الجامعة الإسلامية العالمية ماليزيا
INTERNATIONAL ISLAMIC UNIVERSITY MALAYSIA
يونيورسيتي إسلام انتارابغسا ملسيا

KULLIYYAH OF ENGINEERING

END OF SEMESTER EXAMINATION
SEMESTER I, 2015/2016 SESSION

Programme	: **Engineering**	Level of Study	: **UG 2**
Time	: **9:00 am -12:00 pm**	Date	: **30/12/2015**
Duration	: **3 Hrs**		
Course Code	: **ECE 2133**	Section(s)	: **1-2**
Course Title	: **Electronic Circuits**		

This Question Paper Consists of **6 (Six)** Printed Pages (Including Cover Page) with **5 (Five)** Questions.

INSTRUCTION(S) TO CANDIDATES

DO NOT OPEN UNTIL YOU ARE ASKED TO DO SO

- Total mark of this examination is **100.**
- This examination is worth **50 %** of the total course assessment.
- Answer **ALL QUESTIONS.**
- Only approved calculator with 'KoE approved' sticker is allowed (non-programmable and non-graphical).
- Marks assigned to each problem are listed in the margins.

Any form of cheating or attempt to cheat is a serious offence which may lead to dismissal.

All electronics gadgets are prohibited in the exam hall / venue.
(e.g. mobile / smart phones, smart watches, and smart glasses)

QUESTION 1 (20 marks)

(a) Find the transfer function of the circuit shown in **Fig. 1(a)** and its the corner frequency. What should be the maximum gain of the circuit? (8 marks)

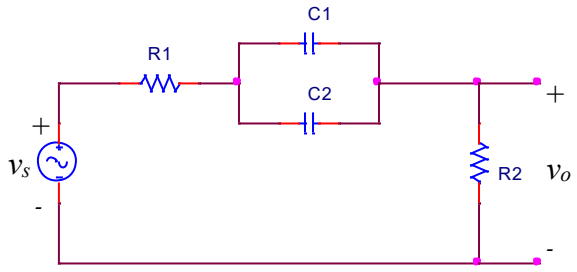

Fig. 1(a)

(b) Draw the frequency response curves, magnitude and phase of the following transfer function by applying Bode plot. (12 marks)

$$H(s) = \frac{10^6 s(s+5)(s+50)}{(s+500)}$$

QUESTION 2 (20 marks)

Design an audio amplifier as shown in **Fig. 2** such that the lower corner frequency is 20 Hz and upper frequency is 20 kHz. The transistor has small-signal hybrid-π parameters, r_π = 3 kΩ, g_m = 40mA/V and $r_o = \infty$. (10 marks)

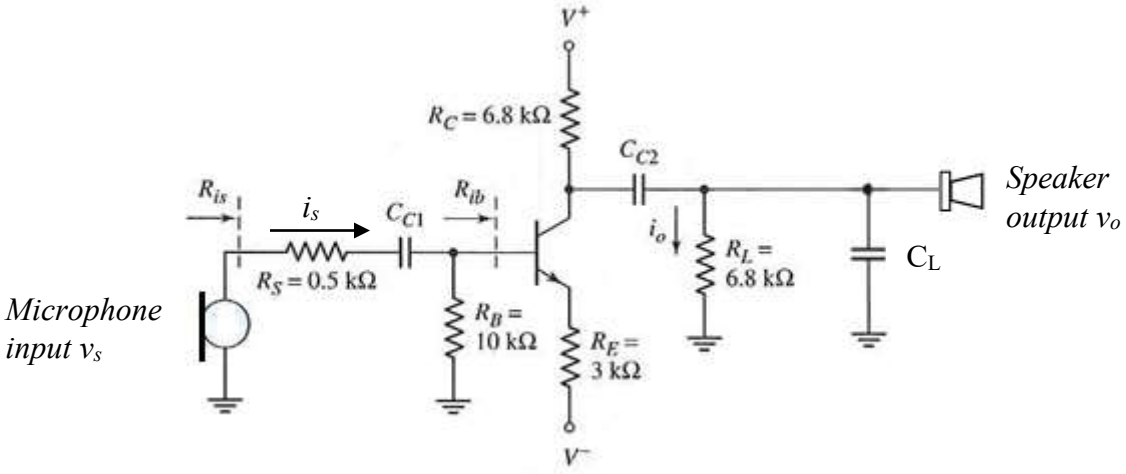

Fig. 2

What should be the output voltage of the speaker, if the microphone input voltage is 20 mV? (5 marks)

