INTERNATIONAL ISLAMIC UNIVERSITY MALAYSIA
END OF SEMESTER EXAMINATION
SEMESTER I, 2013/2014 SESSION
KULLIYYAH OF ENGINEERING

Programme	: ENGINEERING	Level of Study	: UG 2
Time	: 2:30 pm-5:30 pm	Date	: 08/01/2014
Duration	: 3 Hrs		
Course Code	: ECE 2133	Section(s)	: 1-2
Course Title	: **Electronic Circuits**		

This Question Paper consists of **Six (6)** Printed Pages (Including cover and a blank page) with **Five (5)** Questions.

INSTRUCTION(S) TO CANDIDATES

DO NOT OPEN UNTIL YOU ARE ASKED TO DO SO

- A total mark of this examination is **100**.
- This examination is worth **50%** of the total assessment.
- Answer **ALL FIVE (5)** questions.
- Useful formula and necessary parameters are given in page 6.

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

Q.1 [20 marks]

(a) Consider the circuit shown in **Fig. 1(a)**, derive the expression (step by step) of the voltage transfer function $T(s)=\frac{v_o(s)}{v_i(s)}$ and find the time constant and the corner frequency. **(10 marks)**

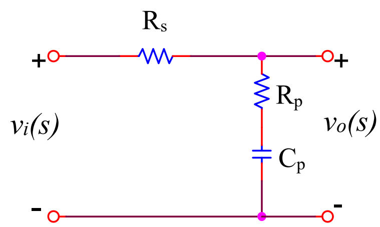

Fig. 1(a)

(b) Draw the Bode plot (magnitude and phase) of the following transfer function.
(10 marks)

$$H(s)=\frac{10^6(s+100)}{s}$$

Q.2 [20 marks]

(a) The MOSFET circuit is shown in **Fig. 2(a)**, the transistor parameters are g_m = 0.65 mA/V and r_o = 100 kΩ. Draw the small signal equivalent circuit for the midband frequency range and find

(i) the small signal voltage gain, $A_v=\frac{v_o}{v_i}$,

(ii) the lower corner frequency,

(iii) the equivalent output resistance R_o seen at the output terminals.

Given that R_1 = 180 kΩ, R_2 = 330 kΩ, R_s = 1.0 kΩ, R_D = 10 KΩ and C_C = 10μF.
(8 marks)

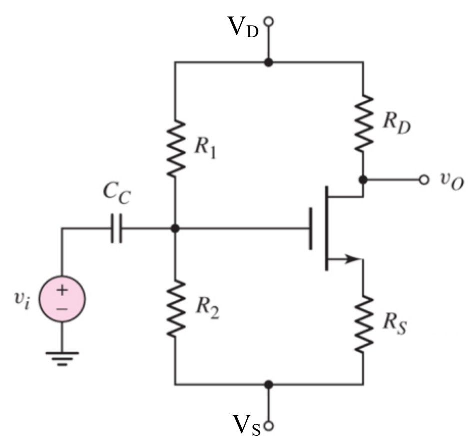

Fig. 2(a)

(b) The transistor circuit is shown in **Fig. 2(b),** the transistor has small-signal hybrid-π parameters, r_π = 3 kΩ, g_m = 40mA/V and r_o = ∞ .The circuit parameters are: R_{si} = 0.1 kΩ, R_1 = 60 kΩ, R_2 = 30 kΩ, R_E = 0.4 kΩ, R_C = 10 kΩ, R_L = 10 kΩ, $C_C \to \infty$ and C_L = 10 pF. Find the followings: **(12 marks)**

(iv) the small signal midband voltage gain, $A_v = \dfrac{v_o}{v_i}$,

(v) the midband current gain, $A_i = \dfrac{i_o}{i_i}$,

(vi) the higher corner frequency (3 dB frequency) due to C_L.

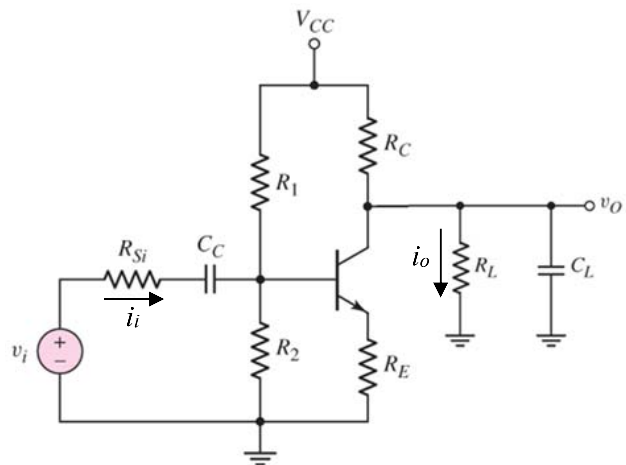

Fig. 2(b)

Q.3 [20 marks]

(a) Draw the simplified high frequency small-signal equivalent circuit diagram of the ac circuit shown in **Fig. 3(a)** and derive step by step short circuit current gain $A_i = \dfrac{I_c}{I_b}$ **.** Then find the beta frequency f_β and cutoff frequency f_T and find the relation between gain and bandwidth. **(8 marks)**

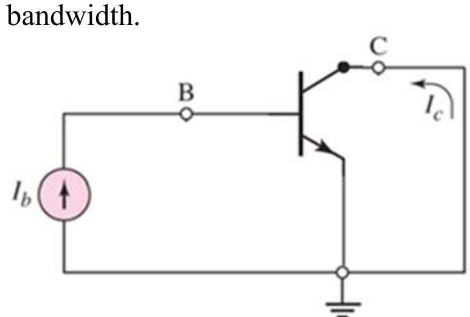

Fig. 3(a)

(b) The common emitter amplifier is shown in **Fig. 3(b)** and operated at high frequencies. The transistor parameters are: $r_\pi = 4$ kΩ, $g_m = 40$ mA/V and $r_o = \infty$, $C_\pi = 35$ pF, and $C_\mu = 4$ pF. **(12 marks)**

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

(ii) Find the Miller capacitance.

