INTERNATIONAL ISLAMIC UNIVERSITY MALAYSIA
END OF SEMESTER EXAMINATION
SEMESTER I, 2012/2013 SESSION
KULLIYYAH OF ENGINEERING

Programme : ENGINEERING
Level of Study : UG 2

Time : 9:00 am-12:00 pm
Date : 05/01/2013
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]

The MOSFET circuit is shown in **Fig. 1**, the transistor parameters are K_n = 0.5 mA/V^2, V_{TN} = 0.8V and λ = 0.

(a) Find V_{GS}, I_D, and V_{DS}. Also calculate the small-signal hybrid-π parameters g_m and r_o. [Given that R_1 = 32 kΩ, R_1 = 18 kΩ, R_D = 4 kΩ, R_s = 2 kΩ and C_C = 10 μF] **(10 marks)**

(b) Draw the small signal equivalent circuit for the midband frequency range and find the small signal voltage gain, $A_v = \frac{v_o}{v_i}$ and the equivalent output resistance R_o seen at the output terminals. **(10 marks)**

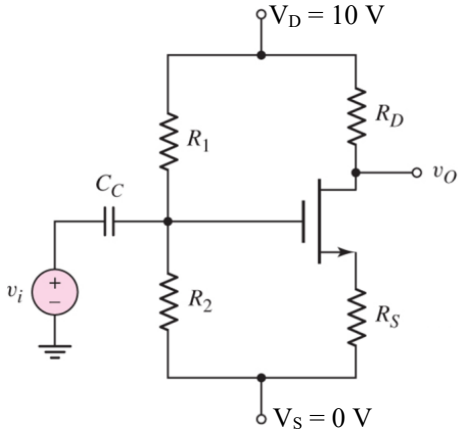

Fig. 1

Q.2 [20 marks]

The transistor circuit is shown in **Fig. 2,** the transistor parameters are β=100 and V_A=∞.

(a) Find I_{CQ}, V_{CEQ} and calculate the small-signal hybrid-π parameters r_π, g_m and r_o. **(10 marks)**

(b) Find the small signal midband voltage gain $A_v = \frac{v_o}{v_s}$, the current gain $A_i = \frac{i_o}{i_{is}}$ and the input resistance R_{ib}. **(10 marks)**

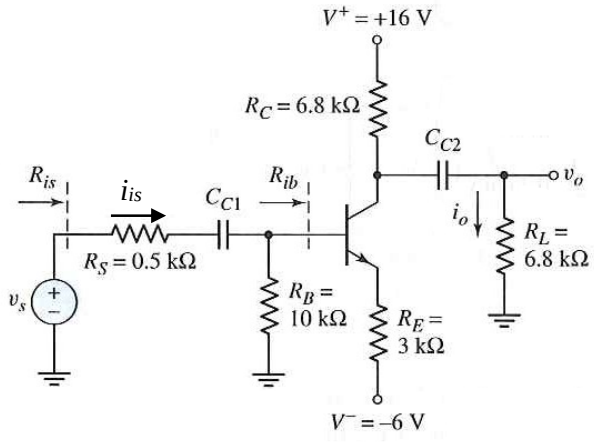

Fig. 2

Q.3 [20 marks]

(a) Draw the Bode plot (magnitude and phase) of the following transfer function.

(10 marks)

$$H(s) = \frac{10^6 s(s+1000)}{(s+100)(s+10000)}$$

(b) The emitter follower transistor amplifier is shown in **Fig. 3(b)** and the transistor has small signal hybrid-π parameters, r_π = 2.61kΩ, g_m= 40mA/V and r_o =100 kΩ.

(**i**) Determine the value of C_C such that the lower 3dB frequency is 15Hz.

(**ii**) Find the maximum voltage gain magnitude, $|A_v|_{max} = \frac{v_o}{v_s}$. **(10 marks)**

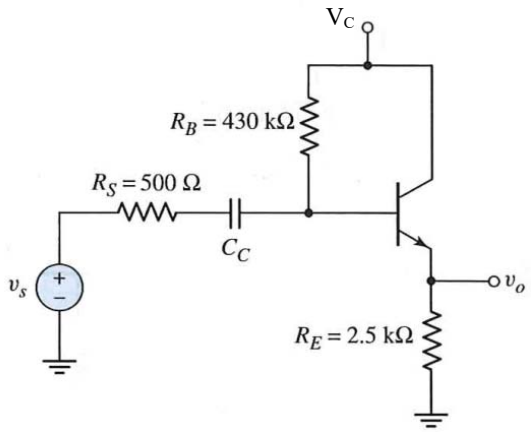

Fig. 3(b)

Q.4 [20 marks]

(a) The common emitter amplifier is shown in **Fig. 4(a)** and operated at high frequencies. Draw the high-frequency small signal equivalent circuit diagram.