Find the current gain, $A_i = \dfrac{i_o}{i_s}$ of the audio amplifier. (5 marks)

QUESTION 3 (20 marks)

a) Draw a small signal high frequency equivalent circuit diagram of a short circuited BJT amplifier shown in **Fig. 3(a)**. Analyze the circuit step by step to find the short circuit current gain, $A_i = \frac{i_o}{i_i}$. Find the beta frequency, f_β of the amplifier. What should be the unity gain frequency, f_T of the amplifier? (10 marks)

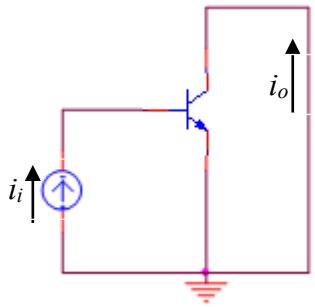

Fig. 3 (a)

b) A common source amplifier is shown in **Fig. 3 (b)** that operates at high frequencies. The transistor parameters are: $g_m = 40$ mA/V and $r_o = 100$ KΩ, $C_{gs} = 15$ pF and $C_{gd} = 3$ pF.

(i) Draw the simplified high-frequency small signal equivalent circuit diagram. (2 marks)

(ii) What is the equivalent Miller capacitance? (3 marks)

(iii) Determine the upper 3 dB frequency. (2 marks)

(iv) Find the midband voltage gain in dB. (3 marks)

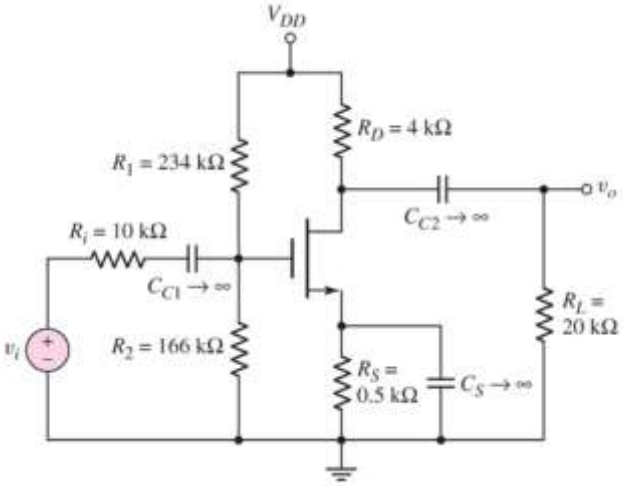

Fig. 3(b)

QUESTION 4 (20 marks)

a) The circuit diagram of a Wildar current source is shown in **Fig. 4(a)**. Design the circuit such that I_o = 10μA and I_{REF} = 150μA by neglecting base current. Also determine V_{BE2} for the circuit [Given that V^+ = 5 V, V^- = -5 V, V_{BE1} = 0.7 V and $V_A = \infty$] (5 marks)

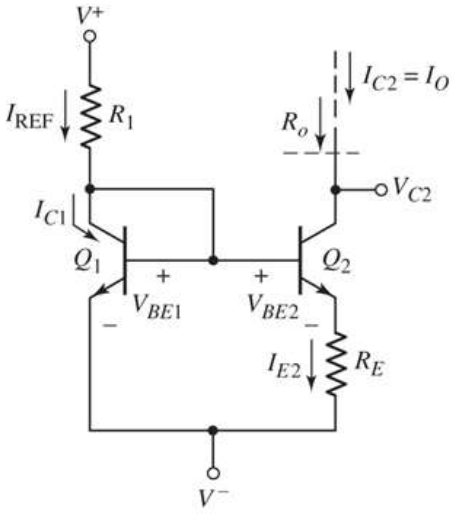

Fig. 4(a)

b)