(iii) Determine the upper 3dB frequency (f_H) considering Miller capacitance and without considering Miller capacitance.

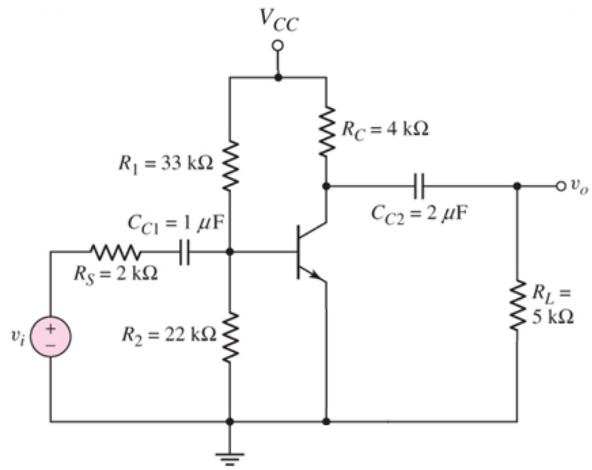

Fig. 3(b)

Q.4 [20 marks]

(a) The circuit diagram of a Wildar current source is shown in **Fig. 4(a)**. Design the circuit such that $I_o = 5\mu$A and $I_{REF} = 50\mu$A neglecting base current. Also determine V_{BE2}. [Given that $V^+ = 5$ V, $V^- = -5$ V, $V_{BE1} = 0.7$ V and $V_A = \infty$] **(10 marks)**

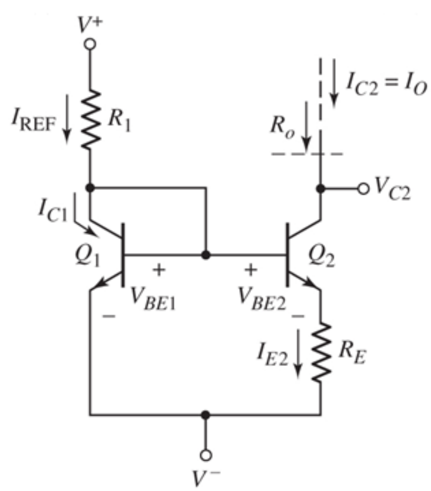

Fig. 4(a)

(b) Design a MOSFET current source as shown in **Fig. 4 (b)** such that I_{REF} = 0.5mA and I_o = 1mA, and $V_{DS(sat)}$ = 0.4 V. The bias voltage V^+ = +5 V. The transistors are available with parameters $k_n' = 40\mu A/V^2$, V_{TN} = 0.4 V and $\lambda = 0$. **(10 marks)**

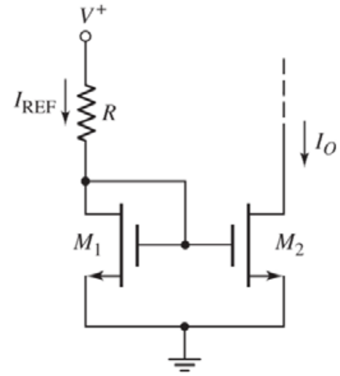

Fig. 4(b)

Q.5 [20 marks]

(a) In a feedback amplifier, the open-loop low-frequency gain is $A_o = 10^6$ and the open-loop 3 dB frequency is 8 Hz. If the bandwidth of closed-loop system is 250 kHz, what is the maximum allowable value of the closed-loop low-frequency gain? **(5 marks)**

(b) The ideal feedback amplifier topology is shown **Fig. 5(b)**. Identify the type of feedback and derive step by step the closed loop current gain, A_{zf}, the input resistance, R_{if} and output resistance R_{of}. **(10 marks)**

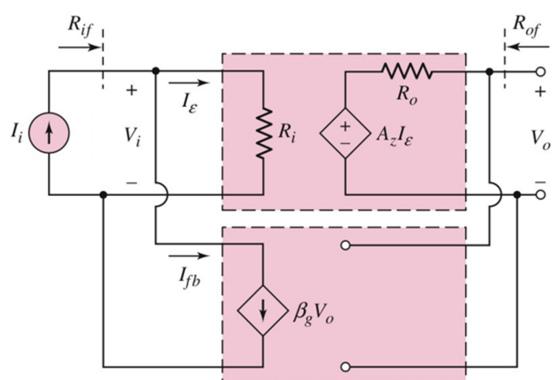

Fig. 5(b)

(b) The OP-amp feedback amplifier is shown **Fig. 5(c)**. Identify the type of feedback and find the feedback factor, β. **(5 marks)**

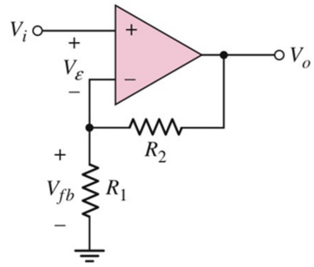

Fig. 5(c)

USEFUL FORMULA

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