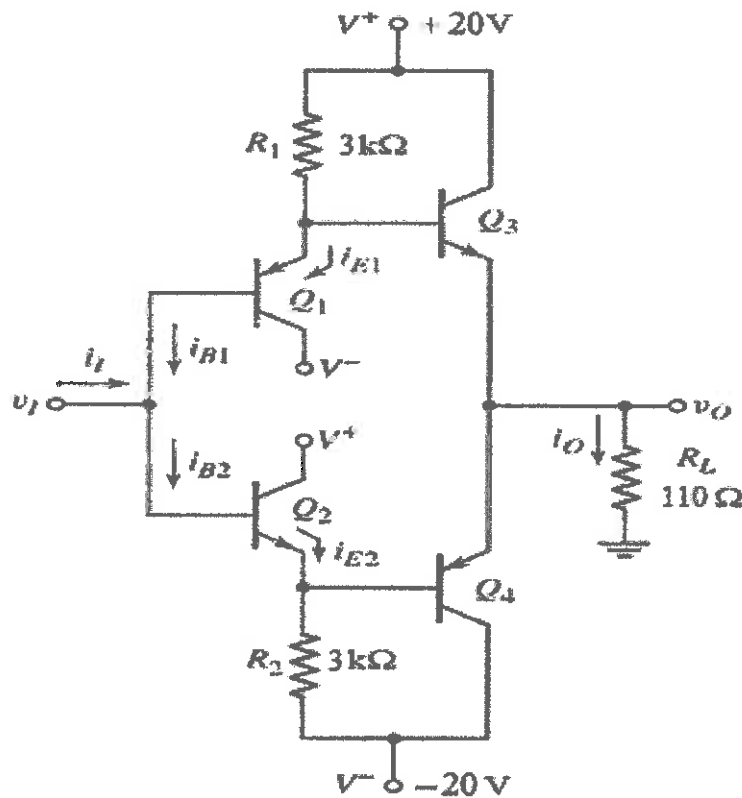


Figure 6
[Rajah 6]

- (i) State the class of power amplifier configuration in Figure 6.

[Nyatakan kelas bagi konfigurasi penguat kuasa dalam Rajah 6.]

[1 Mark / Markah]

- (ii) For $V_i = 0V$, determine all the quiescent bias currents.

[Untuk $V_i = 0V$, tentukan semua arus-arus pincang quiescent.]

[1 Mark / Markah]

.../10-

SULIT

- (c) Based on **Figure 6**, for $V_1 = 15V$, determine the following:
[Berdasarkan Rajah 6, untuk $V_1 = 15V$, tentukan yang berikut:]
- (i) output current, I_o .
[arus keluaran, I_o .] [1 Mark / Markah]
 - (ii) emitter current, I_{E3} .
[arus pemancar, I_{E3} .] [1 Mark / Markah]
 - (iii) base current, I_{B3} .
[arus tapak, I_{B3} .] [1 Mark / Markah]
 - (iv) current across R_1 , I_{R1} .
[arus merentasi R_1 , I_{R1} .] [1 Mark / Markah]
 - (v) emitter current, I_{E1} .
[arus pemancar, I_{E1} .] [1 Mark / Markah]
 - (vi) base current, I_{B1} .
[arus tapak, I_{B1} .] [1 Mark / Markah]
 - (vii) emitter current, I_{E2} .
[arus pemancar, I_{E2} .] [1 Mark / Markah]
 - (viii) base current, I_{B2} .
[arus tapak, I_{B2} .] [1 Mark / Markah]
 - (ix) input current, I_i .
[arus masukan, I_i .] [1 Mark / Markah]
 - (x) current gain, A_i .
[gandaan arus, A_i .] [1 Mark / Markah]

ooOoo

SULIT