(i) Design a MOSFET current source as shown in **Fig. 4(b)** such that I_R = 25 mA, I_o = 50 mA, and $V_{DS2(sat)}$ = 0.3 V. The biasing voltages V^+ = 5 V . The transistors are available with parameters: $k_n' = 60\mu A/V^2$, V_{TN} = 0.4 V and λ = 0. (4 marks)

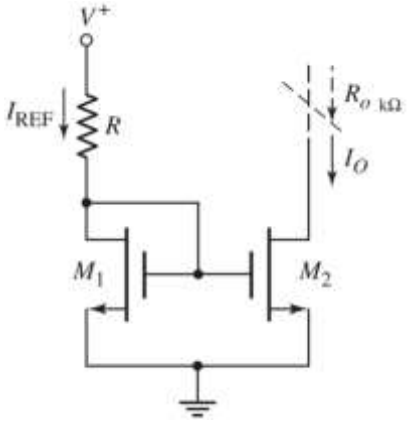

Fig. 4(b)

(ii) Draw a new current source by using only BJTs with replacing the MOSFETs in **Fig. 4(b)** (1 marks)

c) Define negative feedback and state its advantages and disadvantages for the amplifier. (5 marks)

d) A negative feedback amplifier has a closed loop gain of $A_f = 100$ and an open loop gain of $A = 5\times10^4$. (i) Determine the feedback transfer function β. (ii) What should be the closed loop bandwidth if the open loop bandwidth is 5 kHz (5 marks)

QUESTION 5 (20 marks)

a) Draw the block diagram and small signal equivalent circuit diagram of a shunt-shunt ideal feedback amplifier and identify the type of amplifiers used in the feedback amplifier. Analyze step by step the feedback amplifier to find the closed loop gain, A_f, the input resistance, R_{if} and the output resistance R_{of} in terms of open-loop amplifier parameters. (10 marks)

b) Define differential input voltage, v_d and common mode input voltage, v_{cm} of a differential amplifier. Derive step by step the DC transfer characteristic equations (i_c as a function of v_d) for the differential amplifier shown in **Fig. 5(b)** and draw its transfer characteristics curve (i_c versus v_d). (10 marks)

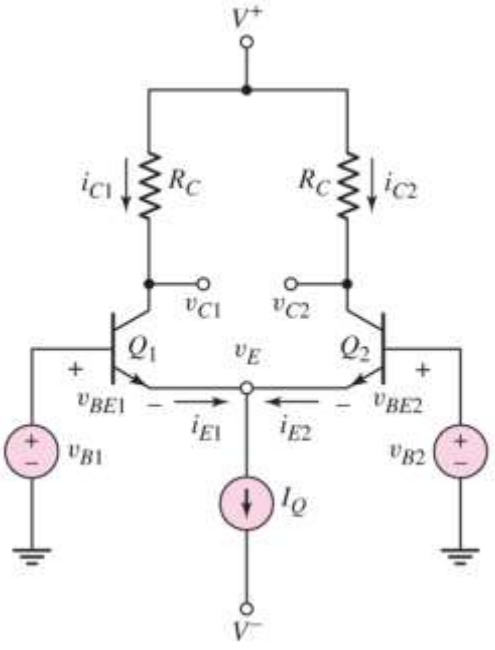

Fig. 5(b)

USEFUL FORMULA

BJT	MOSFET
$i_C = I_S e^{v_{BE}/V_T} \cdot \left(1 + \frac{v_{CE}}{V_A}\right)$ $g_m = \frac{I_{CQ}}{V_T}$ $r_\pi = \frac{\beta V_T}{I_{CQ}}$ $r_o = \frac{V_A}{I_{CQ}}$ $V_T = 26\,\text{mV}$ $V_{BE}(on) = 0.7\text{V}$	$I_D = \frac{1}{2} k_n' \left(W/L\right)(V_{GS} - V_T)^2 (1 + \lambda V_{DS})$ $g_m = 2\sqrt{K_n I_{DQ}}$ $r_o = \frac{1}{\lambda I_{DQ}}$ $K_n = \frac{k_n'}{2}\left(\frac{W}{L}\right)$

END OF PAPER