(10 marks)

(i) Find the Miller capacitance.

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

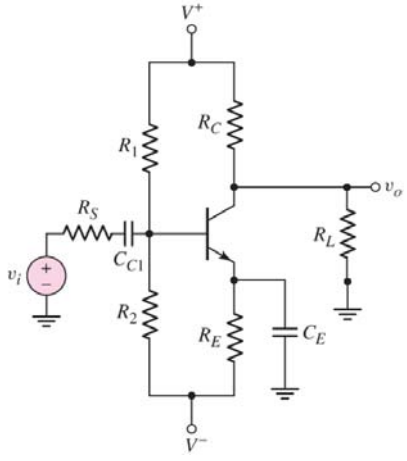

Fig. 4(a)

The circuit parameters are:

R_s=0.1kΩ, R_1= 40kΩ, R_2= 6.8 kΩ, R_E = 1.2 kΩ, R_C = 5 kΩ, R_L = 10 kΩ, C_C =∞μF and C_E = ∞ μF, C_μ =10pf, C_π= 10pf, V^+= 5V, V^- = 5v and β= 100

(b) Draw the frequency response of an amplifier and define the bandwidth of the amplifier. **(3 marks)**

(c) The two-transistor current source is shown in **Fig. 4(c)**. Derive the following equation showing all the steps, where the symbols have their usual meanings:

$$I_o = \frac{I_{REF}}{\left[1+\frac{2}{\beta}\right]}$$

(7 marks)

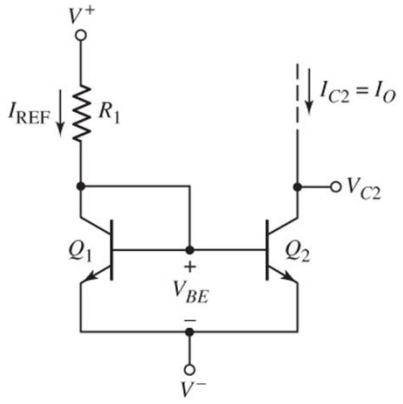

Fig. 4(c)

Q.5 [20 marks]

(a) The circuit diagram of a Wildar current source is shown in **Fig. 5(a)**. Design the circuit such that I_o = 30μA and I_{REF} = 150μA neglecting base current. Also determine V_{BE2}. [Given that V^+ = 5 V, V^- = -5 V and $V_A = \infty$] **(5 marks)**

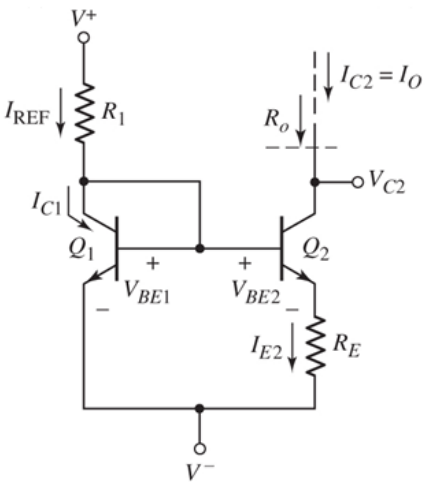

Fig. 5(a)

(b) Draw a basic configuration of a feedback amplifier and show step by step that the bandwidth of the amplifier is increased by a factor of $(1+\beta A)$. **(5 marks)**

(c) An ideal shunt-series feedback amplifier topology is shown Fig. 5(c). Find the closed loop current gain, A_{if}, the input resistance, R_{if} and output resistance R_{of}. **(10 marks)**

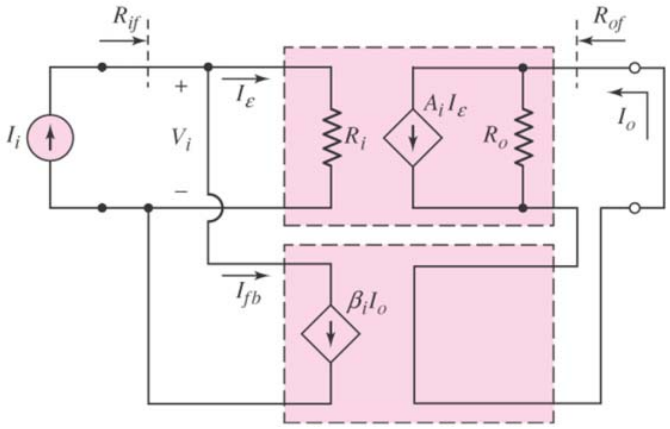

Fig. 5(c)

USEFUL FORMULA

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